

**Dijlah University College**  
**Computer Techniques. Eng. Dept.**



**(Design and Implementation a system that measures air pollution  
and display it on a smartphone via the Blynk app)**

**A Project Submitted to the Department of Computer Techniques  
Engineering  
Dijlah University College  
In partial fulfillment of the Requirement for the  
Degree of B. Eng.  
In  
Computer Techniques Engineering.**

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**SUPERVISOR CERTIFICATION**

I certify that this Project “**Design and Implementation of IOT Based Air quality monitoring system using Arduino** “ was prepared under my supervision at the Department of Computer Techniques Engineering, Dijlah University College - Baghdad, in partial fulfillment of the requirements for the degree of B. Eng. in Computer Techniques.

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## **Abstract**

Air pollution is a growing issue these days. It is necessary to monitor air quality and keep it under control for a better future and healthy living for all. Here we propose an air quality monitoring system that allows us to monitor and check live air quality in a particular area through IOT. System uses air sensors to sense presence of harmful gases/compounds in the air and constantly transmit this data to microcontroller. Also system keeps measuring sound level and reports it to the online server over IOT. The sensors interact with microcontroller which processes this data and transmits it over internet. This allows authorities to monitor air pollution in different areas and take action against it.



# **Chapter One**

## **Introduction**

### **1.1 Introduction**

Air pollution is the biggest problem of every nation, whether it is developed or developing. Health problems have been growing at faster rate especially in urban areas of developing countries where industrialization and growing number of vehicles leads to release of lot of gaseous pollutants [1]. In the past, the air quality measuring sensors were very big, non-portable and expensive. Presently, most air pollution sensors developed on five most common air pollutants viz. nitrous oxide, carbon monoxide, ozone, sulfur dioxide and particulate matter. In today's world, air pollution and quality monitoring are really vital as it has a great effect on human health. The developed air-quality measurement sensor can identify and observe the incidence of air pollution in the adjacent areas. It can be employed for both indoor and outdoor [2-3]. With the help of future technological improvements, these sensors will become cheaper and more common, inexpensive, portable air-quality sensors which can be wearable by people to observe the local air quality [4-5]. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. According to a survey, due to air pollution 50,000 to 100,000 premature deaths per year occur in the U.S. alone whereas in EU number reaches to 300,000 and over 3,000,000 worldwide. Various kinds of anthropogenic emissions named as primary pollutants are pumped into the atmosphere that undergoes chemical reaction and further leads to the formation of new pollutants normally called as secondary pollutants [6-8]. For instance, according to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), nearly all climate-altering pollutants either directly or indirectly (by contributing to secondary pollutants in

the atmosphere) are responsible for health problems. Almost every citizen spends 90% of their time in indoor air. Outdoor air quality of the cities of developed countries improved considerably in recent decades. In contrast to this, indoor air quality degraded during this same period because of many factors like reduced ventilation, energy conservation and the introduction to new sources and new materials that cause indoor pollution. The design of buildings for lower power consumption resulted in decrease of ventilation which further decreases the quality of air inside the building. This increases the need for indoor air quality (IAQ) [9-14].

## **1.2 Objectives**

1. To build an air pollution system contains air pollution sensor, a flame detector, and a heat sensor.
2. To detect if any polluted air the area.
3. Real time display of the air quality
4. LEDs are used to indicate three different levels of air quality (good, medium and poor) .
5. To view the air quality value online using Blynk application.
6. To send an alarm system is controlled by the microcontroller when the air quality value exceeds threshold limit.

## **Chapter Two**

### **Theory**

#### **2.1 Introduction**

This project implements an IOT based Air Pollution Monitoring System, in which air quality is monitored over the internet online using Blynk application using mobile phone and an alarm will be triggered if the air quality goes beyond a certain level. The thresholds have used are very general, so they may vary place to place. For example, as pointed out during evaluation of the project, concentration of Carbon Dioxide is high in households and closed places, and this may raise the overall PPM Value. We connect our sensor as an input to the arduino (Arduino Nodmcu), and buzzer. The voltage levels are converted into appropriate ppm values by calibration, as there are inbuilt functions in the MQ-2 Library. The buzzer is used as an alarm and the ESP8266 Wi-Fi Module gives the access to the Wi-Fi network and connected a potentiometer along that the brightness can be varied, and kept less at night.

#### **2.2 System Components**

The system is mainly constructed of several components unveiled as follows:

- A. Arduino (Nod-MCU) Microcontroller.
- B. Three light emitting diodes
- C. MQ-2 Air quality Sensor
- D. Buzzer
- E. Blynk application for online air quality monitoring

#### **2.3 Nod-MCU Microcontroller**

Node-MCU V3 is an open-source firmware and development kit that plays a vital role in designing an IoT product using a few script lines. Multiple GPIO pins on the board allow us to connect the board with

other peripherals and are capable of generating PWM, I2C, SPI, and UART serial communications.

The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module. The firmware is based on Lua – A scripting language that is easy to learn, giving a simple programming environment layered with a fast scripting language that connects you with a well-known developer community.

The existing module and keep changing the entire interface until you succeed in optimizing the module as per your requirements.

USB to UART converter is added on the module that helps in converting USB data to UART data which mainly understands the language of serial communication. Instead of the regular USB port, Micro-USB port is included in the module that connects it with the computer for dual purposes: programming and powering up the board.

The board incorporates status LED that blinks and turns off immediately, giving you the current status of the module if it is running properly when connected with the computer. The ability of module to establish a flawless WiFi connection between two channels makes it an ideal choice for incorporating it with other embedded devices like Raspberry Pi

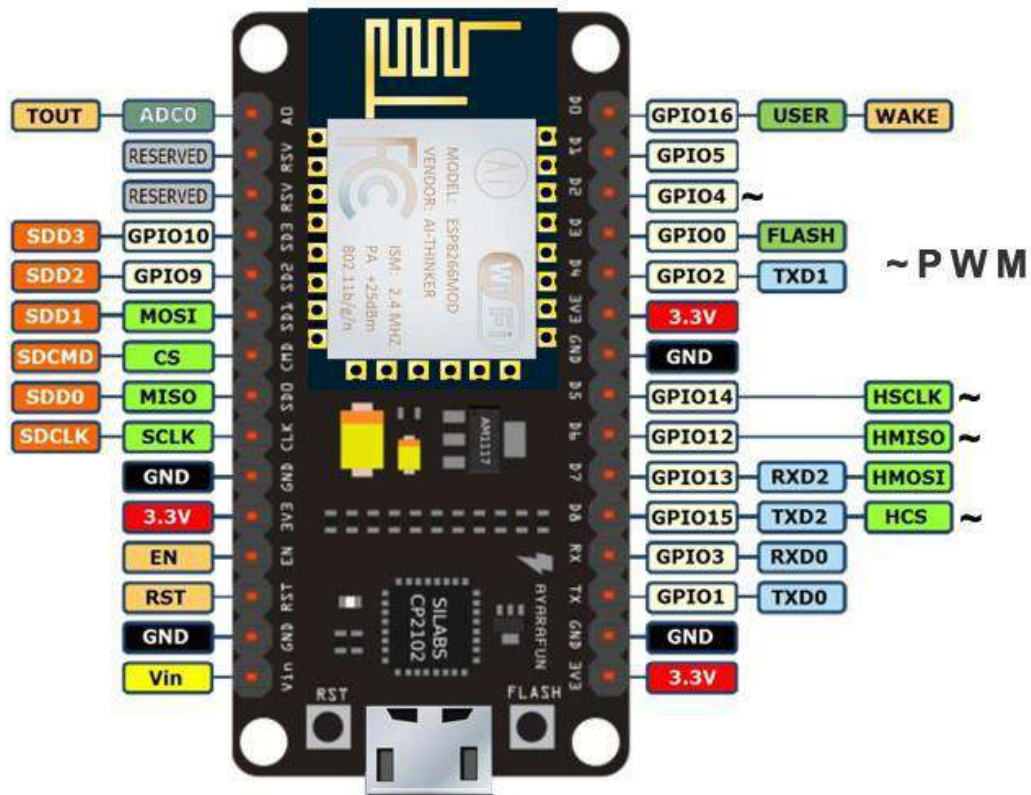


Figure 2.1: Arduino Nod-MCU microcontroller

## 2.4 MQ-2 Sensor Modules

Liquefied Petroleum Gas (LPG) or the sensitive material of the MQ-2 gas sensor is SnO<sub>2</sub> considered as lower conductivity in the clean air. The conductivity of the sensor shown in Figure 4 gets higher as long as the gas concentration is elevated. The sensitivity of the MQ-2 sensor is considered exceptionally higher to propane, LPG, hydrogen, methane, and the other steam. Moreover, the cost limitation of the proposed sensor is assigned to be appropriate for numerous applications [12]. The sensor realizes the flammable gas by an increase in the temperature when excited by the heating components. As a working principle, when a gas leak is detected the conductivity of the sensor gets higher proportionally with gas concentration raising.

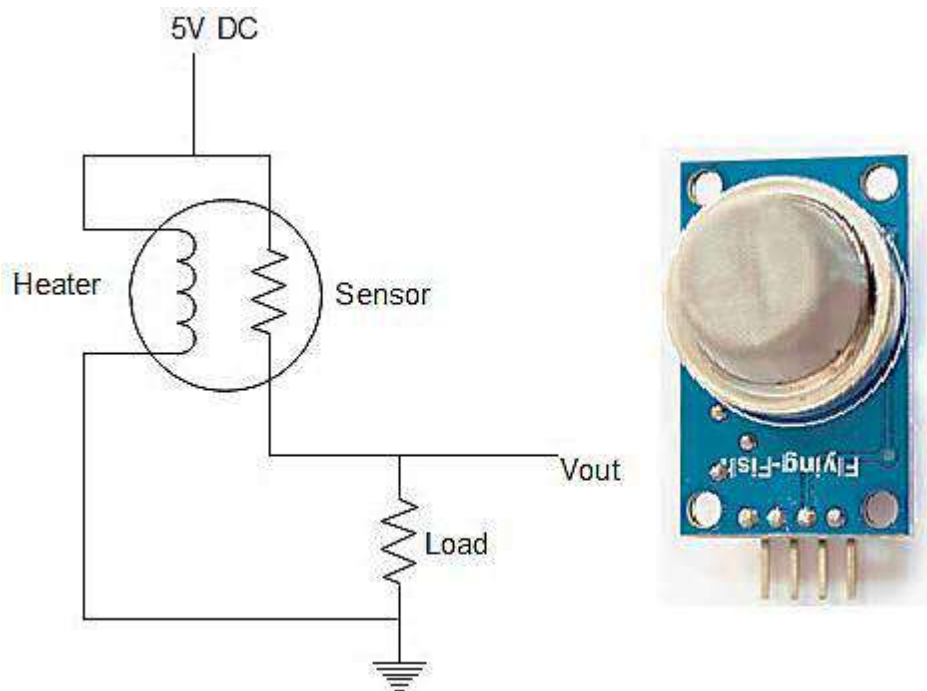


Figure 2.3: The schematic sensor module

Where,

: Power of sensitivity body.

: Loop voltage.

: Sensing resistance.

: Load resistance.

As long as, a sensitive resistor is attached in between the output and the GND as shown in Figure 5, the value of the load resistance does not make sense to be restricted. While, the value of the chosen  $R_L$  is preferred to be around (2 – 47 K $\Omega$ ), meaning that the lower value offers less sensitivity, the higher value offers less accuracy [13].

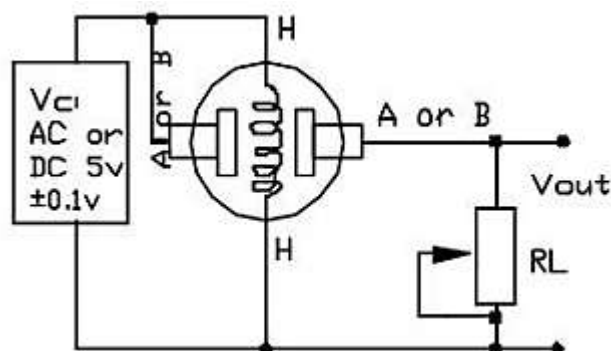


Figure 2.4: sensor interior construction

## 2.5 LED

LEDs are small, powerful lights that are used in many different applications. It is as simple as turning a light on and off. To find out the polarity of an LED, look at it closely. The shorter of the two legs, towards the flat edge of the bulb, indicates the negative terminal.

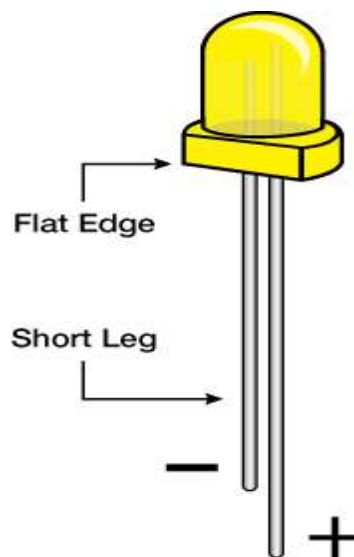


Figure 2.6: LED

## 2.6 Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or Piezoelectric (Piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.



Figure 2.7: The Piezo buzzer

## **Chapter Three**

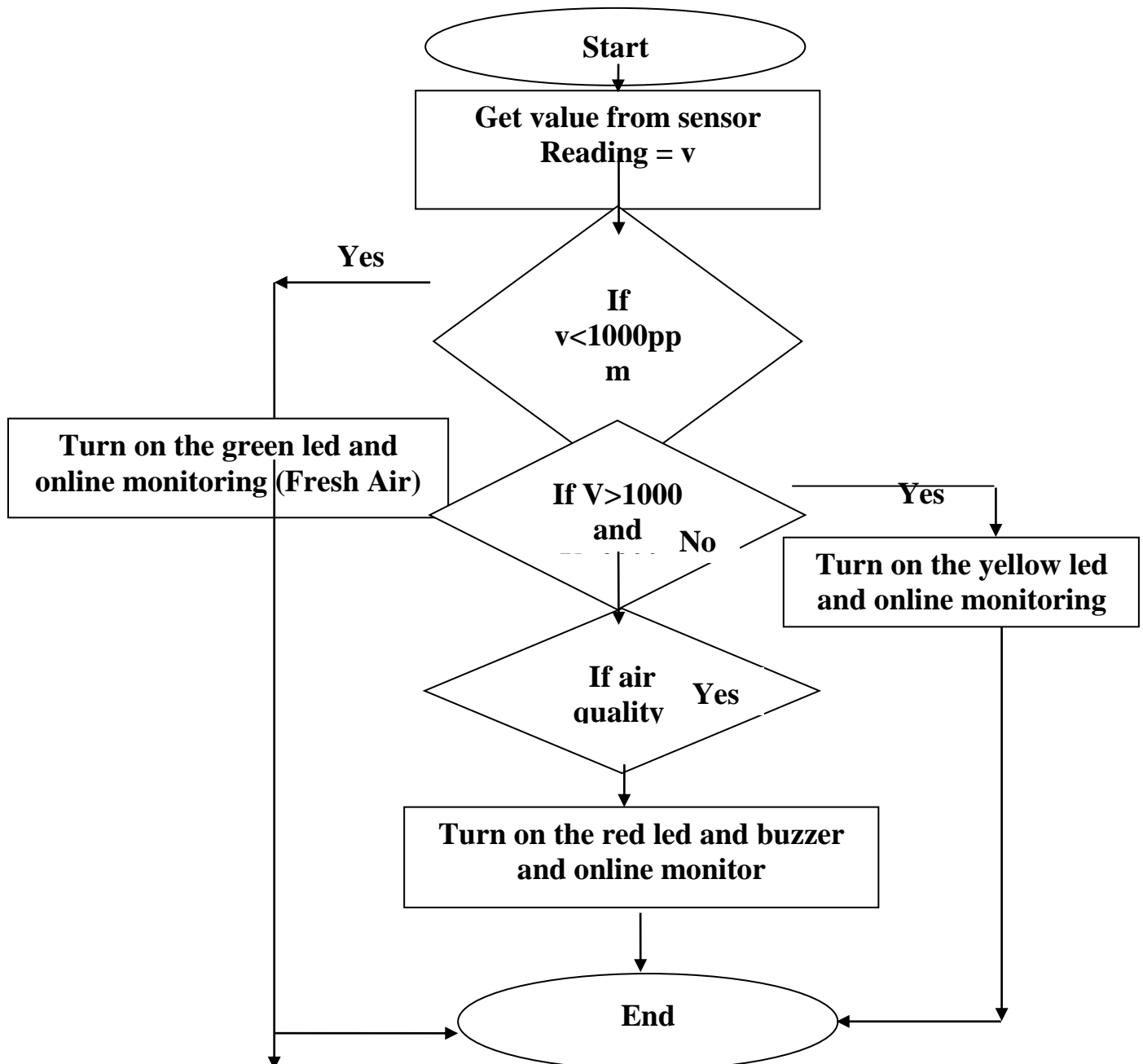
### **The Proposed System**

#### **3.1 System design**

This project contributes in the direction of monitoring the quality of air. The system proposed here is air quality monitoring system in the Arduino Nod-MCU that measures the surrounding temperature, dust particles and presence of suspended items in the air using MQ-2 sensor. These sensed parameters are show to the authorized person online via an application on mobile phone follow with the sound of buzzer if the air quality exceeds the threshold level so that proper action can be taken by the people in outdoor activities to reduce the possible health problem that could occur. When the user switches off the buzzer by pressing button, red, yellow, green light emitting diode will light up indicating three different air quality levels (good, medium and polluted air) respectively. The diagram describing the proposed system and its interconnection along with the stages involved is as described in diagram below.



### 3.2 Flow Chart of the proposed Alarm system



### 3.3 System Implementation

The security system is implemented using the following components Arduino UNO, GSM module, Gas sensor, Heat sensor, Flame sensor, LED, and buzzer. The connection of the system is illustrated as follows.

1. The buzzer is connected to digital pins number (5).

2. The green LED is connected to Arduino digital pin number (16), 17, and 18).
3. The yellow LED is connected to Arduino digital pin number (17).
4. The yellow LED is connected to Arduino digital pin number (18).
5. MQ-2 sensor is connected to Arduino digital PIN (34)

Hence the 5V power supply is given to the sensor through the board and the output of the sensor is connected to the digital input of the Arduino board.

### 3.4 Schematic diagram of the proposed system

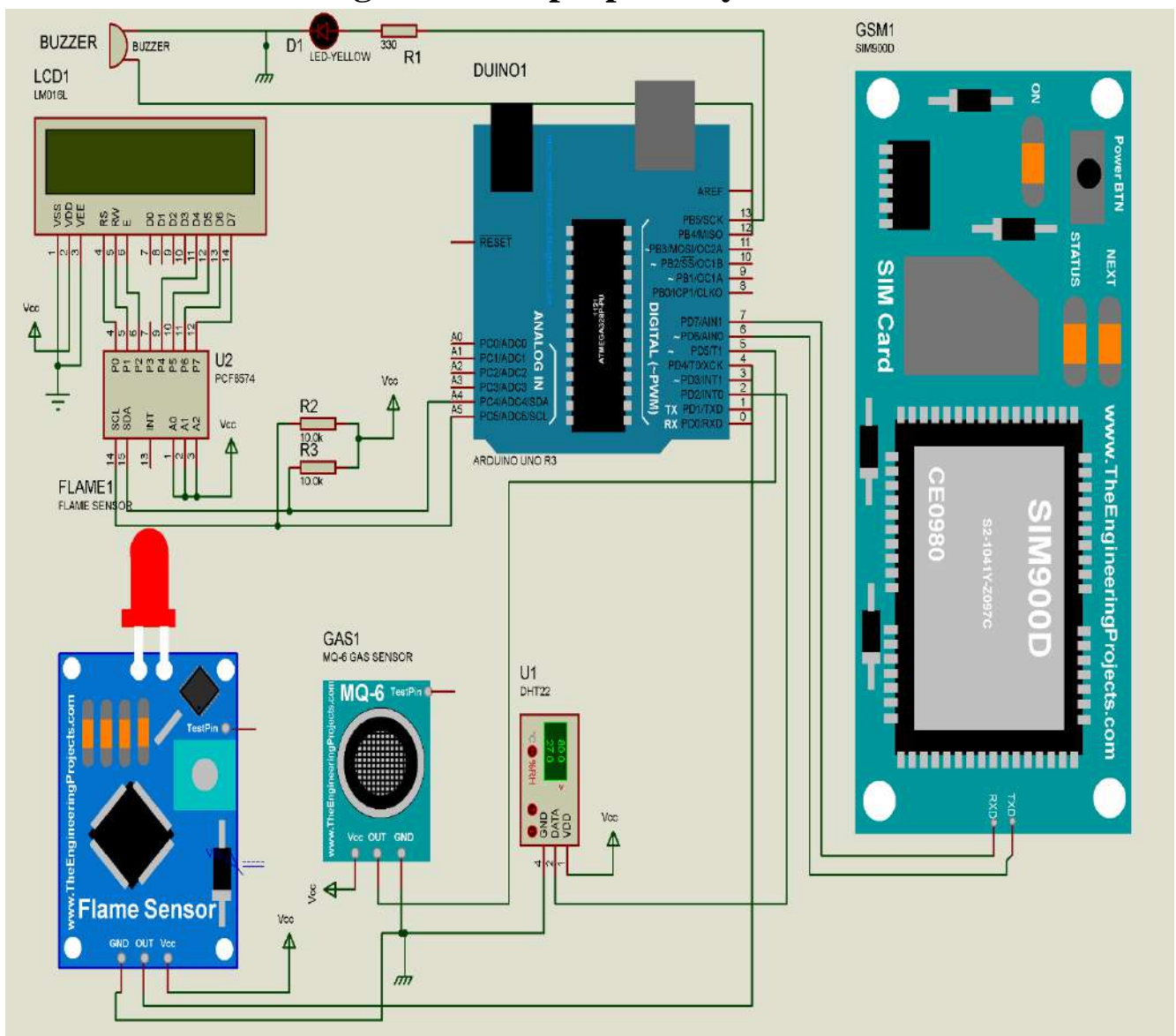


Figure 3.1: The proposed System circuit Diagram

### 3.5 Blynk Application

Blynk is a platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where we can build a graphic interface for our project by simply dragging and dropping widgets. Blynk can control hardware remotely. It can display sensor data, store and visualize it, among other cool things. Blynk server is responsible for all communication between the smart phone and hardware. We can use Blynk Cloud or run our private Blynk server locally. It is open source, and can handle thousands of devices. Blynk Libraries are available for all popular hardware platforms. The libraries help to communication with the server, and process all incoming and outgoing commands. When we press a button on Blynk app on the phone, the signal travels to the Blynk Cloud, where it finds its way to hardware. It works the same way in the opposite direction, and everything happens in a blink of an eye.

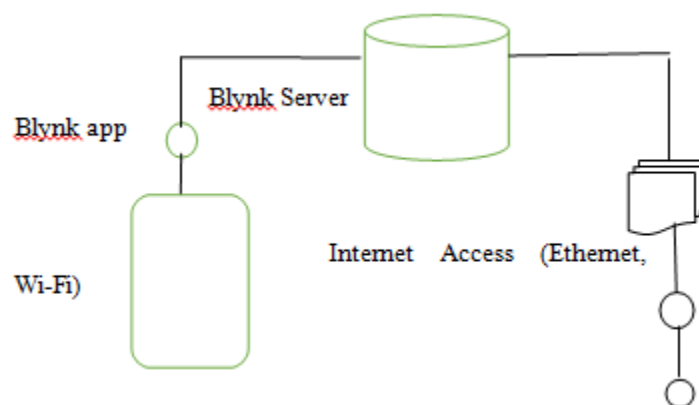


Fig 3:1: Blynk Software

## **Chapter Four**

### **Results**

#### **4.1 Introduction**

This project is very useful for human health. And can be implemented broadly, it is very successful

Advantages

- Domestic Gas Leakage Detector
- Home
- Portable Air pollution system
- Factories
- Industrial Combustible pollution Detector
- LPG Storage

#### **4.2 System operation**

The goal of the project is to develop a smart automatic air pollution detection system. The system is designed for homes, offices, industries, etc. In this system, there will be an alert system. It is designed to detect sudden pollution,. It contains necessary sensor for detecting. When the system will detect pollution it will take the following steps.

##### **1. Scan Air quality**

After activation, the device will continuously scan the air quality If the air quality level below 1000 ppm, it will be displayed on Blynk application, and the green LED will turn on.

##### **2. Medium Air quality**

If the air quality level is greater than 1000 ppm and equal to 2000 ppm and it will be displayed on the Blynk application, and yellow LED will turn on.

### 3. Polluted Air

If the air quality level is greater than 2000 ppm, the quality level it will be displayed on the Blynk application, and the red LED will turn on.

#### 4.3 Testing the led indicator circuit

Led testing is done by connecting the anode on the Arduino output pin that passes through the resistor first and the cathode is connected to ground on Arduino. Then give the program logic the On-Off control program (High-logic or low-logic). Led will be ON if given High logic and OFF if given Low logic.

#### 4.4 Software Testing

Software testing this means is program testing. The finished program is created using Arduino sketch, then uploaded to Arduino using a USB cable. After that, the program is tested whether it is under good result or not by observing the outputs of the device such as a LED, Buzzer.

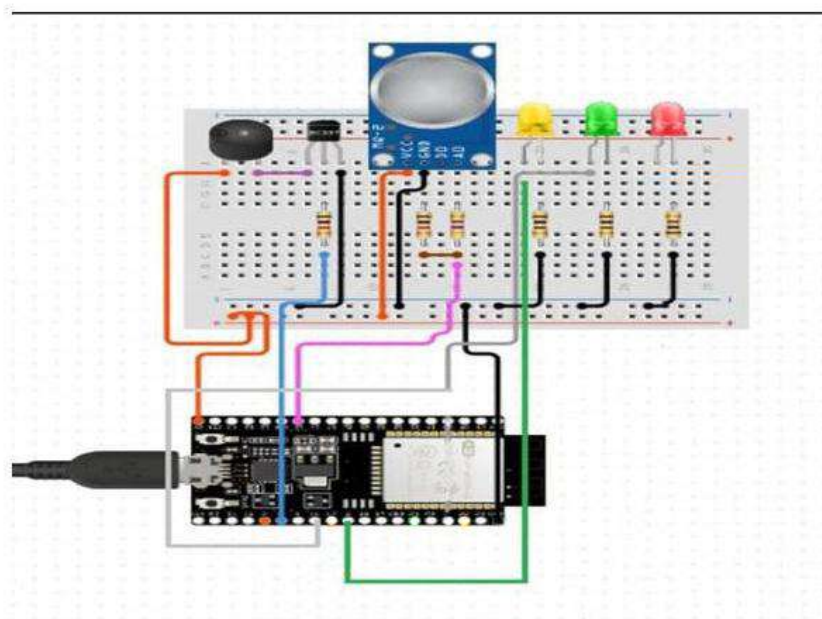


Figure  
Dircuit

4.1:  
Diagram

## **Chapter Five**

### **Conclusion and Future Work**

#### **5.1 Conclusion**

The proposed IoT based air quality measurement system is a good device to measure the air quality in outdoors and indoors. This device can be useful to measure the level of gases in a highly dense area like markets, bus stand, railway station etc. from the remote-control room. If data is stored, we can use the data for further experiments which can conclude a significant result. This system is IoT based so it can be used in the smart home for the purpose of cooling, ventilation and other purposes. IoT will enhance the artificial intelligence in the world, so the system can be used in automated systems in factories and industries. The system to monitor the air of environment using Arduino microcontroller, IoT Technology is proposed to improve quality of air. With the use of IoT technology enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed. Here using of MQ135 gas sensor gives the sense of different type of dangerous gas and Arduino is the heart of this project which controls the entire process. Wi-Fi module connects the whole process to internet is used for the visual Output.

#### **5.2 Future Work**

In the future works, a website server based android system can be made to be able to see and analyze data in more detail and Real-time.

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## الخلاصة

يعتبر تلوث الهواء مشكلة متنامية وخاصة في هذه الأيام. لذلك من الضروري مراقبة جودة الهواء وإبقائه تحت السيطرة من أجل مستقبل أفضل وحياة صحية للجميع. نقترح هنا نظام مراقبة جودة الهواء الذي يسمح لنا بمراقبة وفحص جودة الهواء الحي في منطقة معينة من خلال إنترنت الأشياء. يستخدم النظام مستشعرات الهواء لاستشعار وجود غازات / مركبات ضارة في الهواء ونقل هذه البيانات باستمرار إلى متحكم دقيق. يحتفظ النظام أيضًا بقياس مستوى الصوت وإبلاغه إلى الخادم عبر شبكة الإنترنت عبر و إنترنت الأشياء. تتفاعل المستشعرات مع متحكم دقيق يعالج هذه البيانات وينقلها عبر الإنترنت. وهذا يسمح للمستخدمين بمراقبة تلوث الهواء في مختلف المناطق واتخاذ الإجراءات ضده.

كلية دجلة الجامعة  
قسم هندسة تقنيات الحاسوب



( تصميم وتنفيذ منظومة عرض نسبة تلوث الهواء في الجو )

بحث مقدم الى كلية دجلة الجامعة – قسم هندسة تقنيات الحاسوب  
كجزء من متطلبات منح درجة بكالوريوس هندسة في تقنيات الحاسوب

من قبل

مهيمن علي خضير  
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حيدر عامر طالب  
عبدالله احسان فائق

المشرف

م. رياض باسل عبد الجبار



**( 5-channel IR remote control)**

**A Project Submitted to the Department of Computer Techniques**

**Engineering**

**Dijlah University College**

**In partial Fulfillment of the Requirement for the**

**Degree of B. Eng .**

**In**

**Computer Techniques.**

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**Supervised by:**

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## الاهداء .....

الى ... من صنع ذاتي فأدركت معنى ان اكون ....

لأبي الذي احترقت مواسمة لأجلي ....

لأبي المعلم وهو كالمشكاة في ظلمات جهلي ...

ولنخلة فرعاء اسمى منزلاً من كل نخلة ...

أمي التي لو استطيع خففت لها الف جناح ذل ....

للغائبين الحاضرين .... احبتي .... ولكل أهلي .....

## شكر وتقدير .....

شكري وامتناني .... لكل من ساهم في انجاز هذا المشروع ....

عسى أن يكون لبنة أولى في بناء مستقبل علمي واعد ....

شكراً .... للاساتذة الكرام .... الذي اناروا المشروع بتوجيهاتهم السديدة  
التي ارشدتني لخطوات علمي الناجح .

شكرا ..... امي التي غطتني بحنانها وانارت دربي بدعائها

شكرا .... أبي الذي علمني الشموخ والرفعة

شكرا .... عائلتي وكل احبتي

## **SUPERVISOR CERTIFICATION**

I certify that this Project entitled 5 Channel IR Remote Control System using Microcontroller was prepared under my supervision at the Department of Computer Techniques Engineering, Dijlah University College - Baghdad, in partial fulfillment of the requirements for the degree of B. Eng. in Computer Techniques.

**Signature:**

**Name: Lec. Mohammed H. Hwidi**

**Date: June 2021**

## **Abstract**

This project aims to design and demonstrate a simple 5-channel impulse control system to drive five loads. Input signals or commands are sent from a transmitter using an infrared transmitter and received by an infrared receiver, processed and used to drive loads in both transmitter and receiver. A microcontroller is used for signal processing. The circuit operates on the principle of infrared communication. Infrared communication involves sending signals using an infrared signal as a carrier. The input signal from switches is processed by a microcontroller, encoded by the encoder, modulated and transmitted by the transmitter. In the receiver, the embedded signal is demodulated by the infrared receiver. Decoded by the decoder and processed by microcontrollers, control the output work.

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## **Chapter One: introduction**

### **1.1Introduction :**

It is an electronic machine that enables us to remotely control the TV and various other devices, in order to transmit instructions. These devices work by means of several non-wireless media: including infrared or radio waves and sometimes ultrasound, and one of the most devices whose name is associated with a device[1] The control is the TV, but that does not diminish the importance of remote control of the air conditioner and a device in addition to the car locking device and other devices. It is based on transmission and reception in two phases, assisted in transmitting information on some media such as light rays, sound waves or radio waves.

The remote-control device is a device that transmits and sends information, commands, and instructions to another device without the presence of visible physical media linking them such as wires. Radio waves or infrared rays{2}

The remote control is used in many devices, the most famous of which are televisions, receivers, stereos, air conditioners, and video game systems.

So that some homes equipped with modern technologies rely heavily on remote control devices, in addition to luxury hotels



## 1.2 Aim of the project:

Remote control devices have made human life easier, and saved a lot of time and effort. The invention of the remote-control device dates back to the late nineteenth century; In 1894, the physicist Oliver Lodge presented a model in which the galvanometer (a device for measuring small currents) is controlled without wires, and this model was subsequently improved by some scientists.

In 1898, the scientist Nikola Tesla presented a model for moving boats remotely using radio waves.{3}

In 1903, a robot called Telekino was designed, working remotely by means of electromagnetic waves sent to him.

In the thirties of the twentieth century, the manufacture of the currently known remote control device began, and its most prominent use was in the Second World War.

Infrared controllers: The digital message sent by the controller consists of a binary code (English: Binary Code) that uses the binary system (English: Binary Number) to represent numbers 1 and 0 only. The form of the sent message is divided into parts, the first part usually represents the starting code for transmission (English: Start Code), and in the middle of the message there are commands and accompanying information, in addition to an identification shared between the sender and the [4]code for the receiving device, or a code receiver; So that the receiving device can distinguish its own remote control device only, and the message ends with an end code (English: End Code) to indicate the end of the message, and the shape of the message may differ according to the standards of the manufacturer, but most of them operate at a frequency of 38kHz

## Chapter Two: Theoretical Background

### 2.1 Arduino UNO:

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. [1] It is similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available [2].

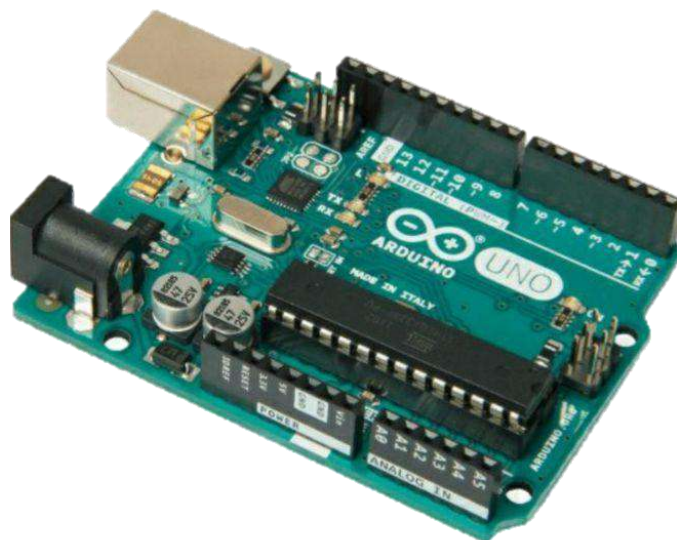


Figure 2.1: Arduino UNO

## **2.2 HT12 Encoder IC:**

To locate misplaced objects using RFID technology. RFID is radio frequency identification. RFID technology consists of RFID tags, an RFID reader, and a user interface. HT12E is the encoder in the transmitter. The RFID tag consists of the transmitter. The HT12D decoder is located in the receiver. The reader consists of HT12D Decoder. Communication is between the mark and the reader. GLCD, i.e. graphic LCD display appeared. If the object is missing, it will be displayed in the graphic LCD screen .[3]



Figure 2.2: HT12 Encoder IC

### **2.3 ULN2003:**

The ULN2003A is an array of seven NPN Darlington transistors capable of 500 mA, 50 V output. It features common-cathode fly back diodes for switching inductive loads. It can come in PDIP, SOIC, SOP or TSSOP packaging. In the same family are ULN2002A, ULN2004A, as well as ULQ2003A and ULQ2004A, designed for different logic input levels.[4]

The ULN2003A is also similar to the ULN2001A (4 inputs) and the ULN2801A, ULN2802A, ULN2803A, ULN2804A and ULN2805A, only differing in logic input levels (TTL, CMOS, PMOS) and number of in/outputs[4].

This method uses AT89S52 and some peripheral components as control system, and has two control modes. In one mode, the control system takes real-time monitoring of the ambient temperature, and correspondingly changes the rotational speed of the motor, providing efficient heat dissipation. And the other Mode 2 provides a way to use infrared remote control to achieve the same goal manually[5].

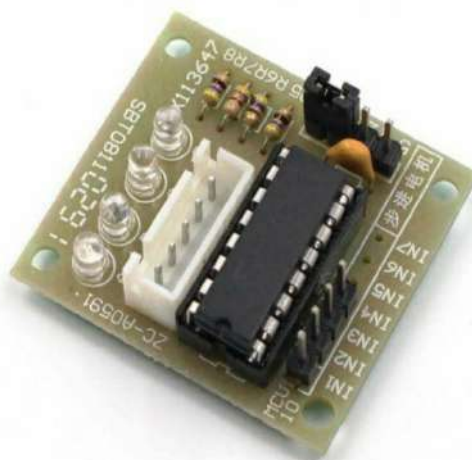


Figure 2.3: ULN2003

## **2.4 Light Emitting Diode**

Over the past decade, developments in LEDs have made it possible to widely replace traditional lighting with solid light sources. If LED performance targets are met, solid-state lighting will provide significant energy savings, we review the LED performance targets needed to achieve these benefits and highlight some remaining technical challenge [6].

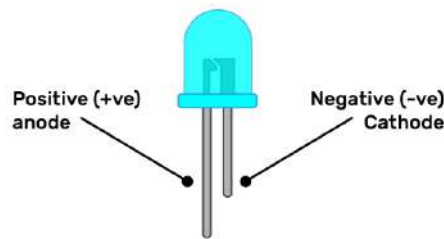


Figure 2.4: LED

## **2.5 TSOP62:**

These are miniature SMD-IR receiver modules for infrared remote-control systems. The PIN diode and preamplifier are assembled on the lead frame, and the epoxy package is designed as an IR filter. The demodulated output signal can be directly decoded by a microprocessor. TSOP62 is the standard SMD-Receiver series infrared remote control, which supports all major transmission codes...Features • Image detector and subwoofer in one package.[7]

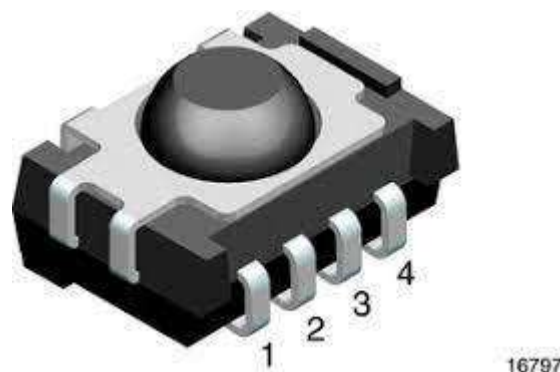


Figure 2.4: TSOP62

## **2.6IR Receiver:**

IR Transmitter and IR Receiver are commonly used to control electronic devices wirelessly, mainly through a remote. TV remotes and AC remotes are the best example of IR transmitters. TV generally consists of TSOP1738 as the IR receiver, which senses modulated IR pulses and convert them into electrical signal. Here in our circuit we are building IR remote and its receiver. We are using IR LED as transmitter and TSOP1738 as IR receiver[8].



Figure 2.5: IR Receiver

## **2.7switch socket**

Recent developments in power electronics have increased the use of DC bus in electrical distribution systems due to its many advantages over AC distribution system in terms of energy efficiency, safety, electromagnetic compatibility, and integration of renewable energy. This study introduces the concept of DC local distribution-based energy management system with smart sockets for smart homes of the future. Energy-efficient smart buildings are possible by integrating smart meters, smart plugs, local renewable energy generation and energy storage systems for integrated energy management.[9]



Figure 2.6: switch socket

## 2.8 5V Relay module

A design algorithm is proposed for mappings of common source channels and numerically evaluated them. The designed system is compared with reference systems, based on the modular source and channel coding, and the distortion rate function of the Gaussian source using known achievable rates for the relay channel. There is a significant gain, in terms of lower power, in the use of (domestic) improved systems compared to reference systems. Interestingly, the design algorithm generally produces paging mappings with a structure similar to Wyner-Zivcompression. [10]

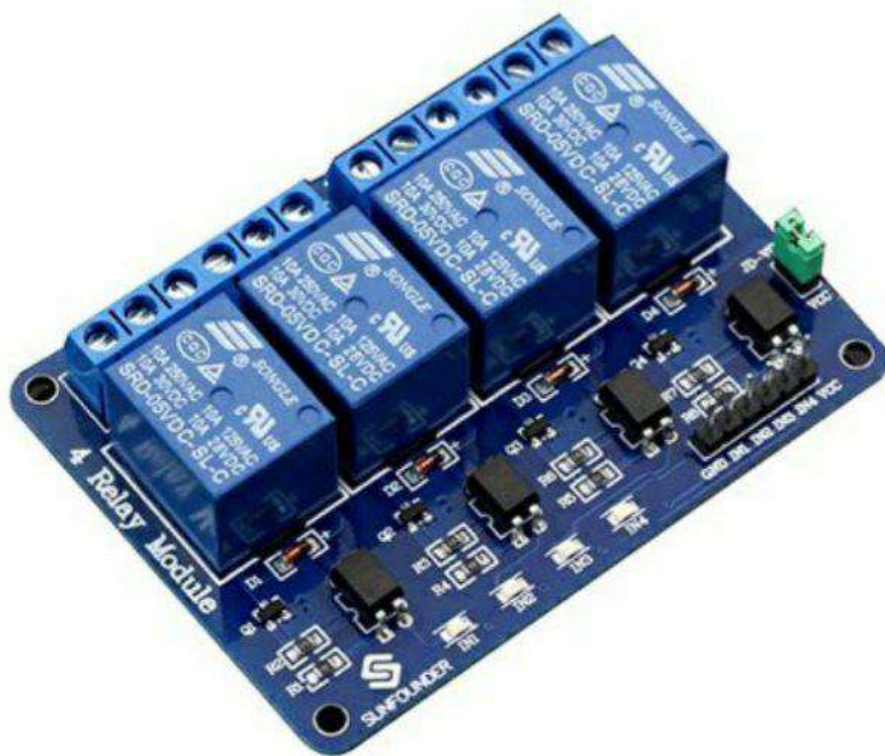


Figure 2.7: 5V relay module



## **Chapter Three: Practical Work**

### **3.1 Principle behind the Circuit:**

The circuit works on the principle of IR communication. IR communication involves transmitting signals using infrared signal as the carrier. The input signal from switches is processed by the microcontroller, encoded by the encoder, modulated and transmitted by the transmitter. At the receiver, the modulated signal is demodulated by the IR receiver, decoded by the decoder and processed by the microcontroller to control the output loads.

### **3.2 5 Channel IR Remote Control Circuit Design:**

The transmitter circuit consists of , Encoder HT12E.and Arduino is using as controlling unit. A TSOP 1738 sensor is using for receiving signal from the remote. Output pin of sensor is connected to the Arduino, when any button of the remote is pressed, IR LED of remote sends a unique encoded signal, this signal is received by sensor and sent to the Arduino, The Arduino decode the signal and turn on and off the lights according to the signal. 12-volt relays are used for switching the appliances.. The reset circuit is designed keeping in mind the required reset pulse width to be 100ms and voltage drop at reset pin to be 1.2V. Here we select a resistor of 10K and capacitor of 10uF to meet the requirements. The output side consists of the HT12E encoder with its 7 address pins and the terminal enable pin connected to ground, 4 data pins connected to Port 0.

### **3.3 Reception circuit design:**

The receiver circuit is similar to the transmitter circuit design and consists of four Ics- AtmelB9C51, decoder HT12D, IR receiver TSOP1738 and relay driver ULN2004. Designing the microcontroller interfacing is same as that in the transmitter circuit, specially the reset circuit and oscillator

design. Here, the input circuit consists of the decoder and TSOP1738. The output pin of TSOP 1738 is connected to data input pin of the decoder IC and the 4 data output pins are connected to port P1 of the microcontroller. The address pins are grounded and an LED is connected to the valid transmission pin to indicate the transmission. The output circuit consists of the relay driver IC ULN2004 with 5 of its input pins connected to port P2 of the microcontroller and the 5 output pins connected to 5 relays operating 5 lamps.

### **3.4 The work of the transmitter circuit:**

When the circuit is powered, the compiler will initialize the stack pointer and other variables and call the main function. It scans the input pins, i.e. the signals from the switch. Now, if I press any button of the IR remote then related hex code will populate on the serial monitor. I need this hex code to control the relay module from the IR remote. So copy all the hex codes of the buttons that you will use in the project.

### **3.5 Components Included in this Transmitter Circuit:**

List of components and the corresponding values are shown below :

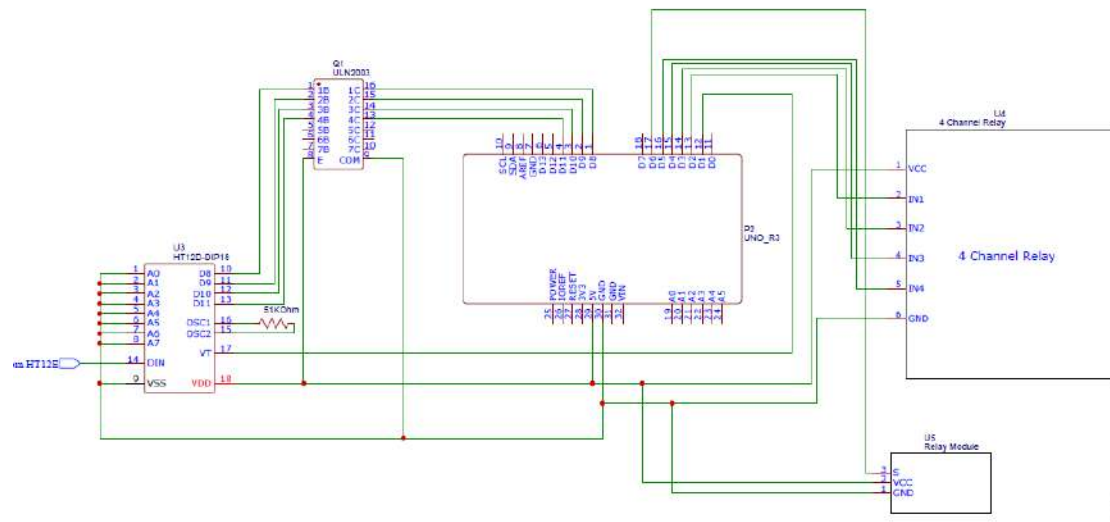
- R1 – 1M
- R2 – 10k
- R3 – 760Ω
- R4 – 1.5K
- R5 – 100Ω
- C1, C2 – 15pF
- C3 – 10μF
- C4 – 0.01μF
- C5 – 0.1μF
- S1 – 5 DIP switch

- V1 – 5V
- U1 – AT89C51
- U2 – HT12E
- U3 – LM555
- U4A – 7408 (AND gate)
- Q1 – BC547

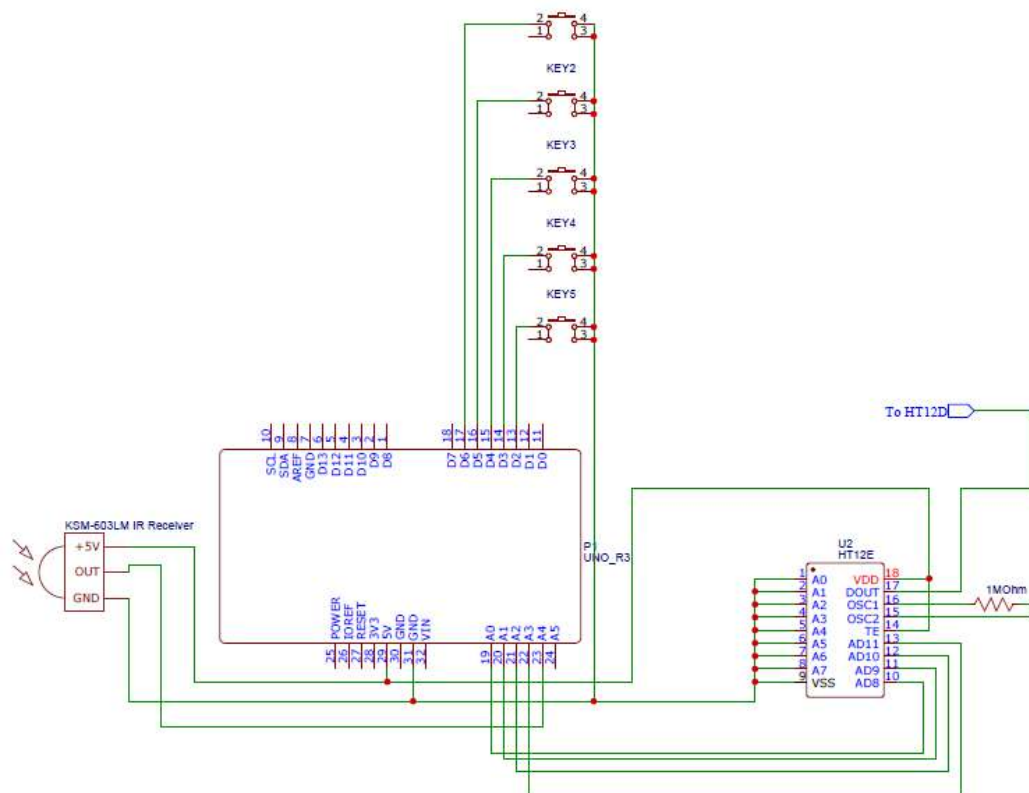
### **3.6 The work of the reception department:**

The transmitted IR signal is received by the TSOP 1738 or the IR receiver, which demodulates the signal using an arrangement of pin diode and filter. Output from the receiver is fed to the input of the decoder which initially checks the received data at least three times and then sends a high pulse to the VT pin so as to indicate a valid transmission. The decoder then converts the serial data input into 4 bit parallel data output. In the mean time, the microcontroller gets booted and the input pins are scanned. For a certain 4 bit input signal, the compiler assigns a high logic signal to the corresponding input pin of the relay driver. The relay driver ULN2004 is actually a Darlington array IC which shifts the voltage level of the received input signal so as to provide a low voltage signal at the corresponding output pin. The relay coil connected to that output pin thus gets energized as current flows through it and armature moves from its original position so as to complete the circuit and the lamp starts glowing (not shown in the picture). This operation is same for switching on all other lamps.

### 3.7 Receiver Circuit Diagram:



### 3.8 transmitter Circuit Diagram:



### **3.9 Components Included in this Receiver Circuit:**

—List of components and the corresponding values are shown below

R1 – 100Ohms •

R2–50K •

R3–10K •

C1 – 10uF •

C3, C2 – 10uF •

V1–5V •

U1 – HT12D •

U2 – Arduino uno •

U3 – ULN2004 •

Q1 – BC547

J1, J2, J3, J4, J5 •

### **3.10 Programming:**

—Run the Arduino using the C++ programming language  
transmitter circuit :

```
;uint8_t inputs[5]={2,3,4,5,6}
```

```
;uint8_t outputs[4]={A0,A1,A2,A3}
```

```
;uint8_t x=0b00000000
```

```
define B0 0xFF6897#
```

```
define B1 0xFF30CF#
```

```
define B2 0xFF18E7#
```

```
define B3 0xFF7A85#
```

```

define B4 0xFF10EF#
<include <Irremote.h#
;Int RECV_PIN = A4
;Irrecvirrecv(RECV_PIN)
;Decode_results results
} For (int I =0;i<sizeof(outputs);i++)
;pinMode(outputs[i],OUTPUT)
;digitalWrite(outputs[i],LOW)
{
;()Irrecv.enableIRIn
{
} ()Void loop
} If (irrecv.decode(&results))
;Int32_t code=(results.value)
;Serial.println(code)//
Switch (code)
}

,Case B0 :digitalWrite(outputs[0]
;HIGH);digitalWrite(outputs[1],LOW)
;digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],LOW)
;delay(100)
,digitalWrite(outputs[0]
;LOW);digitalWrite(outputs[1],LOW)
;digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],LOW)
;break

```

: Case B1

```
,digitalWrite(outputs[0]  
;LOW);digitalWrite(outputs[1],HIGH)  
;digitalWrite(outputs[2],LOW)  
;digitalWrite(outputs[3],LOW)  
;delay(100)  
,digitalWrite(outputs[0]
```

```
;LOW);digitalWrite(outputs[1],LOW)  
;digitalWrite(outputs[2],LOW)  
;digitalWrite(outputs[3],LOW)  
;break
```

: Case B2

```
;digitalWrite(outputs[0],LOW)  
;digitalWrite(outputs[1],LOW)  
;digitalWrite(outputs[2],HIGH)  
;digitalWrite(outputs[3],LOW)  
;delay(100)  
;digitalWrite(outputs[0],LOW)  
;digitalWrite(outputs[1],LOW)  
;digitalWrite(outputs[2],LOW)  
;digitalWrite(outputs[3],LOW)  
;break
```

: Case B3

```
;digitalWrite(outputs[0],LOW)  
;digitalWrite(outputs[1],LOW)
```

```

;digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],HIGH)
;delay(100)
;digitalWrite(outputs[0],LOW)
;digitalWrite(outputs[1],LOW)
digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],LOW)
;break

```

: Case B4

```

;digitalWrite(outputs[0],HIGH)
;digitalWrite(outputs[1],HIGH)
;digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],LOW)
;delay(100)
digitalWrite(outputs[0],LOW);
;digitalWrite(outputs[1],LOW )
;digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],LOW)

```

```

;break

```

```

{

```

```

Irrecv.resume(); // Receive the next value

```

```

{

```

```

;X=0

```

```

For (int i=0;i<sizeof(inputs);++i)

```

```

}

```

```

;X|=digitalRead(inputs[i])<<i

```



```

{
Switch (x)
}
;Case 31: digitalWrite(outputs[0],LOW)
;digitalWrite(outputs[1],LOW)
;digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],LOW); break
;case 30: digitalWrite(outputs[0],HIGH)
;digitalWrite(outputs[1],LOW)
;digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],LOW);break
;case 29: digitalWrite(outputs[0],LOW)
;digitalWrite(outputs[1],HIGH)
;digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],LOW);break
;case 27: digitalWrite(outputs[0],LOW)
;digitalWrite(outputs[1],LOW)
;digitalWrite(outputs[2],HIGH)
;digitalWrite(outputs[3],LOW);break
;case 23: digitalWrite(outputs[0],LOW)
;digitalWrite(outputs[1],LOW)
;digitalWrite(outputs[2],LOW)
;digitalWrite(outputs[3],HIGH);break
{
;Delay(200)

}

```

### **3.11 Receiver Circuit :**

```
;Int outputs[5]={7,3,4,5,6}
;Int inputs[4]={8,9,10,11}
;UInt8_t data
} ()Void setup
;pinMode(13,OUTPUT)
for (int i=0;i<sizeof(inputs);i++)
{
;pinMode(inputs[i],INPUT_PULLUP)
;for (int i=0;i<sizeof(outputs)
;i++){pinMode(outputs[i],OUTPUT)
{
;pinMode(2,INPUT)
,attachInterrupt(digitalPinToInterrupt(2)
;(detect, FALLING
}
} ()Void loop
{
;digitalWrite(13,HIGH)
;data=0
For (int i=0;i<sizeof(inputs);++i)
{
;Data|=(!digitalRead(inputs[i])<<i)

{
Switch (data)
}
```

```
!,Case 1 :digitalWrite(outputs[0]
;digitalRead(outputs[0])); break
!,case 66 :digitalWrite(outputs[1]
;digitalRead(outputs[1])); break
!,case 4 :digitalWrite(outputs[2]
;digitalRead(outputs[2])); break
!,case 68 :digitalWrite(outputs[2]

;digitalRead(outputs[2])); break
!,case 8 :digitalWrite(outputs[3]
;digitalRead(outputs[3])); break
!,case 76 :digitalWrite(outputs[4]
;digitalRead(outputs[4])); break
!,case 3 :digitalWrite(outputs[4]
;digitalRead(outputs[4])); break
{
;digitalWrite(13,LOW)
```

## **Chapter Four : Results and Discussion**

### **4.1Results:**

#### **Transmitter circuit :**

The timer produces a 38 kHz signal that is used to power the IR LEDs, thus producing a 38 kHz modulated IR signal .

#### **receiver circuit :**

The relay coil connected to this output pin is energized with current flowing through it and the motor moves from its original position to complete the circuit and the lamp begins to glow This process is the same for turning on all other lamps .

### **4.2Discussion:**

#### **Transmitter circuit :**

- 1 .The transmission circuit consists of microcontrollers of Ics, an Encoder HT 12E.
- 2 .The first step of the design is to design the interface of the microcontroller.
- 3 . At the input side, a 5-element DIP switch is connected to port P1 of the microcontroller.
- 4 .The other part of the input circuit design is the design of the oscillator circuit and the reset circuit.

—The oscillator circuit is designed by selecting two 15pF capacitors connected to both ends of the crystal oscillator.

—Then the reset circuit is designed taking into account the required reset pulse width to be 100ms and the voltage drop when resetting the pin to 1.2V. Here we choose a 10K resistor and a 10UF capacitor to meet the requirements .

5. The output side consists of an HT12E encoder with its 7 address pins and terminal enable pin connected to ground, and 4 data pins connected to port 0.

.

#### **4.3 Reception circle :**

1 .The receiver circuit consists of Arduino uno and four integrated circuits- HT12D decoder, TSOP1738 IR receiver and ULN2004 relay driver .

2 .The interface design of the microcontroller is the same as that of the transmission circuit, especially the reset circuit and the design of the oscillator.

3 .The input circuit consists of a decoder and a TSOP1738. The TSOP 1738 output pin is connected to the data input pin of the decoder IC and the four data output pins are connected to the P1 port of the microcontroller. The address pins are grounded and the LED is connected to the valid transmit pin to indicate the transmit .

4 . The output circuit consists of the ULN2004 relay motor IC with 5 input pins connected to the P2 port of the microcontroller and the 5 output pins connected to 5 LEDs powered relays.

## **Chapter Five: conclusions and recommendations**

### **5.1 Conclusions:**

#### **From this project the following points were concluded**

1. The circuit can be developed from IR to RF, which is best suited for determining radio frequencies.
2. The circuit can be broken, and the devices can be operated by wire, not by radiation.
3. The smart home circuit can be developed and the devices can be operated by distances.

### **5.2 Recommendations for future work :**

1. Solar panels and battery so you don't need electricity these panels are the primaryComponent of the platform, representing a continuous stream of sunlight, future energy.
2. The circuit can be developed from IR to RF, which is best suited for determining radio frequencies.
3. The smart home circuit can be developed and the devices can be operated by distances to protect homes.

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## الخلاصة :

يهدف هذا المشروع إلى تصميم وعرض نظام تحكم بسيط من 5 قنوات في الانفعالات لدفع خمسة أحمال. يتم إرسال إشارات الإدخال أو الأوامر من جهاز إرسال باستخدام إرسال الأشعة تحت الحمراء واستلامها بواسطة مستقبل الأشعة تحت الحمراء ، ومعالجتها واستخدامها لقيادة الأحمال. في كل من المرسل والمستقبل ، يتم استخدام متحكم دقيق لمعالجة الإشارات. تعمل الدائرة على مبدأ اتصال الأشعة تحت الحمراء. يتضمن اتصال الأشعة تحت الحمراء إرسال الإشارات باستخدام إشارة الأشعة تحت الحمراء كحامل. تتم معالجة إشارة الإدخال من Smitches بواسطة متحكم دقيق ، يتم ترميزها بواسطة المشفر ، ويتم تعديلها وإرسالها بواسطة جهاز الإرسال. في المستقبل ، يتم إزالة تشكيل الإشارة المتضمنة بواسطة مستقبل الأشعة تحت الحمراء. فك التشفير بواسطة وحدة فك التشفير ومعالجتها بواسطة وحدات التحكم الدقيقة للتحكم في أحمال الإخراج.



(5 قناة IR نظام التحكم عن بعد باستخدام متحكم )

بحث مقدم الى كلية دجلة الجامعة – قسم هندسة تقنيات الحاسوب  
كجزء من متطلبات منح درجة بكالوريوس هندسة في تقنيات الحاسوب

من قبل

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3. علي مطلب محمد
4. ايمن حسن هادي

المشرف

م . محمد حسين هويدي

# **AN ACCIDENT DETECTION SYSTEM BASED ON MULTIPATH ROUTING PROTOCOL FOR VANET**

A project Submitted to the Department of Computer Techniques Engineering

Dijlah University College

In partial fulfilment of the requirement for the degree of B.eng.

In

Computer Techniques.

**By:**

Ahmed kareem chaloob

Mustafa saad naeem

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Mahmood alaa adel

**Supervised by:**

Dr. Hussam Alddin Shihab Ahmed

## **ABSTRACT**

The advent of technology has also rise the traffic hazards and the road accident take place repeatedly which causes massive loss of life and property because of the poor emergency facilities. Every day a large number of human lives are lost with many of them sustaining a disability as a result of their injury due to car accidents and the delay in calling the rescue services as the first aid and the Ambulances reach the accident spot too late. Recently, Intelligent Transportation Systems (ITS) have emerged as an efficient way of improving interpretation of transportation systems and enhancing travel safety. In this project, an Accident Detection System based on AODV protocol is proposed for more better reliability in vehicular safety messaging, also to detect the dangerous accidents and can give an optimal solution to this drawback through automatically notifying the rescue services center about the accident's coordinates and time as well as to solve the most common lack of proper communication to the emergency services. Accident detection systems are one of the most effective (ITS) tools. The accident detected system which based on Global Positioning System (GPS) and Global System for Mobile communication (GSM) can be accomplish though one or several sensors, the system can gather the information and coordinates of accident spot then send this data to the rescues services center over a network link in shortest time. Visual basic Simulation result analysis shows that the proposed method has the advantage of choosing the optimum route to deliver data.

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# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 INTRODUCTION**

Advances in wireless technologies have transformed cellular communication and wireless home networking industries. To date, worldwide, there are more than four billion cellular phone subscriptions and over one billion Wi-Fi enabled devices that provide two-way communication functionality and Internet access capabilities. Further, wireless technologies are being developed for other application environments such as wireless sensor networks, smart grid mesh networks, and vehicular communication networks. Although these systems incorporate some form of Ad-hoc communication, they have varying design characteristics related to node mobility, system resources, and network performance measures.

Road traffic injuries are among the top challenges for public health. In the US alone, there are more than five million traffic accidents each year, resulting in more than two million injuries and more than forty thousand fatalities (National Highway Traffic Safety Administration, 2020). Naturally, these numbers are much more significant on a global scale. According to the World Health Organization, there are an estimated between twenty to fifty million injuries and 1.35 million deaths due to motor accidents worldwide each year (World Health Organization, 2020). Further, the economic cost of traffic congestion is huge. Estimates of this cost vary widely from about \$100 to \$200 billion annually in the US.

For many years now, transportation planners have been pursuing an aggressive agenda to increase road safety through Intelligent Transportation System (ITS) initiatives.

For example, in 2001 the European Commission set the goal to reduce road fatalities by 50% by the year 2010. Similarly, in 2008 the US DOT's Research and Innovative Technology Administration (RITA) challenged the industry to reduce traffic crashes by 90% by the year 2030. Various stakeholders have come together in recent years to address these short-term and long-term challenges and initiative efforts have been formed such as the US Intelli-Drive<sup>SM</sup> and European eSafety programs.

These efforts are driven by the promise and capabilities of ITS and share a common theme of incorporating advanced vehicular technologies to improve road safety. Efforts related to the mechanics of motor vehicle handling and crash worthiness have been progressing rapidly since the 1990s (for example, anti-lock brakes, airbags, electronic stability control, and tempered glass windshields). Further, vehicle telematics have taken off, providing drivers with practical applications such as GPS navigation (for road driving), sensor detection (for parking), and car-kit technologies (for hands-free telephony for example).

Vehicular communication networks based on DSRC encompasses several possible communication methods that include:

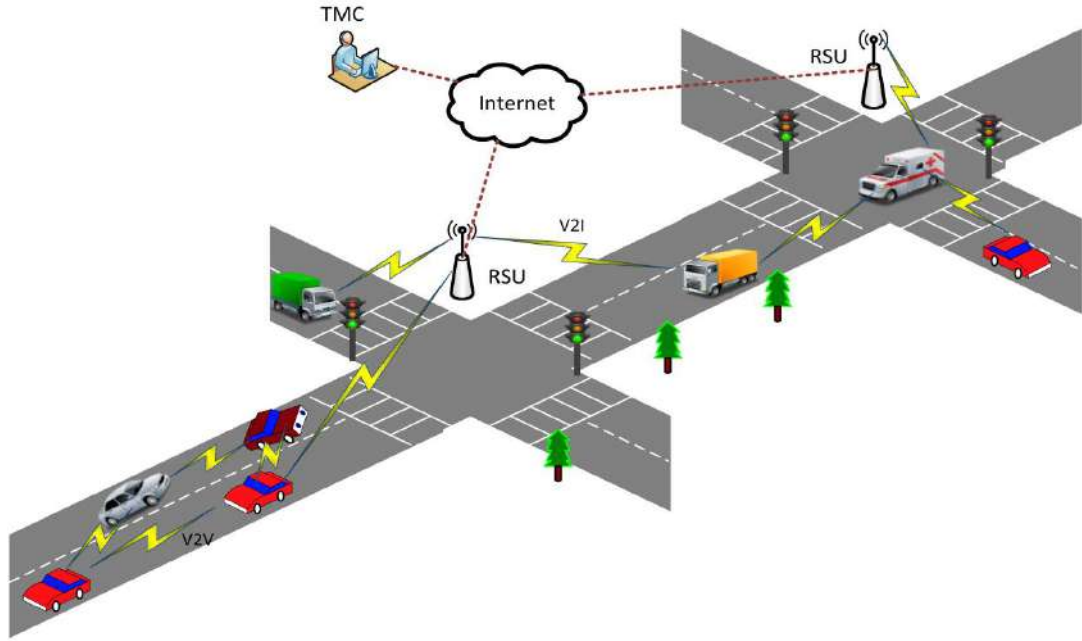
- Vehicle-to-Vehicle (V2V): messages are transmitted between neighboring vehicles or from one vehicle to the next.
- Vehicle-to-Infrastructure (V2I) / Infrastructure-to-Vehicle (I2V): messages are transmitted from vehicles to a road-side unit (RSU) located nearby an arterial road intersection or highway on-ramp or from a RSU to proximity vehicles.
- Vehicle-to-People (V2P)/ People-to-Vehicle (P2V): messages are transmitted from vehicles to pedestrian with blind spot information or from people to vehicles with passenger pick-up desirability.

Among the application domains for the communication methods described above include safety, traffic, and specific user-based information. Two flows of data are disseminated in a multi-hop fashion through a few vehicles before being sent to a road side unit placed either in a smart traffic light or gas station.(Bossom et al., 2009).



**Figure 1.1:** Example of Vehicular ad – hoc Network

Accident detection system uses different types of sensors embedded in a car to respond when an accident has occurred. These systems immediately send emergency message to guide medical personnel to the serious accident spot. (Rauscher et al., 2009). A vehicular ad hoc network (VANET) uses cars to create a mobile network. A VANET mutates every participating car into a wireless router allowing cars to connect to each other and in turn, creates a network with a wide range. In order to avoid any critical situation like an accident, VANET assists vehicle drivers to communicate and to coordinate among themselves as shown in Figure 1.2



**Figure 1.2:** Efficient accident detection by VANET

## 1.2 PROBLEM STATEMENT

Most Accident detection systems are based on GSM technology, and there are many areas on the roads that have poor GSM network coverage, especially inside a long road tunnel. Adding to that the GSM network problem is like the hand-off problem and so on. VANETs operate without permanent infrastructure and are characterized by high mobility movement, deterministic network layouts, specific velocity and traffic patterns in congested conditions, and little or no power constraints or storage limitations. When the message is sent using VANET, it employs a standard routing protocol to broadcast the information to all other neighbor vehicles around the accident spot causing blind flooding to occur with flooding many copies of each message that are retransmitted. AODV Protocol uses sequence numbers to track the accuracy of information and only keeps track of the next hop for a route instead of the entire route; this process can overcome the blind flooding. In addition, the proposed method takes into account for

mobility problem by choosing the best link for sending data. Proposed method has also the potential to reduce the time needed for rescue or emergency services arriving at the place of the accident, and the risk of deaths along with the severity of the injuries.

### **1.3 RESEARCH OBJECTIVES**

The aim of this research is to design an accident detection system to be seamlessly integrated into a car capable of providing accurate accident information and direct communication to rescue center. The objectives of this project are to increase the data delivery in Vehicular Ad hoc Network (VANET) by providing a reliability path to send emergency message based on the enhanced vehicle reliability algorithm, and to validate and test the improvement of VANET performance.

### **1.4 PROJECT OUTLINE**

In this section, the contents of individual chapters of the thesis are reviewed. In addition to chapter one which includes the introduction and problem statement, research objective.

Chapter two describes the background to the technologies which integrated to establish this system like GSM, GPS technologies, the application and services of these technologies.

Chapter three Commences by the introduction about research methodology explaining the hardware components used in the accident detection system, thereafter it is addressed to the second part of the project which is the (VANET) using intelligent method to overcome the problem of broadcast.

Chapter four describes the design and implementation of the proposed algorithm in visual basic.net program and shows the results depending on scenarios and the distribution of the node

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

A comprehensive background is presented in this chapter on the vehicular communication networks. It presented the underlying work of Intelligent Transportation Systems and their potential applications in VANETs.

#### **2.2 BACKGROUND**

Nowadays, the development in mobile tracking technology focuses on two principal technologies, global systems for mobile communication and global positioning systems. GSM is used to send and collect data from a central unit through a data call. GPS receives location's information from satellites, but it cannot communicate with a central unit.

Navigation systems have been big, costly, and used only in flying and military applications. However, the presence of the GPS and the recent propagation of small low-cost motion sensors have made it possible for the navigation systems that are small and inexpensive enough to be used in consumer products. These days, commercial consumer-grade navigation systems are easily found in the areas like the United States, Europe, and Japan (Thakre, Raut, & Shaik, 2014).

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services. GSM supports voice calls and data transfer speeds of up to 9.6 kbps together with the transmission of SMS (Short Message Service). GSM operates in the 900MHz and 1.8 GHz bands in Europe and the 1.9 GHz and 850 MHz bands in the US.

Due to the many applications of both GSM and GPS systems, there is a wide usage of them by millions of people around the world, The GPS/GSM Based System has become one of the most important systems which integrate both GSM and GPS technologies. This system designed for users in land construction and transport business provides real-time information about speed, expected arrival time and the location of the moving vehicles in a brief and easy format. This system may also be helpful for communication process between any two points across the world (Chen, Chiang, Chang, & Wang, 2010).

### **2.2.1 Vehicular Networking**

The ability of vehicles to establish communication with either other vehicles (vehicle-to-vehicle) or with nearby roadside stations (vehicle-to-infrastructure) is promising technology approaching maturity. These vehicular communication networks enable novel safety measures beyond vehicle's line-of-sight with information on acceleration and braking behaviors of other nearby vehicles that are not within immediate visibility. A fully connected vehicular network which can offer safety measures that can reduce accidents, more accurate and better real-time traffic information, and possibly new driving strategies which are eco-friendly are envisioned. The allocation of dedicated frequency spectra in the 5.9 GHz range supports the emergence of the vehicular communication systems. In the US, 75 MHz of frequency is occupied by dedicated short range communication (DSRC) for vehicular networks, which is comparable to the 2.4000 to 2.4835 GHz allocated for wireless local area networks (WLAN). The standard activities of the overall system and vehicular communication framework are controlled by several entities which include the Japanese Association of Radio Industries and Business (ARIB) with ARIB STD-T75 and ARIB STD-T88 and 4 the CAR 2 CAR Communication Consortium (C2C-CC), the US Institute of Electrical and Electronics



Engineers (IEEE) through the IEEE 802.11p and their IEEE 1609 working groups, and the European Telecommunications Standards Institute (ETSI) TC ITS, and CALM ISO TC204 Working Group 16. The 802.11p was approved by the IEEE standards in the mid-2010, and it has progressed from a draft to a published state.

The DSRC-based VANETS encompasses several communication methods such as:

- i. *Vehicle-to-Vehicle (V2V)*: the neighboring vehicles transmit the message between them.
- ii. *Vehicle-to-Infrastructure (V2I)/ Infrastructure-to-Vehicle (I2V)*: the vehicles transmit the messages to roadside units (RSU) nearby a highway on-ramp or from an RSU of nearby vehicles.
- iii. *Vehicle-to-People (V2P) / People-to-Vehicle (P2V)*: the vehicles transmit the messages to the pedestrian using blind spot information or vice versa.

These described communication methods are mainly applicable to safety, traffic, and specific user-based information communication.

### **2.2.2 Intelligent Transportation Systems**

The intelligent transportation systems endeared the researchers in the 1980s and early 1990s with the visions of automated highways where vehicles could be off the driver's control. It may be argued such issue as the lack of sufficient funding, lack of stakeholder's cooperation, lack of adequate policy mechanisms, issue of liability, and a lack of technological maturity may contribute to the predictions that automated highways are still far from reality. The ITS has, however, continued to improve surface transportation over the years. ITS development and enhancement have received enormous attention globally. The ITS initiative is been driven by the US, Europe, and Japan.

Over the past two decades, the development of ITS in the US has been authorized through a series of major highway bills. These bills include the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), the 1995 National Highway System Designation Act (NHS), the 1998 Transportation Equity Act for the 21st Century (TEA-21), and the 2005 Safe, Accountable, Flexible, Efficient<sup>13</sup> Transportation Equity Act –A Legacy for Users (SAFETEA-LU). These programs encourage basic research and development, deployment, and operational testing of new surface transportation ICT technologies. The major aims of ITS include life-saving, productivity improvement, and traffic congestion reduction. For over a decade now, there has been the development of various ITS technologies, of which some were more successful than others.

### **2.2.3 Global Positioning System (GPS) History**

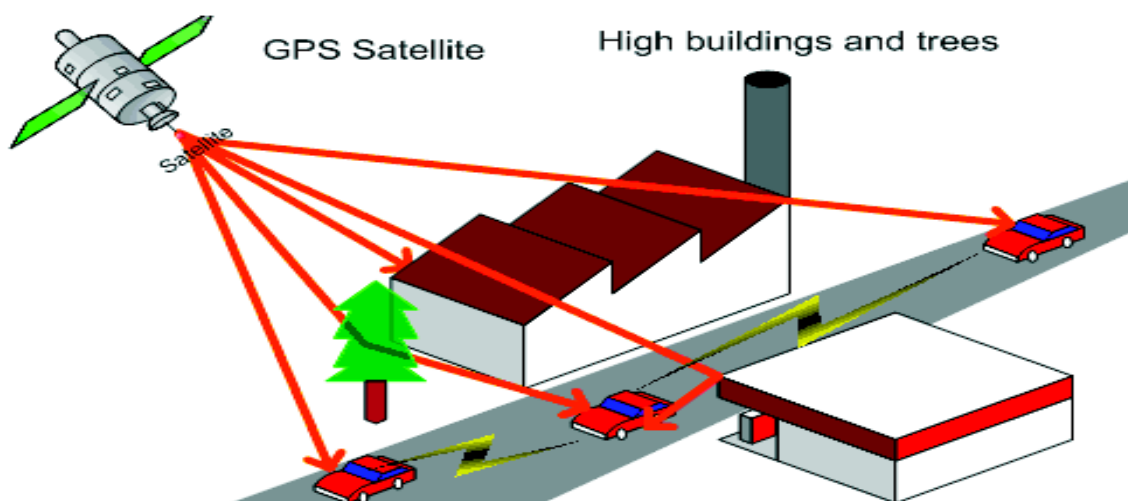
People have over time, developed several ways of finding their relative position on earth, as well as to navigate a route. The early Mariners depend on the celestial bodies (angular measurements) such as the sun to estimate their location. The more advanced technique that is based on radio navigation was first developed in the 1920s on radios. These radios allowed the navigators to locate the direction of shore-based transmitters within range. The artificial satellites were later developed and this made it possible for more-precise, line-of-sight radio navigation signals to be transmitted, ushering in a new era in navigation technology. The satellites were initially used for finding positions in a two-dimensional Navy system called Transit which is simple and reliable. This formed the basis for the GPS system which has changed the navigation technology.

The GPS System which was formally referred to as the Navstar Global Positioning System was initiated in 1973 to minimize the increase in navigation tools. It later attracted a wide range of users through the creation of a system that addressed the challenges of the existing navigation systems. It has been a success in all navigation tools. The GPS is

also used in several applications worldwide because of its ability to be accessed using small and inexpensive equipment (Airianto, 2009).

#### 2.2.4 GPS Applications

Although the GPS was designed initially for military and intelligence application during the Cold War, it was made available for public use in the 1980s. Millions of people today depend on GPS to navigate their route. The most notable GPS application is the vehicular, satellite and ships satellite navigation. People with GPS enabled devices can locate their speed and position on land, air or sea with great accuracy. Drivers can navigate their route and find detours around traffic problems with additional software that can receive traffic and safety alerts. Engineers and scientists can also monitor experiments and geological activities such as earth tremors and quakes using GPS applications. They can track climate changes and other phenomena using strategically positioned GPS devices. With the GPS, very accurate maps can be produced. The GPS can be used in emergency services for a faster location of the route to an incident, and also pinpoint the location of accidents for a quicker staff follow-up. This is important for search and rescue teams at extreme weather conditions on the land and sea (Rehman, 2014). Figure 2.1 shows the GPS Satellite in VANETs.



**Figure 2.1:** GPS Satellites in VANETs

## 2.3 GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM)

### OVERVIEW

The GSM system was designed as a second generation (2G) cellular phone technology. The provision of a system that can enable the achievement of greater capacity more than the first-generation analog systems was its major aim. By using a digital time division multiple access approaches (TDMA), the GSM achieved this feat. More users can be accommodated within the available bandwidth using this technique. Additionally, privacy was retained by adopting the ciphering of the digitally encoded speech. Using the earlier analog cellular technologies, anyone with a scanner receiver can listen to calls, and several famous personalities had eavesdropped with great consequences. Table 2.1 below summarizes the main points of the GSM system specification, showing some of the highlighted features of technical interest (Pratishruti Saxena 2014).

**Table 2.1: GSM Specification**

<b>SPECIFICATION SUMMARY FOR GSM CELLULAR SYSTEM</b>	
Multiple access technology	FDMA / TDMA
Duplex technique	FDD
Uplink frequency band	890 - 915 MHz (basic 900 MHz band only)
Downlink frequency band	933 -960 MHz (basic 900 MHz band only)
Channel spacing	200 kHz
Modulation	GMSK
Speech coding	Various - original was RPE-LTP/13
Speech channels per RF channel	8
Channel data rate	270.833 kbps
Frame duration	4.615 ms

#### 2.3.1 GSM Services

One of the primary functions of the GSM system is speech or voice calls. Speech is achieved through digital encoding and decoding using a vocoder. Several vocoders exist for use, being aimed for different situations. Additionally, other data services are also supported by the GSM cellular technology. Although they are behind in performance

compared to the 3G providers, they are still useful and important. Several data services are supported with user data rates up to 9.6 kbps. The services that can be supported are Videotext, Teletext, and Group 3 facsimile.

The short message service is one service that has enormously grown. It was developed as a component of the GSM system but has been incorporated into other cellular technologies. It can be regarded as a similar service to the paging service but quite more comprehensive, permitting a two-way messaging, alpha-numeric messaging of a reasonable length, and can store and forward delivery. This service has been popular due to its simple and low fixed cost (Zaki, 2012).

## **2.4 VEHICULAR NETWORKING**

This section reviewed the dedicated short range communication (DSRC) and the ITS communication technology. The DSRC was defined by 802.11p as an amendment of the initial IEEE 802.11 standard, making it more suitable for application in VANET, such as supporting high mobility, low latency, and longer ranges of communication. Some perspective was also provided on throughput and delay analysis for 802.11p. We also discussed why the latter performance measure was more important in vehicular networking.

### **2.4.1 DSRC/IEEE 802.11p**

The DSRC is also referred to as wireless access in a vehicle environment (WAVE). The 75MHz spectrum in the 5.9 GHz band has been allocated for DSRC use by the US Federal Communications Commission (FCC), while Japan and Europe have allocated their own spectrum band and system design. The DSRC in the US has seven licensed channels shared between private applications and public safety. Unlike standard 802.11 where each channel is 20 MHz wide, the channels in 802.11p are 10 MHz and the

signals are more resistant to fading (with an option of using 20 MHz by combining two 10 MHz channels) (IEEE P802.11p, 2010). The IEEE 802.11p is similar to 802.11a/g at the physical layer based on the Orthogonal Frequency Division Multiplexing (OFDM) modulation. The 802.11p is different from the normal 802.11 by having a unique ad hoc mode, IPv6 for routing in the network layer, and random MAC addresses for privacy preservation.

The unique ad hoc mode aids the communication of the 802.11p nodes outside the basic service set in a highly mobile environment where association and authentication are not defined in 802.11p PHY/MAC, rather handled by the station management entity or the upper layer. This minimizes the delay incurred in an initial first frame exchange, in which there is a short communication timing between two vehicles, especially when the vehicles are moving in opposing directions. The IEEE 802.11p also includes 802.11e-based priority class enhancement 802.11h-based power control. The enhanced distributed channel access (EDCA) with different contention window size is addressed by the prioritization and quality of service for safety time-critical messages in VANET. DSRC/WAVE provides a flexible architecture with multiple protocol stacks above the network layer (for instance TCP, UDP, and WAVE Short Message in the transport layer). IEEE 802.11p is used in the standard for DSRC/WAVE in the lower layers (Physical and MAC) and IEEE 1609 in the upper layers (1609.1 for application services, 1609.2 for security services, 1609.3 for networking services, 1609.4 for multi channel and EDCA mechanisms).

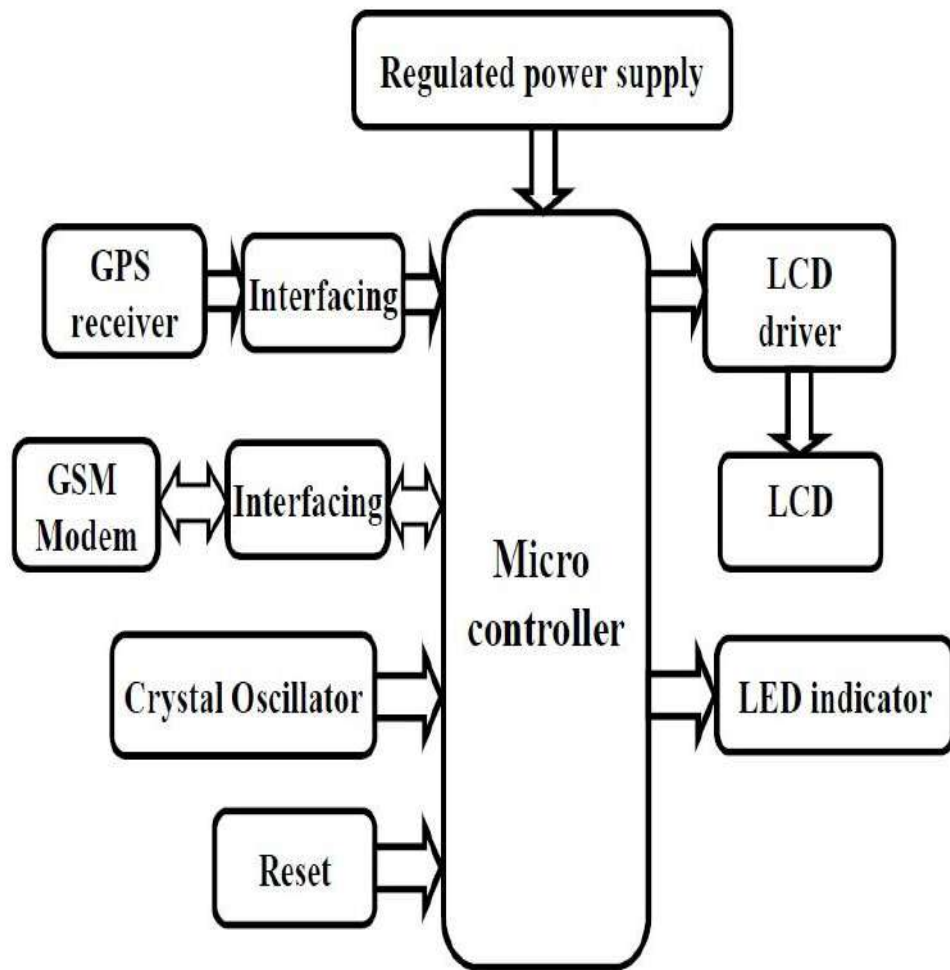
A V2V communication application package consists of information such as timestamp, GPS coordinates, vehicle speed, vehicle direction, and vehicle acceleration; while I2V application package contained additional information like the number of detected vehicles and traffic signal status. These messages are about 150 bytes or less with the remaining

overhead attributed to the other layers of the protocol stack. USDOT (2005) provided further details on the structure of the application message of different safety and non-safety scenarios.

## **2.5 VEHICLE TRACKING SYSTEM BASED ON GPS & GSM**

The tracking system of most vehicles is GPS and GSM based. The SMS is a mobile feature which is available for mobile phones that allow the sending of a small amount of text from one user and another. The GPS is made up of 24 satellites in six different 12-hour orbital paths which are so spaced that at least 5 of them can be visible from any point on the globe.

The GPS has found application in areas such as stolen vehicle recovery, satellite data processing, emergency response, surveying, law enforcement, roadside assistance, recreation, search and rescue, wildlife tracking, exploration, tracking package delivery, and mobile commerce. In our daily lives, mobile phones have taken a greater position; the need for context-aware applications is increasing daily. A major information context is a location, which enables a range of mobile phone applications such as security, navigation, and location-aware social networking (Aashish, Suraj, & Bipin, 2014). The GPS and GSM tracking system block diagrams are illustrated in Figure 2.2.



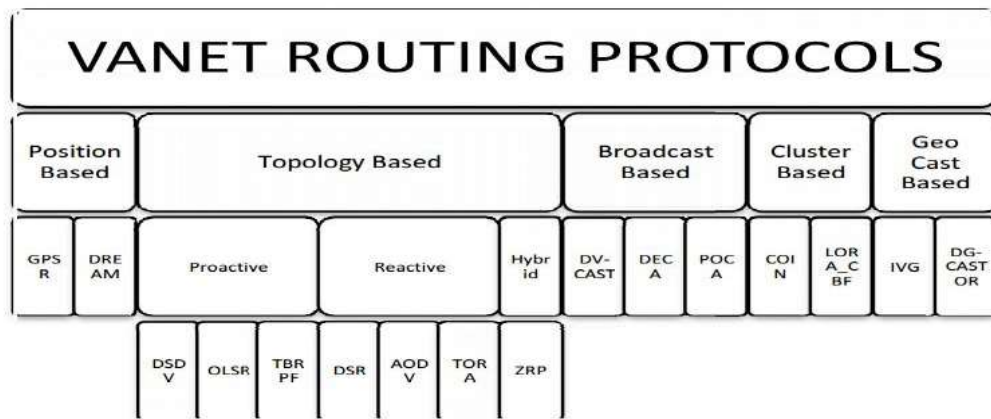
**Figure 2.2:** GPS & GSM Tracking System Block Diagram

## 2.5 ROUTING IN VANET

In the last few years, routing has been analyzed in VANET. Being a particular type of ad-hoc network, the major difference between VANET and MANET is in the mobility pattern and topology changes. The VANET routing protocols are classified into five categories as presented in Figure 2.3 (Venkatesh, A, & R, 2014). They are:

- i. *Geo Cast Based Routing Protocol*
- ii. *Topology Based Routing Protocol*
- iii. *Broadcast Based Routing Protocol*
- iv. *Cluster Based Routing Protocol*
- v. *Position Based Routing Protocol*





**Figure 2.3:** Routing Protocol Hierarchy

## 2.6 BROADCAST IN VEHICULAR NETWORKS

The MANET routing protocols that presently exist in MANET cannot be applied in VANET. For the proactive protocols (OLSR and DSDV for instance), it is expensive to frequently exchange messages between nodes to keep an updated routing table, and this is not ideal in large scale VANETs. For the reactive protocol (AODV and DSR for instance), routing errors for distances spanning several hops can occur by identifying a packet's route on-demand before sending the first packet. In VANETs, a path may disappear after been initially discovered. Also, in un-congested traffic such as off-peak hours in highway or in suburban or rural arterial roads where the vehicle density is sparse, mobility is more severe in VANET than in MANETs. This period of disconnection makes the conventional MANET protocols unfit for VANETs; thereby creating the need for new VANET routing protocol. For unicast or one-to-one, routing protocols are used for the identification and establishment of route paths from the source node to the destination node. In broadcasting or one-to-all, routing protocols facilitate an efficient dissemination of data to all the nodes through avoiding un-necessary rebroadcast and mitigating duplicate messages.

## **2.7 BROADCAST PROTOCOLS**

In this section, a survey of the proposed broadcast routing protocols for solving broadcast problems in VANETs was carried out. These protocols improve the blind flooding re-broadcast, which is a situation where each node upon receiving a message will re-transmit same irrespective of the number of the same message that has been sent already by the neighboring nodes. It is assumed in VANETs that vehicles are equipped with GPS, and there is information on the node position and digital maps. Numerous schemes have been proposed for the classical MANET to address the challenges of the broadcast storm problem with serious redundancy, packet collision, and wireless contention. The schemes include:

- i. probabilistic-based
- ii. distance/hop-based
- iii. location/position-based methods (Tseng, 2002).

In VANETs, these schemes are used together with novel proposed schemes such as the traffic-based and cluster-based methods.

## **2.8 AODV ROUTING PROTOCOL BASED ON VANET TECHNOLOGY SYSTEM**

A prototype architecture known as e-NOTIFY was proposed by Fogue et al. (2012). Its aim was to offer a framework that permits a) a preliminary and automatic assessment of the damage to the vehicle and its occupants based on the information from the vehicles involved and from the accident reports database, b) direct V2V involved in the accident, and c) automatically send data files containing vital information on the incident to the control unit. From the preliminary accident estimation and reported information, the needed rescue workers will be alerted by the system to optimize their accident assistance. A novel proposal has been designed for the improvement of the

chances of passengers' survival when there is an accident. The proposed system provides automated detection, reports, and assistance to the involved passengers through exploiting the offered capabilities by the communication technologies.

Bossom et al. (2009) suggested a Come Safety prototype with the main goal of developing a European set of standards that will support the deployment and implementation of cooperative ITS. It also aims to coordinate the activities for the realization of the cooperative systems of European roads, with a focus on the issues that relate to V2V and V2I communications. In India, such technologies do not prevail, and hence, this system is proposed.

An efficient system which automatically notifies and guides the emergency services to the spot of an accident was proposed by Praveena, Sankar, Jeyabalaji, & Srivatsan (2014). In the case of an accident, the Crash Sensor of the Air Bag System installed in the vehicle detects the crash. If the observations are above the critical point already preset, a message is triggered by the controller to notify the emergency services. This message is delivered to the rescue services center using VANET. VANET also helps the services team to locate the shortest route to the scene of the accident using the ABEONA algorithm and a traffic signal module. The system is proposed as a completely automatic system for the detection of the accident through alerting the rescue services and guiding them to the accident spot.

Manpreet & Amit (2014) proposed a performance analysis in VANET routing protocols with the aim of studying the important QOS metrics in VANET and vehicular traffic management solutions for the improvement of the overall traffic safety. From this study, it was found that delay and jitter in VANET can be adequate for most of the unicast-based applications, while the ratio, packet delivery, and duration of connection may not satisfy the requirements for most unicast-based applications.

## **2.8 SUMMARY**

VANET in communication and traffic network context was described in this chapter. The development of scalable and reliable VANETs requires a cross-layer design approach which will consider the traffic characteristics, communication infrastructure, and the application requirements. The next chapters of this report will present the role played by the GSM and GPS module in tracking and monitoring vehicles. It has been found that some gaps still exist in the GSM technology. There are many regions of the highway that have poor GSM network coverage such as long road tunnels and GSM hand-off spots. Should an accident occur at these spots, an emergency message for rescue services via GSM cannot be sent. On the other hand, it has been observed in many studies that the AODV algorithms enhance network performance metrics.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 INTRODUCTION**

Road accidents are painful to human as they usually lead to a high human physical suffering and financial costs in terms of injuries, repairs, and death. Most accident victims are unfortunately within the working group of 25 - 65 years. Significant reduction in accident related injuries has been achieved using advanced life-saving measures such as electronic stability control. A simple observation of the accident history chart revealed that many people in many countries die because of the accident.

Moreover, people are denied of emergency care at accident scene every minute. This emergency care can have a great difference in the rate of survival. Analysis has shown that a-one-minute reduction in accident emergency response correlates to a 6% difference in the total lives saved (Alwarsamy, 2014). The cooperation of the sensors and processing capabilities of the GPS and GSM with an intelligent broadcast algorithm for VANET which can be employed to overcome the difficulties traffic accident scene detection and emergency message delivery in a short time is portrayed in this study.

#### **3.2 ACCIDENT DETECTION SYSTEM**

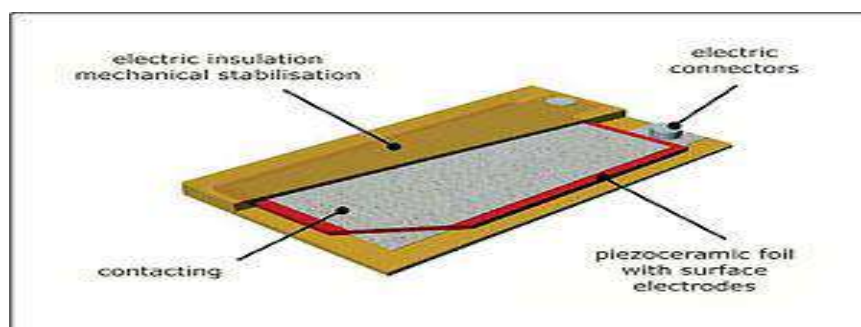
The ADS is made up of GSM modems, in-vehicle GPS receivers, and a microcontroller. The users of the ADS can monitor the geographical location on Google Earth or any other mapping software. There are 40 pins in the microcontroller employed in the ADS, and 8-bit microcontroller (Alwarsamy, 2014). An industrial GSM modem is used as the GSM terminal for data transfer. In the world of modern, there are many sensors, but in ADS, the vibrator sensor is used to sense the vehicular vibration; in this

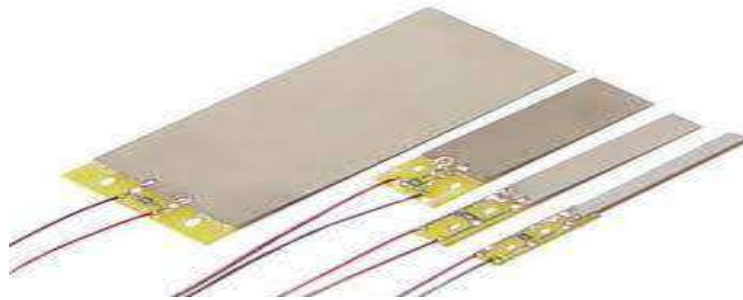
situation, the vibrator sensor which is used as accident sensor detects the accident. The GPS location, time and information about the accident are shown on the LCD. The location of the vehicle is tracked with the GPS. The level of vibration on the sensor is used to estimate the degree of the accidents. The power supply unit powers all the respective systems of the ADS (Rajkiran & Anusha, 2014).

### 3.2.1 Vibration Sensors

Many types of sensors can be employed to detect the vibration of the vehicle during or before an accident. The piezo electric is used to measure the pressure, acceleration, strain, and force in the piezoelectric sensors through converting the signals to electrical charges that displace the silicon diaphragm attached to it. These Piezoelectric sensors are mainly used in quality assurance and process control. Additionally, the vibration, shock, and displacement in automobiles are measured with the uniaxial and triaxial accelerometers. In automotive mechanical systems, vibration sensors can also be used (Haran & Suriyanarayani, 2012).

The increase in the use of the piezoelectric technology is related to the advantages of the system. The high modulus of elasticity of their materials is similar to that of many metals. Though they are electromechanical systems which respond to compression, no deflection is detected in the sensing elements. This accounts for their ruggedness and for this reason, they are mainly used in the ADS system. Figure3.1 below shows the parts of vibration sensors





**Figure 3.1:** Vibration Sensor

### **3.2.2 GSM Modem**

GSM modems are wireless modems which work with a GSM wireless network. Wireless modems function as dial-up modems with the main difference being that dial-up modems use fixed telephone lines to send and receive data while wireless modems use radio waves to send and receive data.

An external GSM modem is typically connected to a computer using a serial cable. A SIM card is required in the GSM modem to function from a wireless carrier such as a GSM mobile phone. A common and extended set of standard AT commands is supported by the GSM modem (Japheth, 2013). GSM modems can be employed for the following:

- i. Writing, reading, and SMS messages deleting.
- ii. SMS message sending.
- iii. Signal strength monitoring.
- iv. Charging status and battery charge level monitoring.
- v. Reading, writing and searching phone book entries.

About six to 10 SMS messages can be processed by the GSM modem per minute, which is a very low number. The GSM network which is used by cell phones offers a long range cost-effective wireless communication channel for applications that need connectivity instead of high data rates (Nazir, Tariq, Murawwat, & Rabbani, 2014).

The ability to use modem's RS232 port to communicate and develop embedded applications is an advantage of using them. The development of applications such as data transfer, remote control, SMS Control, and logging is possible as well. GSM modem

provides high-performance levels at low price and power input. It can also connect to the internet in GPRS mode and perform data logging and control functions. This modem can, therefore, be conveniently used in the ADS system. Figure 3.2 below indicates the main parts of the GSM modem card.



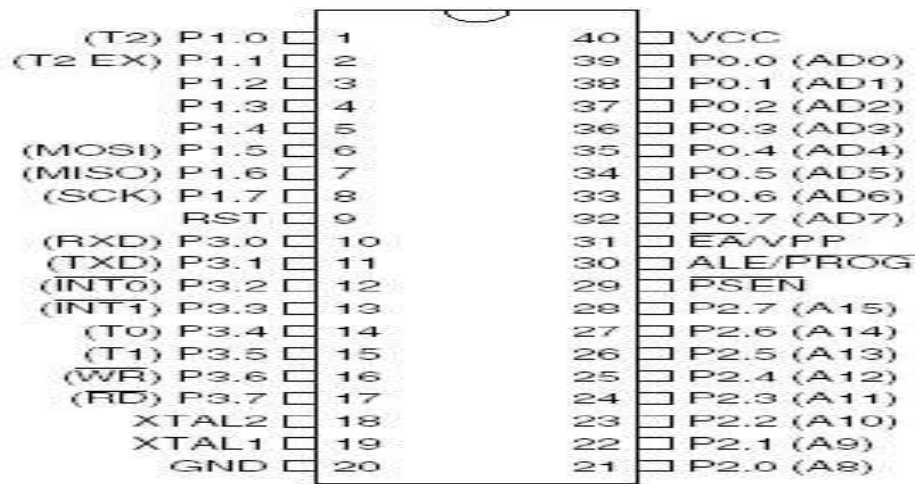
**Figure 3.2:** GSM Modem

### **3.2.3 Microcontroller**

The processor used to control and manage the ADS is the Atmel AT89S52 microcontroller. It is produced using the highest density nonvolatile memory technology and it works with the 80C51 industrial standard set. The ATMEL AT89S52 is a low power, 8 Kbytes high-performance microcontroller in-system programmable flash memory. The program in the system can be reprogrammed through the conventional nonvolatile memory programmer or on-chip flash; the chip is a powerful microcontroller that provides a low cost and flexible solution to several control applications (Nazir et al., 2014). These stated features make this type of micro controller preferable in the ADS system.



When the GSM modem, GPS, and micro controller are turned on, the microcontroller gets the location of the vehicle, the date and time, and monitors the vibrator sensor. The micro controller keeps monitoring the vibrator sensors to check for any accident. If vibrator sensor is activated, the microcontroller assumes an accident has occurred and analyzes the vibration level to estimate the severity level and sends the vehicle location, priority level, date, and time to the RSC for rescue operation (Alwarsamy, 2014). Figure 3.3 below show the pins layout of the microcontroller ATMEL AT89S52.



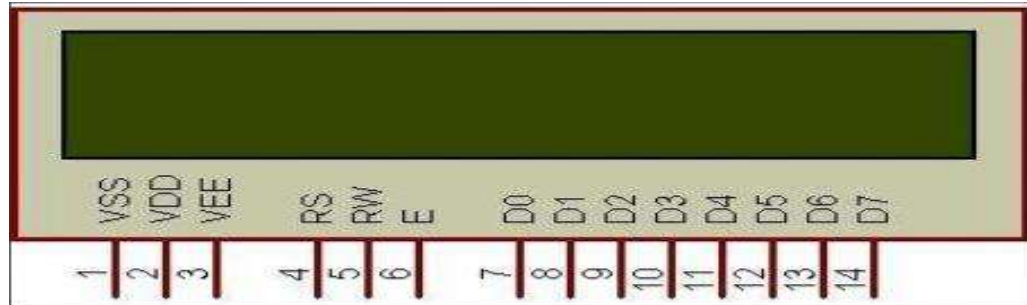
**Figure 3.3:** Atmel AT89S52 Microcontroller

### 3.2.4 Liquid Crystal Display (LCD)

Whenever a low power consumption and compact size are critical, the LCD is the preferred technology. They are widely used in many applications such as television, instrument panels, computer monitors, aircraft cockpit displays, and signage. They are commonly used in consumer devices like gaming devices, clocks, video players, watches, telephones, and calculators.

The LCDs are compatible with low power electronic circuits since their power consumption level is low and can be powered for longer durations (Abhinaya, 2014). The LCD can use 8 all data pins. However, a careful comparison is found with the little speed advantage. The LCD can also use the R/W pin if the R/W speed up is desired. The R/W

pin is only used by the Liquid Crystal Fast as shown in Figure 3.4. So, this type of LCD is better used in the ADS.



**Figure 3.4:** Liquid Crystal Display (LCD)

### **3.2.5 GPS Unit**

#### **3.2.5.1 GPS Receiver**

A device that uses the GPS to determine the exact location of people, vehicle or other assets to which it is attached and record its position at regular intervals is a GPS tracking device. The location data recorded may be transmitted to a central location data base, or to a computer connected to the internet using a cellular network or satellite modem embedded in the unit. The data may also be stored within the tracking unit of the device. This allows the real-time or later display of the asset's location against a map backdrop. A GPS receiver functions as the sensor for location detection as shown in Figure 3.5. (Ramadan, Al-Khedher, & Al-Kheder, 2012).

A sensitive and accurate GPS modem device is required in the ADS system. It can have a short specification setup time of < 8 seconds in the hot start and < 40 seconds in the cold start. A tracking sensitivity of  $-159$  dBm gives a better navigation performance even in populated areas. It also has 4000 search bins and 20 parallel channels that provide fast satellite signal acquisition.



**Figure 3.5:** GPS Receiver

#### **3.2.4.2 GPS Software Design**

Three key messages are sent by every satellite to the ground terminal when using GPS to position. These messages are the satellite position, the satellite number, and the time. The messages are stored by the receiving station and used to fix the time on the GPS receiver. The distance from each satellite to the receiver is calculated by comparing the time difference of receiving each satellite signal and the time signal was sent. Trigonometric formulas can be used to calculate the receiver's location when the receiver can communicate with many satellites. In positioning, 3 satellites can operate longitude and latitude (2D) positioning, while 4 or more can operate longitude, latitude, and height (3D) positioning. Using differential technique, positioning accuracy can be achieved in cm or even mm levels because accuracy is the major positioning indicator. Most Civilian GPS receivers have a horizontal position accuracy of about 5 to 10 m. (Lokhande, Bahe, & Kumar, 2014).

#### **3.2.6 Analog to Digital Converter (ADC).**

The ADC is signal conditioners given as an input to the micro controller. Most signals that carry information such as current, voltage, temperature, time, pressure and time are in the analog form. But to process, transmit and store this information, it is better

to present such signals in the digital form. When digitalized, they offer a better accuracy and reduce noise.

The conversion from analog to digital (A to D) is a quantizing process where the analog signal is converted into the equivalent binary word. Based on the conversion techniques, the ADCs are classified into two general groups. One involves a comparison of between a given analog signal and the reference voltage that was internally generated. This group comprises of a successive approximation, dual slope technique, and flash A to D type converters. The other technique involves a change of the analog signal in time or frequency and comparing against established values. This group includes the V to F and integrator converters.

### 3.2.6 Electronic Circuit Diagram

The Accident detection system circuit diagram can be illustrated as shown in Figure 3.6 below:

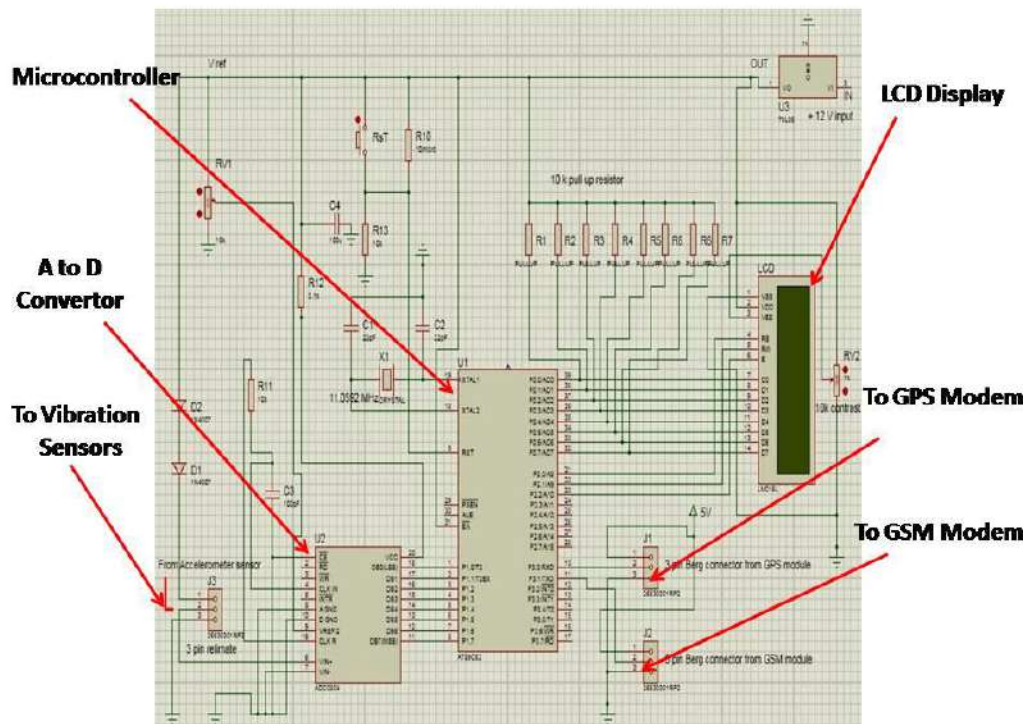


Figure 3.6: ADS Circuit Diagram

### **3.3 VEHICULAR AD-HOC NETWORK (VANET)**

To broadcast messages from the Crash sensor, this system uses VANETs which are special MANETs where vehicles equipped with wireless communication capability serve as the network nodes (Praveena et al., 2014). They deliver data without depending on the centralized administration by coordinating with each other. A set of onboard units (OBUs) fixed inside vehicles and roadside units (RSUs) setup along roads make up VANETs. The OBU and RSU can communicate among themselves using DSRC or the European Standard for ITS. The vehicular communication can be grouped into vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I).

The Federal Communications Commission (FCC) designed the wireless access in the vehicular environment (WAVE) as a multi channel approach reserved for one control channel from 5.855 to 5.865 GHz for high availability low latency vehicle safety communications. The WAVE is the first VANET standard published in 2006 when the IEEE 802.11 standard required an enhancement to support applications from the ITS (Samara, Salem, & Alhmiedat, 2013). The 802.11p standard was meant for communication in VANET and it uses the DSRC spectrum. It is divided into eight 10 MHz channels with just one control channel dedicated for safety application communication. The safety applications in VANET depend on the V2V or V2I safety information exchange using the control channels.

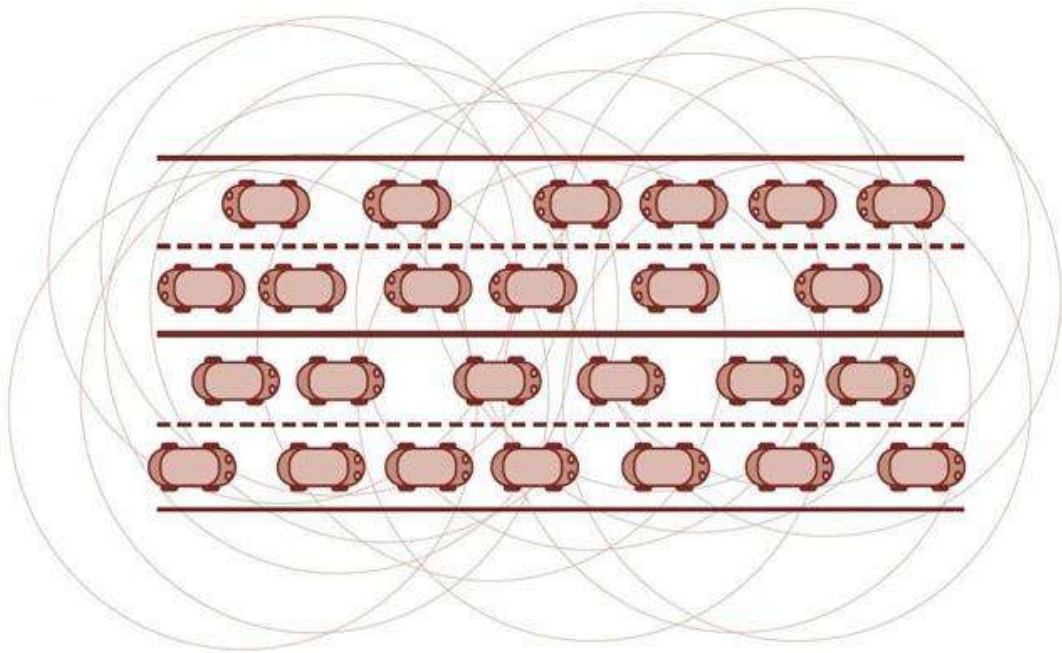
There are two ways of implementing safety communication in VANET, namely, the periodic safety message (hereby called beacon) and the event-driven message (hereby called emergency message). They share a common control channel. The beacon messages contain the status information of the sender vehicle such as the position, speed, and direction. Beacons give the updated information of the sender vehicle to the other vehicles within the network, keeping them updated on the status of the network, and predicting

vehicular movements. Beacons are aggressively sent to the neighboring vehicles at the rate of 10 messages per second.

### 3.3.1 Broadcasting in VANET.

VANET broadcasting is similar broadcasting in MANETs though its implementation is more difficult and complex in VANETs because vehicular movement follows road signs and directions, and sometimes, broadcasting is relevant only to a specific geographical area. For instance, vehicles are only alerted of accident scenes if they are on the same side of the road with the scene; those moving on the other side of the road are not alerted. Broadcasting in VANETs should, therefore, be made to cope with the road layout and manage message dissemination to the target vehicles. Figure 3.7 shows the VANET broadcasting storm.

Several solutions have been proposed regarding coping with VANET broadcasting. A different solution has been adopted by each proposal to optimize network performance and solve the issues of broadcast storm (Bani, 2013).



**Figure 3.7:** VANET Broadcasting Storm

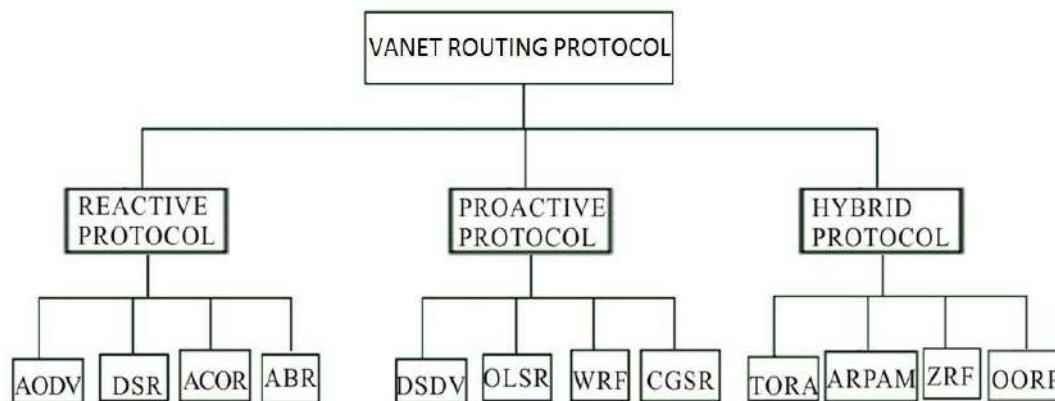
### 3.3.2 Routing Protocols for Vehicle AD-HOC Network

To discover the route from a sender to a receiver, a routing protocol is needed.

The protocol should:

- i. Have a minimal overhead control functions.
- ii. Have routing functionality over multiple hops.
- iii. Manage the dynamic topology.
- iv. Prevent loops in discovering routes.

Three basic approaches are taken for routing protocols in vehicle ad-hoc network as shown in Figure 3.8 below.



**Figure 3.8:** VANET Routing Protocols

#### 3.3.2.1 Proactive Routing Protocols

- i. Each node should maintain its route to other nodes.
- ii. Occasionally exchange routing information.
- iii. Avoid sending unnecessary control packet bandwidths.
- iv. Not suitable for large networks as it needs to maintain the route information of every node's routing table.
- v. Examples: Destination Sequence Distance Vector Routing (DSDV), and Optimized Link State Routing (OLSR).

#### 3.3.2.2 Reactive Routing Protocols (ON DEMAND)

- i. Route discovery is initiated by the source on demand.
- ii. Does not require route searching and maintenance when no route request exists.
- iii. Pleasing in environments with limited resources.

- iv. Manage only active routes.
- v. Offers less overhead control and better scalability compared to the proactive routing protocols.
- vi. Examples: AODV and DSR

### **3.3.2.3 Hybrid Routing Protocols**

- i. A combination of the two protocols.
- ii. Example: ZRP

### **3.3.3 Route Selection Based on Average Signal Strength**

The VANET is a network containing mobile nodes with constantly changing topology. These mobile nodes can quickly move from place to place. Most recent VANET routing protocols choose paths based on the minimum hop count. The minimum hop paths perform poorly because they may contain wireless links between distant nodes. These long wireless links can be sluggish, resulting in poor throughput; and the link between far nodes can easily break due to mobility (Manjhi & Patel, 2012).

As discussed in Section 3.3, safety communication is implemented in VANET in two ways, using beacons or emergency messages which share a common control channel. Beacons are sent to neighboring vehicles at the rate of 10 messages per second. This could, in turn, cause an increase in the channel collision which the control channel may not handle, especially when it occurs in small geographical areas. The VANET structure that controls beacon messages could be executed through the control of the transmission power or message repetition. A high power sending of the message may result in the message getting to longer distances, thereby increasing the load on the channel; whereas low power sending will get the message to short distances. Beacon power adjustment (increase or decrease) is not the best solution to emergency message delivery.

A solution that depends on the provision of a second path to message delivery in emergency situations in GSM network out-of-coverage areas is proposed in this study.



The proposed system is achieved by adopting a VANET through enhanced routing method that selects paths from the source to the destination with more stability than other paths through intermediate nodes. More stable paths can be selected by measuring the signal strength of the nodes and calculating the average values. A node with signal strengths close or equal to the average values will be selected as the data sending route. The scheme is advantageous in optimizing the network lifetime and meeting the ADS goal by sending emergency messages in the shortest time and ensuring their arriving at the RSC. The performance of the network will be improved with this method.

### **3.3.4 Received Signal Strength Algorithm**

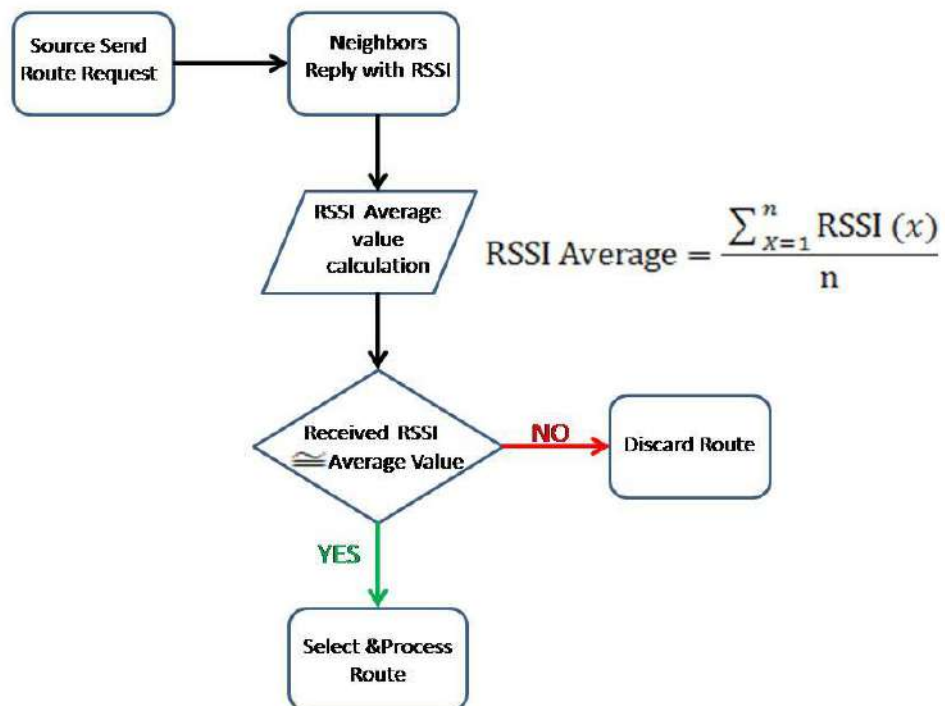
A major issue in VANET is the maintenance of a stable and reliable route between nodes despite their mobility. A stable routing protocol is needed to maintain route reliability over a standard transmission period (Krupa & Benakappa, 2014). This can be achieved through a new reliable routing protocol algorithm that chooses routes based on the calculation of the signal strength of the node. In this project, routes based on average signal strength (RASS) is proposed.

Regarding the RASS algorithm, the route request 'RREQ' is broadcast by the sender to the neighboring nodes and they reply with their Received Signal Strength Indicator (RSSI) value. The RSSI of all the nodes is stored by the sender to buffer. From the RSSI values of the neighboring nodes, the sender calculates the average RSSI of the neighboring node because it is obvious that the node with the average RSSI very close to sender node; hence, the end to end delay can be reduced by avoiding choosing the nearest node with maximum RSSI value, and minimizes the chances of link breakage by avoiding the far nodes with minimum RSSI values.

Through selecting the average value node, the message will be transmitted to the selected node and the same process will continue between the intermediate nodes until the message reaches the nearest RSU or base station and is delivered to the destination.

### 3.3.4.1 (RASS) Route Discovery

In RASS, the major difference is the RREQ message from the standard AODV. The message header contains the RSSI Value. During a broadcast, the vicinity of the adjacent nodes is checked by the RREQ to determine the RSSI value. Then, the average RSSI node will be calculated by the source by summing all the neighboring RSSI values and dividing same by the number of neighbors to determine the average. The average is later compared with each monitored RSSI value stored in the buffer to know the closest value to the average. The average node will emerge as the next hop. The path with the average nodes will be selected as the final route to transmit the message. Figure 3.9 shown below represents the flowchart to the RASS route discovery and summarizes steps.



**Figure 3.9:** RASS Route Discovery

### 3.3.4.2 Received Signal Power Calculation

The Free Space Propagation model (FSP) was used in this project for the prediction of the strength of the received signal with a clear, unobstructed line-of sight path between the sender and the receiver. Based on these conditions, the signal power received is calculated using the following formula:

$$Pr(d) = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 d^2} \quad (3.1)$$

Where  $Pr(d)$  represents the power received, which depends on the transmission-receiver separation;  $P_t$  represents the transmitted power;  $G_t$  is the gain in transmitter antenna;  $G_r$  is the gain in receiver antenna;  $\lambda$  is the wavelength, and  $d$  is the transmitter-receiver separation.

The received signal strength and the signal power may be expressed in milliwatts (mW) or in decibel – milliwatts (dBm). The conversion is performed using the following mathematical formula:

$$dBm = \log(mW) * 10 \quad (3.2)$$

$$mW = 10^{(dBm/10)} \quad (3.3)$$

## **CHAPTER 4**

### **Design and Implementation**

#### **4.1 INTRODUCTION**

This chapter gives a brief description and general overview of the main features of VANETs models and simulation methods in addition to a brief about Visual Basic.net based simulation. It also discusses the proposed (ADS-RASS) algorithm design with an explanation of each algorithm component. Lastly, it presents the implementation of the proposed RASS with AODV routing protocol including the wireless vehicular Ad-hoc network configuration and the experimental scenario of the Ad-hoc network. This implementation will be evaluated concerning the end to end delay and link stability. Moreover, a comparison between the proposed RASS with AODV routing protocol will be performed in term of RSSI scenarios in three distrusted distance.

#### **4.2 VANET MODELS**

VANETs are consider as a large and complex overall system model (Martinez et al., 2010). Basically, it consists of four sub-models that define human driver behavior of different aspects such as driver and vehicle model, traffic flow model, communication model and application model (Liu et al., 2013) which are detailed as follow:

1. Driver and Vehicle Model: the aim of this model is to reflect the single vehicle behavior. Two main factors should be taken into consideration within this model which are different driving style such as aggressive or passive drivers and vehicle characteristics such as normal or sport cars.
2. Traffic Flow Model: the aim of this model is to reflect interaction between drivers, vehicle and infrastructure through developing an ideal road network.

3. Communication Model: the aim of this model is to exchange data among driver and road users, this model is considered as an important part of research methodology to address data exchange problem.
4. Application Model: the aim of this model is to address the behaviour and quality of cooperative VANETs applications. Moreover, this model is considered important in market introduction and necessary due to the following reasons:
  - Variety of visualization and functionalities are provided for cooperative application, which are gained by different vehicles manufacturers.
  - A prioritization of information such as warnings are desirably needed among the simultaneous existence of some cooperative applications.

#### **4.3 SIMULATIONS DESIGN**

Simulation design is an essential step before any new technology implementation in VANETs. It requires two different components which describes as follow:

- Traffic simulation: three components should be available when analysing vehicular in Ad-Hoc, which are network characteristics, protocol performance, traffic simulator to generate a position and movement information of a particular vehicle within VANETs environment.
- Network simulators: for modelling and analysing VANETs functionality, some important features must be possessed by network simulator including a comprehensive model, efficient routing protocols like AODV (Ad-Hoc on-demand distance vector) and communication standards such as IEEE.802.11 and IEEE 1609 specifications.

#### **4.4 VISUAL BASIC BASED SIMULATION**

Visual Basic (VB.net) based simulation presents a unique opportunity for revolutionary changes in the process of developing simulation models as well as the

mission of the simulation software firms that provide tools to support the model development process. Moreover, it enables a new version of a simulation industry populated by application-specific simulation specialists that generate compatible and reusable simulation component. These object-oriented components can be inexpensively developed with VB.net environments (Tun, 2008).

#### **4.5 DISCOVERY ALGORITHM ROUTE**

The purpose of this algorithm is to find the average route from source to destination node before sending the data based on average signal calculation. If the accident spot (source) and the RSU or base station (destination) are located within the same transmission range. Then, it has no need for an intermediate node in transmission routing to be directed. Whereas, if the destination node is not located in transmission range of the source node. Then, an intermediate node is required to find that destination. The route process discovery usually implements some query dissemination mechanism. The AODV performance improvements of the proposed algorithm are detailed in two steps as follow:

Step one: In route discovery, when the RREQ packet is transferred from source node to its neighbors. Then, every single packet should be associated with a sequence number in order to avoid the duplication, because receiving node will only accept the packet with sequence number.

Step two: In sending Data, neighbors RSSI value is calculated by RASS algorithm to determine the average value. Then, node with equal or approximately equal to average RSSI value will be selected for sending the data.

Many of the existing on-demand routing protocols perform flooding of control packets (e.g. Route Request) in order to find a route from the source to destination node with the required constraints. Flooding or network wide broadcasting in the process in which one

node sends a packet to all other nodes in the network. A straightforward approach for broadcasting is build flooding. Many Ad-Hoc routing protocols use broadcasting in the route discovery in which each node will be required rebroadcast the packet whenever it receives the packet.

In AODV standard protocol, when one node needs to send a message to another node that is not in its neighbor, it broadcasts a route request (RREQ) message, which contains several information key bits. The source, the destination, the lifespan of the message and a sequence number which serves as a unique ID. AODV uses sequence numbers to track the accuracy of information that keeps the track of the next hop for a route instead of the entire route. It also uses periodic HELLO message to track neighbors.

Furthermore, RASS improves the data sending route by minimizing the number of transmission nodes required by performing selective forwarding based on RSSI (signal strength) where only node has average RSSI can be selected in the network for transmitting, the measurement of signal strength is categorized as: excellent, very good, good, low and very low depending on the distance between the node and its neighbor. As the calculating sample number of enhanced RASS percentage in wireless transmission decreases whenever there's increasing between two nodes.

The following neighbor's nodes are discarded by the proposed (RASS) algorithm with AODV protocols:

- Excellent signal strength neighbors nodes are too close to the transmission node. Moreover, the routing will discard these nodes if other neighbors with very good or good signal strength are appears.
- It is shown that transmitting node will detect any low signal, which represents the node that is too far from the transmitted node. Thus, for obtaining a reliable link, then, these nodes will be discarded.

The source is able to communicate directly with neighbor nodes that located within radio range without needing for intermediate nodes to route their packets.

Algorithm 1 will displays the sequential steps for direct transmission

**Algorithm 1: Direct transmission**

**Input:**

Assign and Allocate: the node IP (S) and the destination node IP (D) in Ad-Hoc network

Assign and Allocate: the signal strength (SS) of all nodes in Ad-Hoc network

**Output:** Find the destination node and the route from source to destination

Step 1: Found = false

Step 2: By using Windows wireless connection signal strength meter tool to construct a network table (NT) of IP's for all neighbor's node in the transmission range of the source node with its signal strength

Step 3: For each node in NT

*If*  $IP(i) = D$  *then*  
    *Found* = *true*  
    S will send route request message to D  
    D will send route Replay to S  
*End if*  
*End For*

Step 4: *If* Found *then*

Exit "Route Discovery" and  
Call "Send Data"  
*End If*

The difficulty in controlling the packet forwarding of route request message for the intermediate nodes which has very low, low or excellent signal strength is that the wireless radio signal is received by all neighboring nodes in transmission range as radio property where the signal of the transmitted node propagate in all directions, so RASS algorithm will use the average RSSI value between and according to the (Accident Traffic Scenario) many nodes have low or excellent signal strength, and the network will be very dense in terms of nodes. Consequently, high interference could occur. Thus, it affects its



communication quality. A proposed Route Request Message option format is constructed by adding the “Signal Strength of the Node” field in it, as shown in Table 4.1.

Table 4.1 Route Request Message option format

Option Type	Opt. Data Len	Target Address	Signal Strength of Node	Path List
----------------	------------------	-------------------	----------------------------	--------------

Where:

1. option type: represents the type of message which is either route request or route replay. It is an integer field that has two values as 1 defend route request or 2 for route replay.
2. Opt. Data Len: refer as option length
3. ID: Identification: which represents a unique value produced by the route request initiator. While, the nodes initiating a route request to generate a new identification value for each route request.
4. Target address: represents the node address that is the target of the route request.
5. Signal strength of node: the signal strength of the current node is added in this field.
6. Path list: Address[1 ..... n]: Address [i] is the i-th address of hop which is recorded in the route request option. Each node propagates the route request adds its own address to path list. It is possible now for the node to make a decision on forwarding the route request message because sender node will store the RSSI values for all nodes for the buffer. The decision rule is inserted in route discovery mechanism as follows:

Read the signal strength from the route request packet format that is send by the sender node.

Read the signal strength which is composed of four types as follow:

- Very low
- Low
- Good
- Very good
- Excellent

Store RSSI value in DB // Node stores the RSSI (Received signal strength indicator) value to the buffer

Calculate average\_neighbor ()  
Set Destination\_ID=Average neighbor ()  
Send (packet).

Receiver node:

Check for Destination\_ID  
If Destination\_ID matched  
Receive (packet)  
Else  
Call forward // Using find Average ()

**Algorithm 2:** shows the sequence steps of multi-hop transmitting when the Destination node is not in the transmission range of the source node, so an intermediate hop to find that destination will be needed. In this algorithm, the source node will send the Route Request messages in its proposed option format to its Neighbors. When the neighbors receive the Route Request message, they will check if it has received the RREQ with same flooding Id and originator node. If it has, then this node silently ignores the newly received RREQ. When the destination is found, it sends a Route Reply to the source node using the reverse order of nodes for the path List Field of the last Route Request message that has been received by the destination.

Algorithm 2: Multi-hop Transmitting

**Input:**

From Network Layer: The source node IP (S) and the destination node IP (D) in Ad-hoc network

From physical Layer: The Signal Strength (SS) of all nodes in Ad-hoc network

**Output:** Find the destination node and the route from source to destination

Step 1: Found= false

Step2: By using Windows wireless connection signal strength meter tool in Construct a Network Table (NT) of IP's for all neighbor's nodes in the transmission range of the source node with its signal strength

Step 3: For each node in NT

*If IP(i) = D Then*

*Found = true*

The destination will send *ROUTE REPLAY* to the source node using the reverse order of nodes from the path list field of the last Route Request message that has been received by the destination.

Go to Step8

*End If*

*End For*

Step 4: If not Found then

For each node in NT

Begin

Generate Route Request message by filling the following fields in the Route Request message option format:

-put destination node IP in the Target Address Field

-put IP(i) node signal strength in the Signal Strength of the Node Field (where the SS. of IP(i) is the same as SS. of source node)

-If IP(i) not Found in Path List Field then

put the current node IP in the Path List Field

*End*

*End for*

Step 5: For each node in NT

Send the generated Route Request messages

*End for*

Step 6: When the neighbors receive the Route Request message, the receiver will check if it has previously received the RREQ with same flooding Id and originator node.

If same ID flooding received

Then Drop Route Request Message

Else

Read is signal strength =" very low" or Signal strength=" low" or Signal or Signal Good" or Signal strength =" Very good" or signal strength=" excellent".

store RSSI value in DB // Node stores the RSSI (Received Signal Strength Indicator) value to the buffer.

Calculate Average \_ neighbor ()

Set Destination\_ ID = Average neighbor ()

Send (packet).

End if.

step7: For each node in the VANET network that is selected as forwarding node go to

Step2

Step8: Exit "Route Discovery" and call "Send Data"

#### **4.6 DATA SEND**

When algorithm 1 (route discovery) is implemented. Then, the route from source to destination ( $S \rightarrow D$ ) will be found. After that, data send algorithm implementation will begin to send data using that route. Since, the connection between two transmitting nodes may get lost due to movement out of transmission range for one or two nodes, which will cause connection problem to the transmission data.

The proposed (RASS) algorithm permits source to check the vicinity of the adjacent nodes. Moreover, those nodes further check the vicinity of their adjacent nodes. After that source finds out the average of the path. Then, the path with average value is selected as a final path to send data as it is considered as a stable path. This will overcome the problem of link failure by following that path only which has average signal strength.

#### **4.7 IMPLEMENTATION OF ALGORITHM**

VANETs network are configured as well as the proposed protocol and algorithm are implemented by utilizing Visual Basic.net programming language.

VB.net has been established and considered as successor to MS Visual Basic, which offers various features required for programming TCP/IP applications. Furthermore, VB.net is become a favorite tool in term of creating applications especially in wireless connection, which has been mentioned previously in section 4.3.

Additionally, the graphical user interface structure based VB.net is easy to accomplish weather with VB5 or VB6 version. While, the network communication under VB.net is slightly more difficult to construct than with its predecessor, this is due to missing Winsock control element with VB.net which no longer provided by Microsoft. Alternatively, network access requires that the import statement need to be used to instance the namespace of the socket class that used in source text header

**VB Code:**

Imports System.Net

Imports System.Net.Sockets

In addition, the socket should be created by the communication and defining the input data buffer is also necessary.

The next subsections will demonstrate two case studies based implementation and mechanism for the proposed RASS with AODV protocol. The first case study is about direct transmission between the source and destination node. While, the second case is about intermediate nodes between them as depicted in figure below:

#### 4.7.1 Multi-Hop Transmission

In case of two nodes (i.e. Accident car and RSU) are not located in the range of VANET wireless networks, multi hop transmission is needed to overcome such condition. Moreover, packet forwarding or routing is necessary within the mentioned condition.

#### 4.7.2 Route Discovery

In this research, the VANET wireless network was created based on four scenarios, which are (5, 10, 15, 20) nodes. While, the network topology is categorized into three distance ranges between cars (small, medium and long)

The set of network topology can be configured by the user according to the information required as shown in Figure 4.1. Then, the source to destination path (path car) will appear when pressing the solve button.

The screenshot shows a software window titled "Vanet". It contains several input fields and controls for configuring a network topology. At the top left, there are dropdown menus for "Num. Of Car" and "Distance", followed by text input fields for "Source" and "Destination". To the right of these are two radio buttons labeled "MaxRSSI" and "MinAvgRam", and a "Solve" button. Below the "Solve" button is a large rectangular area with a table header containing "Node" and "RSSI". At the bottom left, there is a "Path" label and an empty text box. At the bottom right, there are labels for "No. Of Nodes :" and "Time :".

**Figure 4.1: Topology Setting**

The  $S \rightarrow D$  path will appear according to the node number that selected based on average signal strength. For example, by running node scenario simulation, which has the source number is 0 and the destination node number is 4, then, average RSSI path from source to destination will be obtained and based on node sequence number which is (0-2-4), as depicted in Figure 4.2.

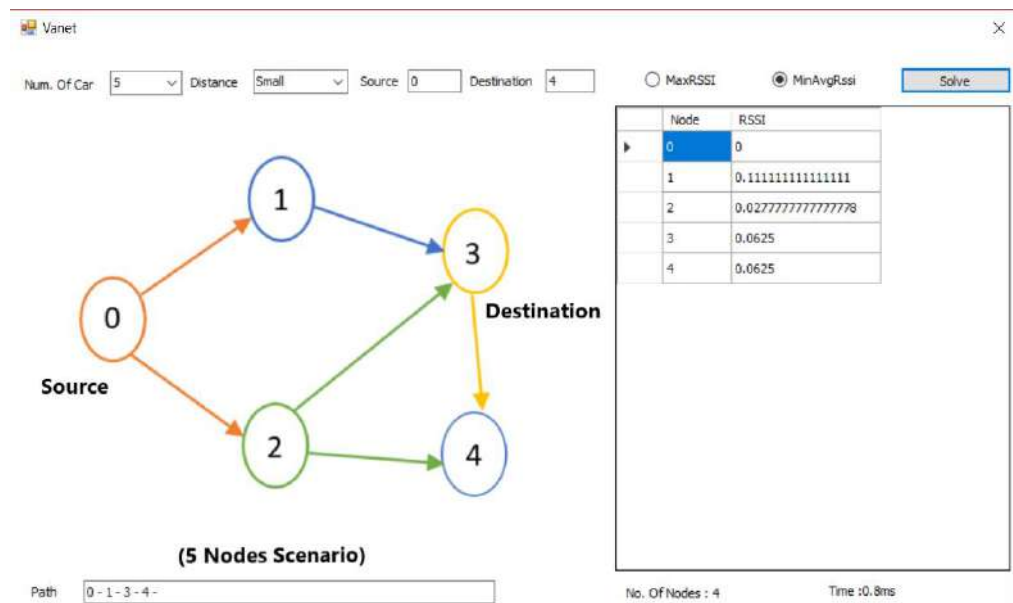


Figure 4.2: Five nodes scenario

Additionally, any path between nodes can be selected based on nodes number and the distance between nodes. Then, the path will show up based on the same RASS algorithm calculation.

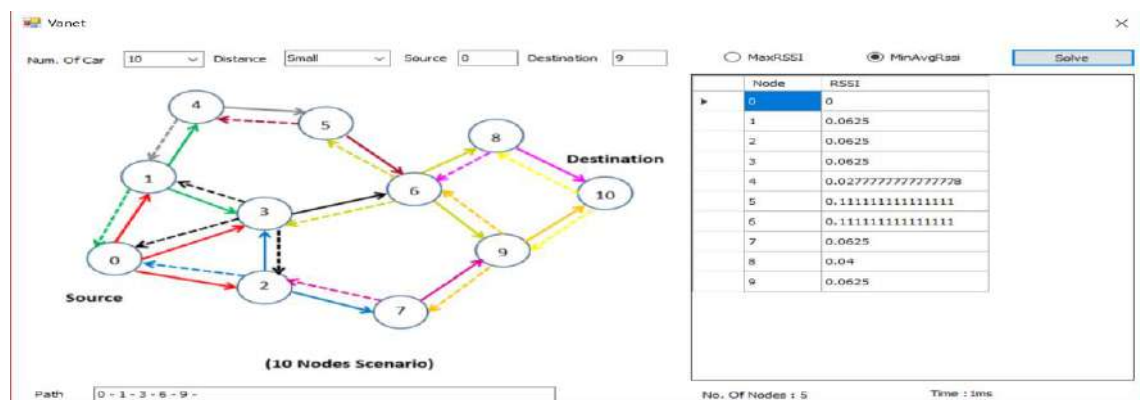


Figure 4.3: Ten Nodes Scenario

This purpose of this projects, is about transferring emergency message from accident spot into the nearest RSU or base station, then to the Rescue Service Center (RSC). This matter is considered in in the proposed implementation by selecting the ( $S \rightarrow D$ ) paths (i.e. from node number zero to the maximum nod's number of each scenario), as shown in the figures 4.3, 4.4, 4.5 in 10, 15, and 20 node scenarios, respectively.

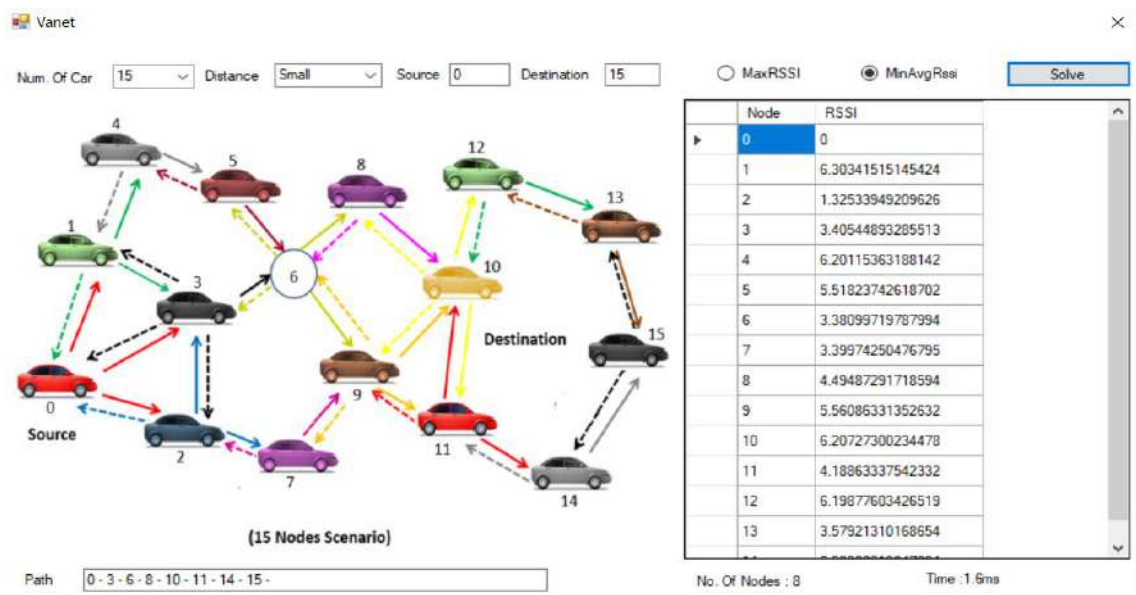


Figure 4.4: Fifteen Nodes Scenario

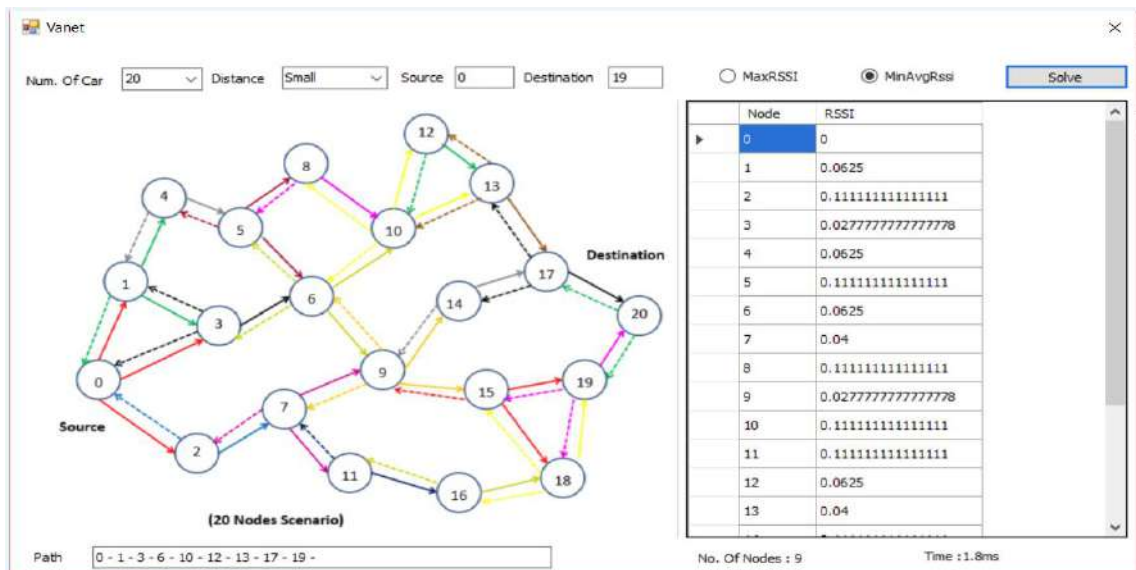


Figure 4.5: Twenty Nodes Scenario

### 4.7.3 Proposed Algorithm Validation

The evaluation of the proposed VANET routing protocol algorithm is demonstrated as follow:

- **Link Reliability:** the purpose of the proposed algorithm is to reduce connection breaking risk or link failure by improving the data transmission quality.

The breakage might happen when a connection is established between vehicles and the infrastructure i.e. Road Side Unit (RSU) as well as between two different vehicles. If the failure occurred. Then, sender has to find a route and deliver a message to destination by reusing the route discovery mechanism.

Obtaining the reliable link by the proposed algorithm is due to the nodes in selected path which have the average signal strength. The path with minimum nodes from ( $S \rightarrow D$ ) will be discarded due to the nodes which have very low and low signal strength. Then, they might leave the transmission range causing weak links which resulted in data lose when the route begins.

- **The END- END Delay:** it is common in VANETs that nodes move within the transmission range. Therefore, network performance directly depends on the hops number with an average delay in VANET. Delay is one of the key parameters to be considered for vehicular network traffic, which is also defined as the time consumption for packet transmitting across the network.
- It is common in VANETs that the nodes move within the transmission range. Therefore, network performance directly depends on the number of hops with an average delay in a VANET. Delay is one of the key parameters be considered for vehicular network traffic. It is defined as the time taken for a packet to be transmitted across a network from source to destination.



With specifically simulation performance metrics, the assess that the delay value is directly proportional to the number of nodes, as the delay increases whenever the nodes are increased in the path. Network delay can be calculated by: (Raw & Lobiyal, 2012), (Aboobaker, 2010).

$$\text{Delay} = \frac{\text{Expected progress distance}}{\text{Bandwidth of the line}} \quad (4.1)$$

So, it can be concluded that RASS is well suited in an Accident traffic scenario where link stability is very important and vehicular density is roughly low when accidents happen. The average path optimizes the number of nodes taken from source to destination, thus the delay will also be optimized according to the estimated equation above.

In order to compare the results that have been obtained by applying the algorithm based on the average value (RASS), simulation program contains an option to find path based on the maximum RSSI value where it can find the paths based on the maximum RSSI value in the same simulation program execution.

The simulation examines three distributed ranges between nodes, as 4-6 meters referred to small range, 7-10 meters will be considered as medium range and 11-15 meters is as long range. By obtaining these paths, comparison is performed between the proposed algorithm based on average RSSI and maximum RSSI, as shown in table 4.2, 4.3, 4.4.

**Table 4.2:** optimization Nodes in the average path compared with the Maximum (small distance)

nodes	(B→D) avg. RSSI	(B→D) Max. RSSI	Discarded Nodes
5	3	4	1
10	4	6	2
15	7	9	2
20	7	10	3

Where B represents the path, and D represents the destination.

**Table 4.3:** optimization Node in the average path compared with the maximum (Medium Distance)

nodes	(B→D) Avg. RSSI	(B→D) Max. RSSI	Discarded Nodes
5	4	4	0
10	5	6	1
15	6	8	2
20	7	9	2

**Table 4.4:** optimization Node in the average path compared with the maximum (Long Distance)

nodes	(B→D) Av. RSSI	(B→D) Max. RSSI	Discarded Nodes
5	4	4	0
10	5	5	0
15	6	7	1
20	7	8	1

Tables 4.5, 4.6, 4.7, below contains the percentage enhancement RASS algorithm in comparing with the maximum RSSI.

**Table 4.5:** Optimization Percentage (Small Distance)

nodes	(B→D) Avg. RSSI	(B→D) Max. RSSI	% ratio	Enhanced Percentage
5	3	4	40%-20%	20%
10	4	6	60%-40%	20%
15	7	9	53.3%-40%	13.3%
20	7	10	65%-50%	15%

The Average is about 17%

In table 4.5 above, the optimized nodes from the source to the destination reduce by 1 in five nodes scenario, 2 in ten node scenarios, 2 in fifteen node scenarios and 3 in twenty node scenarios. The average enhanced percentage in RASS is about 17% as compared to the maximum RSSI path.

**Table 4.6:** Optimization Percentage (Medium Distance)

Nodes	(B→D) Avg. RSSI	(B→D) Max. RSSI	% ratio	Enhanced Percentage
5	4	4	20%-20%	00.00 %
10	5	6	50%-40%	10.00 %
15	6	8	60%-46.7%	13.03 %
20	7	9	65%-55%	10.00 %

The Average is about 08.03 %

In the table 4.6 above, the optimized nodes from source to the destination are equal to Zero in five node scenarios, 1 in ten nodes scenario, 1 in fifteen nodes scenario and 2 in twenty nodes scenario. The average enhanced percentage is RASS is about 8.3% as compared to the maximum RSSI path.

**Table 4.7: Optimization Percentage (Long Distance)**

Nodes	(B→D) Avg. RSSI	(B→D) Max. RSSI	% ratio	Enhanced Percentage
5	4	4	20%-20%	0%
10	5	5	50%-50%	0%
15	6	7	60%-53.3%	6.7%
20	7	8	65%-60%	5%

The Average is about **3%**

In the table 4.6 above, the optimized nodes from source to the destination are equal to Zero in five node scenarios, also Zero in ten node scenarios, 1 in fifteen node scenarios and 1 in twenty node scenario. The average enhanced percentage in RASS is about 3% as compared to the maximum RSSI path. Theses enhancement percentages depend on total number of nodes in VANET network and the accident node topology which have different arrangement across the road with different signal strength compared to transmitting node.

In order to evaluate the optimized network performance through simulation, and compare the obtained results, the curve scheme which is shown in Figure 4.6, 4.7, 4.8 below embodies the relationship between probability of vehicle density change and the end-to-end delay in the three ranges of distributed distances.

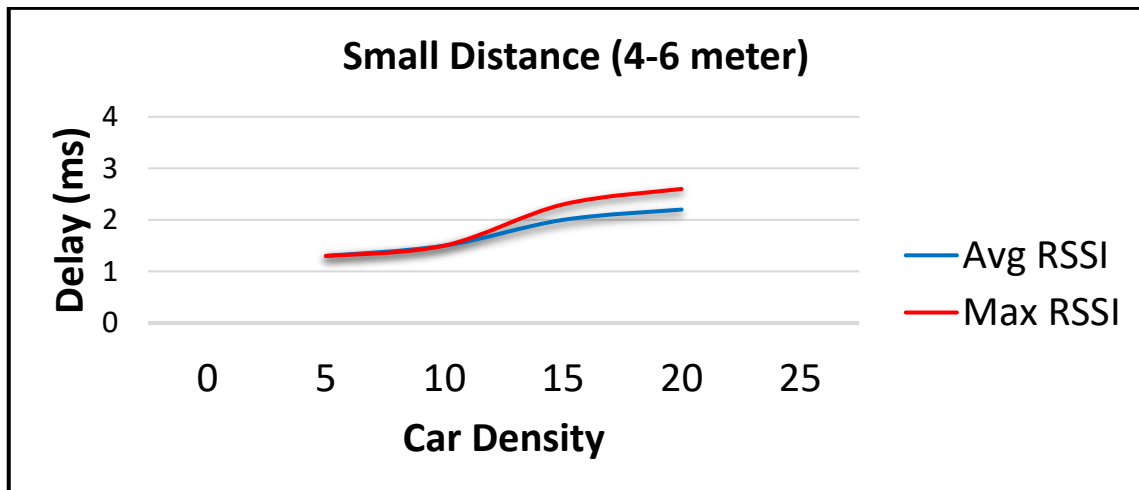


Figure 4.6: Car density VS. End to End delay (small Distance)

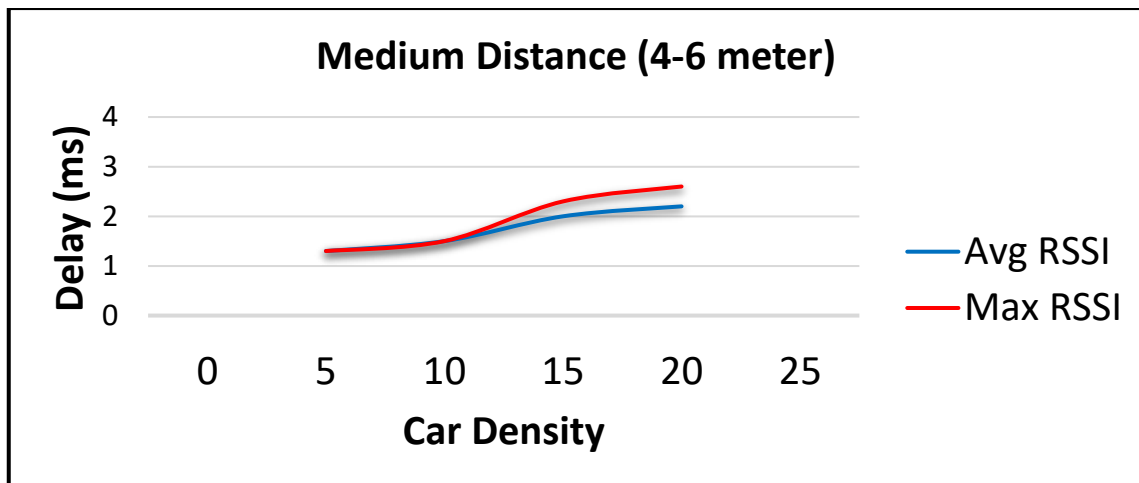


Figure 4.7: Car density VS. End to End delay (Medium Distance)

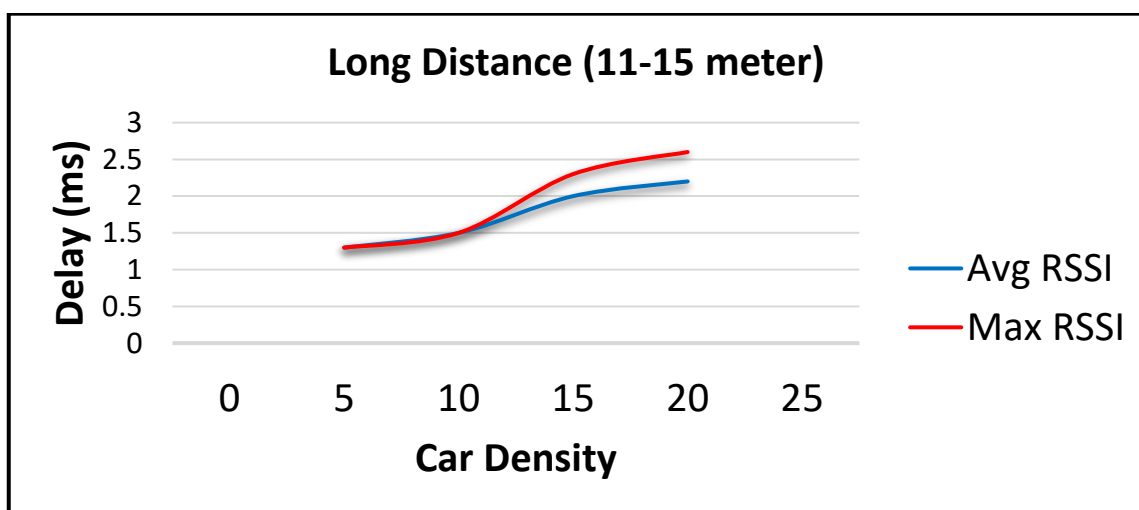


Figure 4.8: Car density VS. End to End delay (Long Distance)

The car density is represented by x-axis, which is supposed in four different scenarios. While, end to end delay in millisecond is represented by y-axis, delay values are defined in Eq. (4.1). Minimum VANET bandwidth channel was assumed to be (3 MB/s), which is based on DSRC regional standards in USA.

Based on graphs above, it is clear to observe that the delay time increases whenever the car density rises, because every car should be competed with more neighbors for channel access. in analyzing the car density Growth (in the four scenarios), leads to conclusion that there is an increase in delay time with both cases (Average RSSI and Maximum RSSI) consistently. Whereas, 17% difference between two increases values within small distance. 8.3% within medium distance, and 3% in long distance due to favor of RASS algorithm. Finally, it can be emphasizing that the proposed RASS algorithm has the highest performance. Moreover, it is suitable to be utilized in car accident scenario whenever cares gets close to each other after occurrences of an accident.

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## الخلاصة

أدى ظهور التكنولوجيا أيضًا إلى زيادة مخاطر المرور وتحدثت حوادث الطرق بشكل متكرر مما يتسبب في خسائر فادحة في الأرواح والممتلكات بسبب ضعف مرافق الطوارئ. كل يوم يُفقد عدد كبير من الأرواح مع إصابة العديد منهم بإعاقة نتيجة إصابتهم بسبب حوادث السيارات والتأخير في استدعاء خدمات الإنقاذ كإسعافات أولية وتصل سيارات الإسعاف إلى مكان الحادث بعد فوات الأوان. في الآونة الأخيرة ، ظهرت أنظمة النقل الذكية (ITS) كطريقة فعالة لتحسين تفسير أنظمة النقل وتعزيز سلامة السفر. في هذا المشروع ، تم اقتراح نظام الكشف عن الحوادث المستند إلى بروتوكول AODV لمزيد من الموثوقية بشكل أفضل في رسائل سلامة المركبات ، وكذلك للكشف عن الحوادث الخطيرة ويمكن أن يقدم الحل الأمثل لهذا العيب من خلال إخطار مركز خدمات الإنقاذ تلقائيًا بإحداثيات الحادث و الوقت وكذلك لحل النقص الأكثر شيوعًا في الاتصال المناسب بخدمات الطوارئ. تعد أنظمة الكشف عن الحوادث من أكثر أدوات (ITS) فاعلية. يمكن تحقيق نظام الكشف عن الحوادث الذي يعتمد على نظام تحديد المواقع العالمي (GPS) والنظام العالمي للاتصالات المتنقلة (GSM) من خلال واحد أو أكثر من أجهزة الاستشعار ، ويمكن للنظام جمع معلومات وإحداثيات موقع الحادث ثم إرسال هذه البيانات إلى خدمات الإنقاذ مركز عبر ارتباط شبكة في أقصر وقت. يُظهر تحليل نتائج المحاكاة البصرية الأساسية أن الطريقة المقترحة لها ميزة اختيار المسار الأمثل لتقديم البيانات.



# نظام للكشف عن الحوادث يعتمد على بروتوكول التوجيه المتعدد لـ VANET

مشروع مقدم لقسم هندسة تقنيات الحاسوب

كلية دجلة الجامعة

كجزء من متطلبات منح درجة البكالوريوس في هندسة تقنيات الحاسوب

بواسطة

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محمود علاء عادل

إشراف

د. حسام الدين شهاب احمد



# **Automatic Home Lights Design Based on Arduino UNO with Voice-Controlled WIFI Access via ESP32S**

**A Project Submitted to the Department of Computer Techniques  
Engineering**

**Dijlah University College**

**In partial fulfillment of the Requirement for the  
Degree of B. Eng.**

**In**

**Computer Techniques.**

**By:**

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**Supervised by:  
Lec. Mohammed H. Hwidi**

**June 2021**

## الإهداء

في البداية نحمدُ اللهَ حمداً كثيراً الذي علم الإنسان مالم يعلم ونصلي على رسوله الكريم الذي نطق بلسان الحق وعلمنا علماً لا زلنا ننتفع به حتى يومنا هذا وصلى الله وسلم على خاتم المرسلين، أما بعد

وصلت رحلتنا الجامعية إلى نهايتها بعد تعب ومشقة..

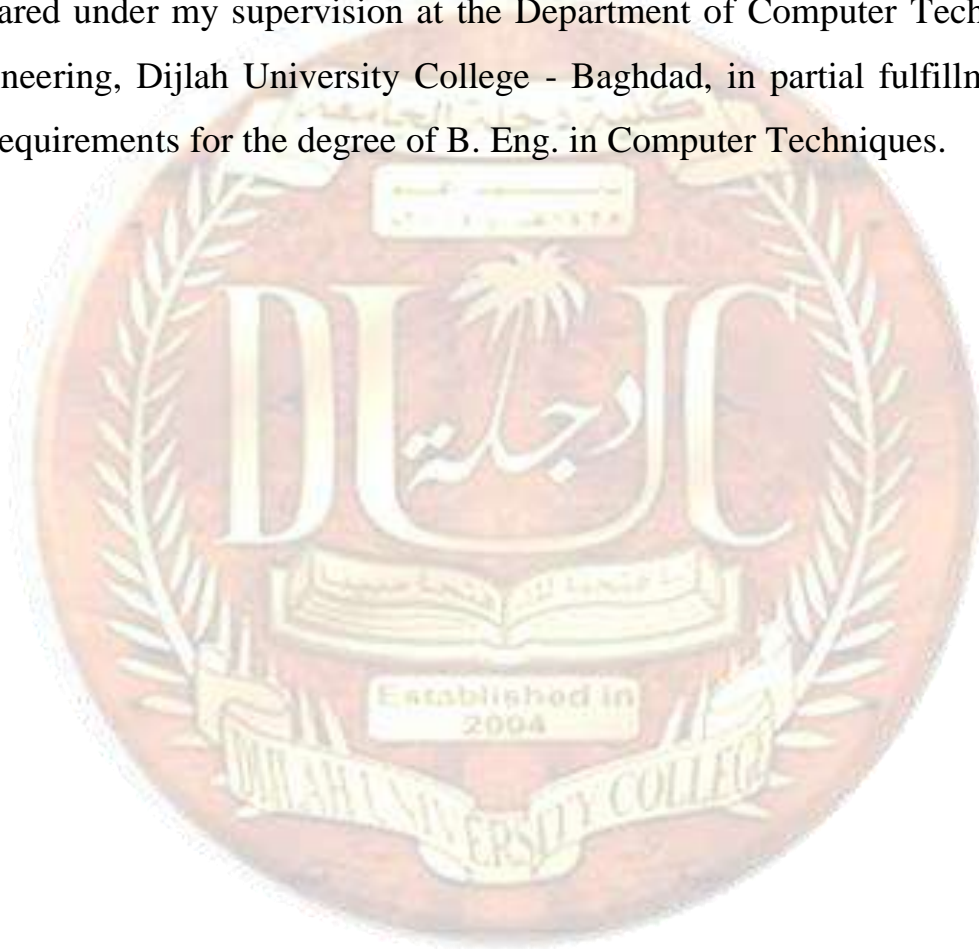
وها نحنُ ذا نختم بحثَ تخرُّجنا بكل همّة ونشاط، ومُمتنين لكل من كان له الفضل في المسيرة وساعد ولو باليسير، إلى الأبيوين والأصدقاء، فلقد كانوا بمثابة العضد والسند في سبيل استكمال البحث، والأساتذة المُبجّلين ممن كان لهم الدور الأكبر في مُساندتنا وإثراؤنا بالمعلومات القيّمة نهدي لكم بحث التخرج ...

داعينَ المولى عزَّ وجلَّ أن يُطيل في أعماركم، ويرزقكم بالخيرات.



## **SUPERVISOR CERTIFICATION**

I certify that this Project entitled **Designing automatic home lights based on Arduino UNO and ESP 32S with voice-controlled WIFI access** was prepared under my supervision at the Department of Computer Techniques Engineering, Dijlah University College - Baghdad, in partial fulfillment of the requirements for the degree of B. Eng. in Computer Techniques.



**Signature:**

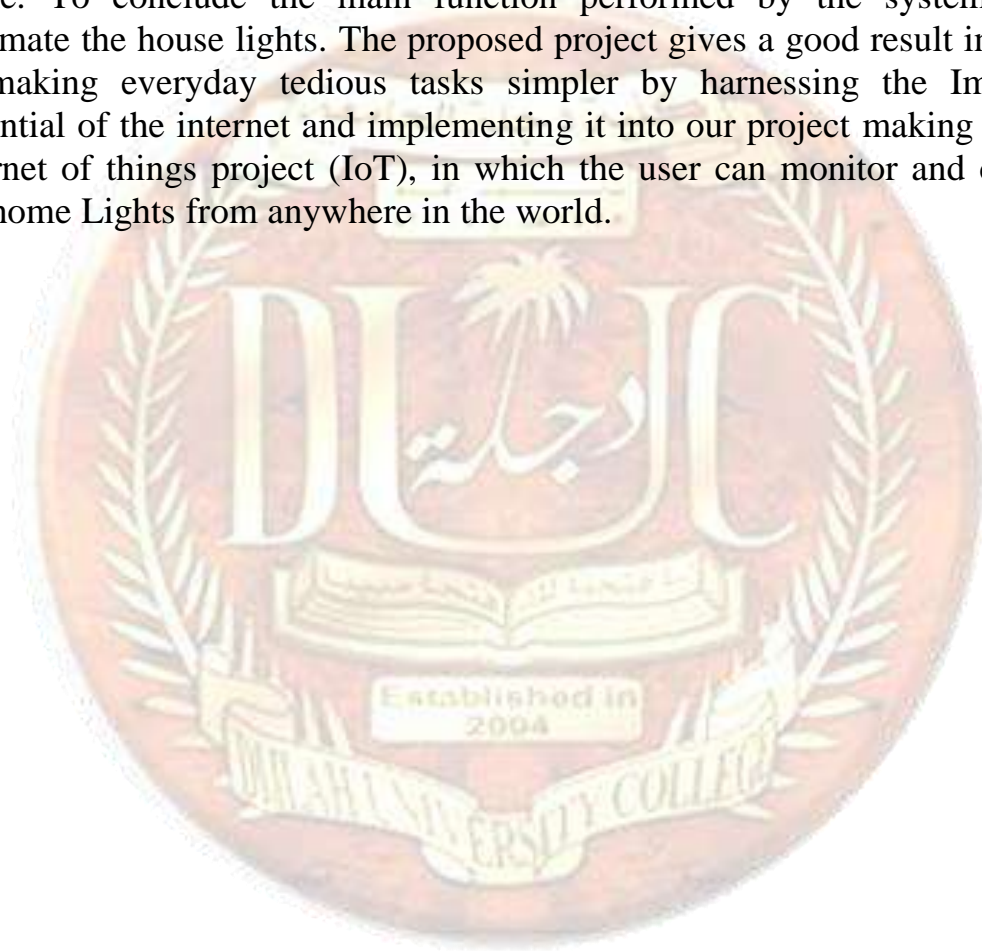
**Name: Lec. Mohammed H. Hwidi**

**Date: June 2021**

## ABSTRACT

Over the past few years, there has been an increased demand for fully automated home systems due to the fact that it Reduces both energy consumptions and human efforts; so that this project aims to design an efficient system to make human life easier.

This project uses two Microcontrollers (Arduino UNO and ESP32S) with PIR and LDR sensors, to make it possible for the user to control the home lighting from with ease, also this system can add efficiency to the user's home. To conclude the main function performed by the system is to automate the house lights. The proposed project gives a good result in terms of making everyday tedious tasks simpler by harnessing the Immense Potential of the internet and implementing it into our project making this an internet of things project (IoT), in which the user can monitor and control the home Lights from anywhere in the world.



## **List of Abbreviations**

### **Abbreviation**

### **Definition**



IoT	Internet of Things
PIR	Passive Infrared Resistor
LDR	Light Dependent Resistor
IDE	Integrated development environment
ID	Identification
IC	Integrated Circuit
MCU	Micro Controller Unit
CPU	Central Processing Unit
SoC	System on Chip
GPU	Graphics Processing Unit
Wi-Fi	Wireless Fidelity
I/O	Input/output
PWM	Pulse Width Modulation
USB	Universal Serial Bus
l2c	Logic Level Converter
AC/DC	Alternating current / Direct Current
SRAM	Static Random-Access Memory
MOS	metal oxide semiconductor
GPIO	General Purpose Input Output
UART	Universal Asynchronous Receiver/Transmitter
SPI	Serial Peripheral Interface



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## **Chapter one: Introduction**

### **1.1 Introduction**

In recent years the people are looking forward to automation in their day-to-day life. And even now the people are eager to save energy consumed in day to day life. People are becoming lazy to switch off the lights while leaving the room. So, a large amount of energy is wasted if the light is ON in the absence of a human being. Generally, in public and private sector companies, offices most people are not interested to switch OFF the consumer electronic appliances like fans, lights, etc. if they are not present. As more and more consumer electronics and home appliances are used, their size is becoming large; power consumption in a home area tends to grow. Moreover, useless power consumption occurs in the absence of human beings in the public and private sectors. Using the automation in switching the home lighting system large energy will be saved which will, in turn, save the money of the owner of the house. Now the people are looking forward to automation in all the simple tasks they need to do. The people are trying to reduce human efforts. The automatic switching of home lighting systems actually reduces human efforts. By the use of automatic switching the person will not have given attention to turning OFF the lights while leaving the room, this system also helps to reduce the power wasted when the lights, fans, and other electric appliances are ON in the absence of any person. The components used are IR sensor for detection of human being LDR for light detection and implementing IOT to make it easier to control the lights when away from home or just too lazy to move, voice-controlled light are also becoming more appealing and that's what we are going to be looking into in this project.



## **1.2 Aim of the project**

The purpose of the project is to design and implement automated home lights based on Arduino and ESP23S Micro-Controllers using various sensors.

Passive infrared which will turn on the light when it detects motion and Light Dependent Resistor module which will turn on the light when the specified light threshold is crossed.

The third method is via the internet making it an IoT project, the fourth and final method is to use voice commands to control the state of lights.

## Chapter two: Methodology

### 2.1 Arduino Integrated Development Environment (IDE):

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards [1].

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that is compiled and linked with a program stub `main()` into an executable cyclic executive program with the GNU toolchain, also included with the IDE [2].

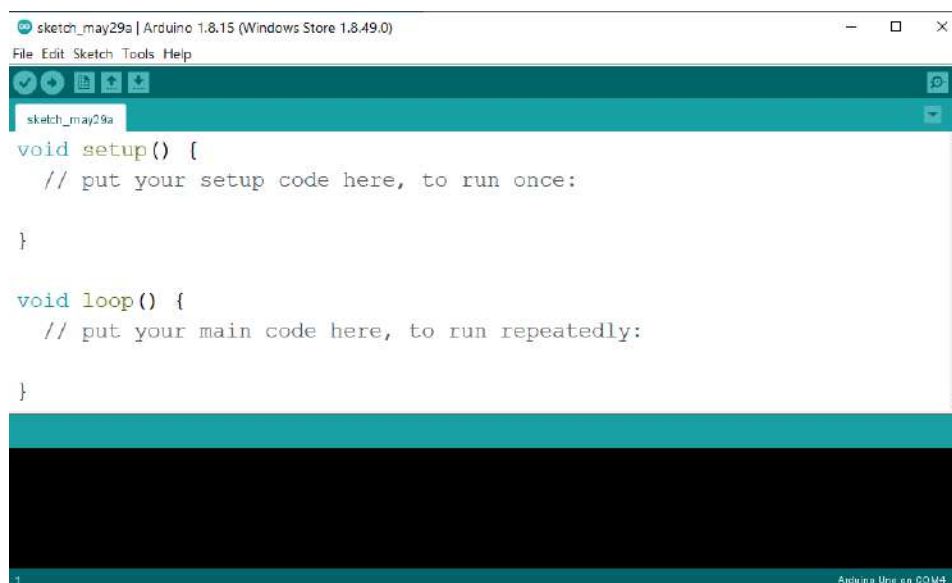


Figure 2.1: Arduino IDE

## 2.2 Sinric:

Sinric is a website that allows linking ESP32S with voice assistants, in our case, it will be either Amazon Alexa or Google Home. Giving each device a unique ID.

Sinric Pro enables developers to integrate IoT development boards (such as the RaspberryPi, Arduino UNO, and ESP32S) with third-party applications or with Amazon Alexa and Google Home. The API can be used to retrieve device logs, find devices, update devices, and get account details. The Sinric Pro API features REST architecture, Tokens for authentication, and JSON responses. It allows us to specify Device types (Light, Switch, Sensor, Appliance, etc.) and whether it is indoor or outdoor.

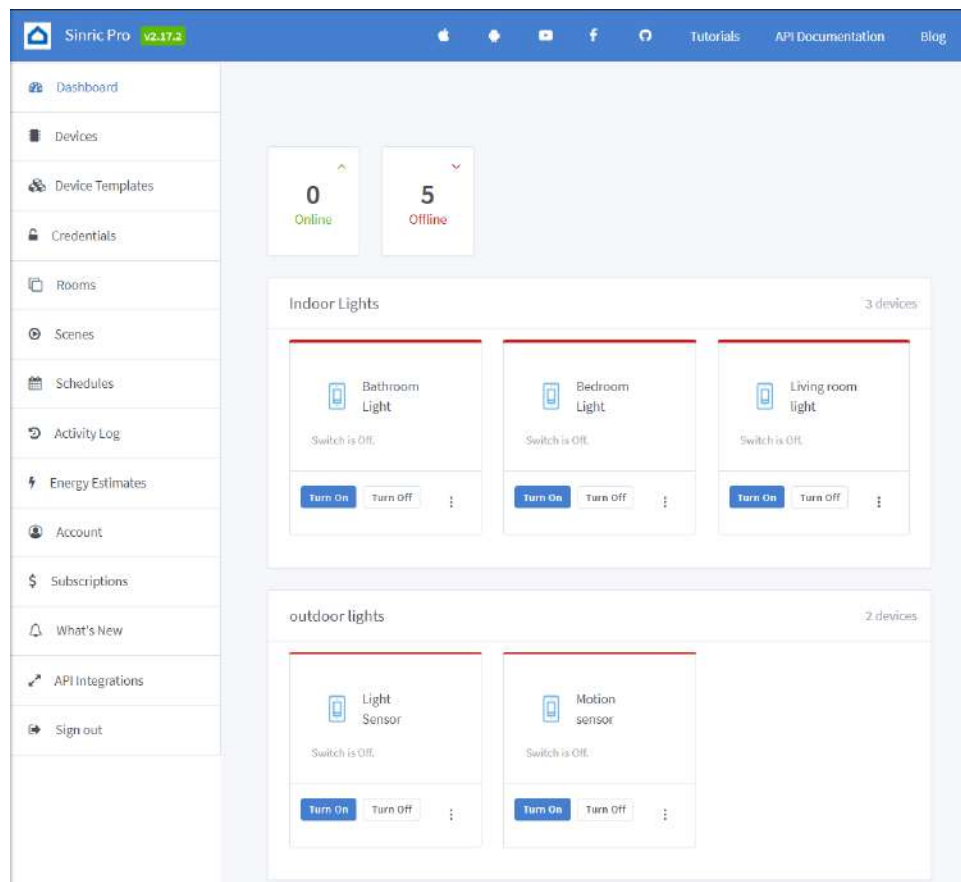


Figure 2.2: Sinric Pro Dashboard

## **2.3 Microcontrollers**

A microcontroller (MCU) is a small computer on a single metal-oxide-semiconductor (MOS) integrated circuit (IC) chip. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Microcontrollers are designed for embedded applications [3].



Figure 2.3: ATmega Microcontroller

In modern terminology, a microcontroller is similar to but less sophisticated than, a system on a chip (SoC). SoC may include a microcontroller as one of its components but usually integrates it with advanced peripherals like graphics processing unit (GPU), Wi-Fi module, or one or more coprocessors.[4]

Microcontrollers are used in automatically controlled products and devices. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Integrating analog components needed to control non-digital electronic systems. In the context of the internet of things, microcontrollers are an economical and popular means of data collection, sensing, and actuating the physical world as edge devices.[4]

### 2.3.1 Arduino UNO

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[5] The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.[6]

Features:

- Microcontroller: Microchip ATmega328P
- Operating Voltage: 5 Volts
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14
- UART: 1
- I2C: 1
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz

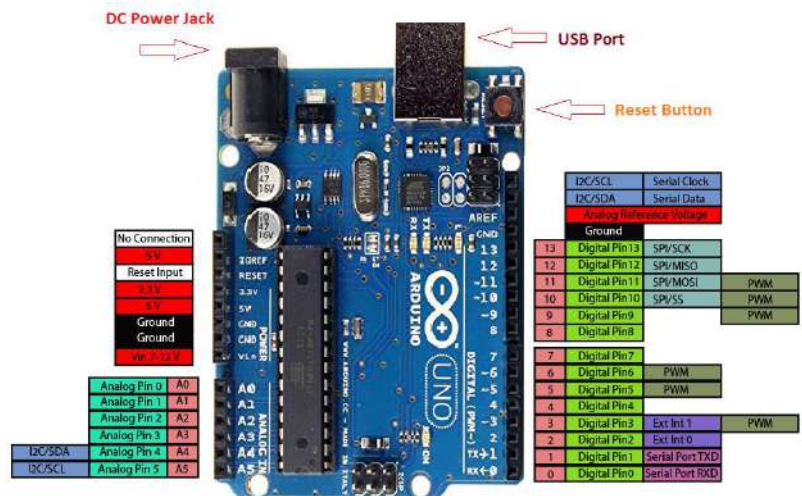


Figure 2.4: Arduino UNO Pin

### **2.3.2 ESP 32S**

The ESP32 is a series of microcontroller chips produced by Espressif Systems in Shanghai. It is available in several low-cost modules.

The ESP32S is a series of a low-cost, low-power systems on a chip (SOC) microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller [7].

Features:

- Up to 18 12-bit Analog to Digital converters.
- Two 8-bit Digital to Analog converters.
- 10 capacitive touch switch sensors.
- Four SPI channels.
- Two I2C interfaces.
- Two I2S interfaces (for digital audio).
- Three UARTs for communications.
- Up to 8 channels of IR remote control.
- Up to 16 channels of LED PWM (pulse width modulation).
- An integrated Hall-effect sensor.
- An ultra-low-power analog preamp.

- An internal low-dropout regulator.

Note that many of the pins on the ESP32 share a number of the above functions [8].

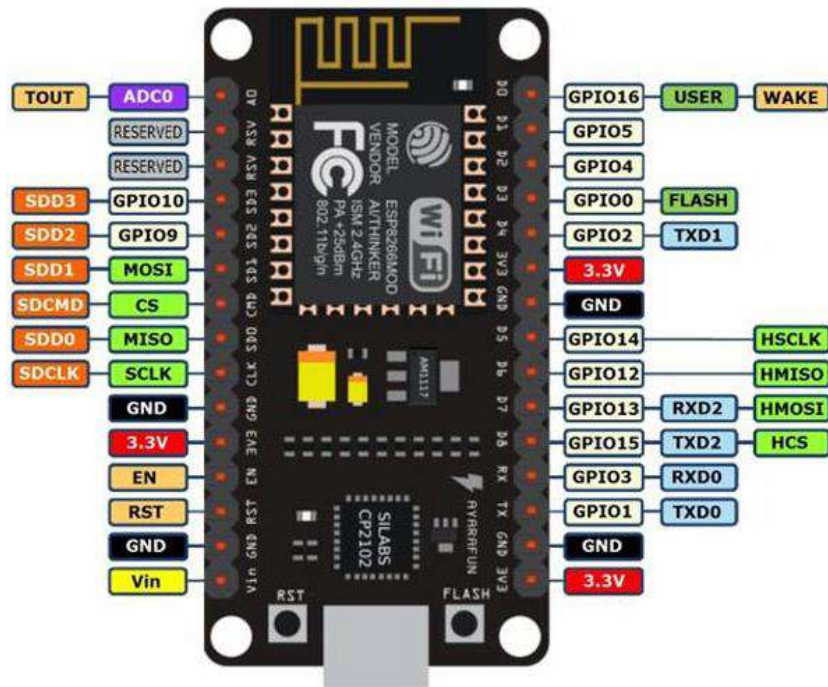


Figure 2.5: ESP32S Pin Layout

## **2.4 Light Dependent Resistor Module**

LDR sensor module is used to detect the intensity of light. It is associated with both analog output pin and digital output pin labeled as AO and DO respectively on the board. When there is light, the resistance of LDR will become low according to the intensity of light [9]. The greater the intensity of light, the lower the resistance of LDR. The sensor has a potentiometer knob that can be adjusted to change the sensitivity of LDR towards light [10].

Features:

- Able to detect ambient brightness and light intensity
- Adjustable sensitivity (via blue digital potentiometer adjustment)
- Operating voltage 3.3V-5V
- Digital switching outputs (0 and 1) -D0
- With fixed bolt hole for easy installation
- Small board PCB size: 3cm \* 1.6cm
- Power indicator (Red) and the digital switch output indicator (Green)

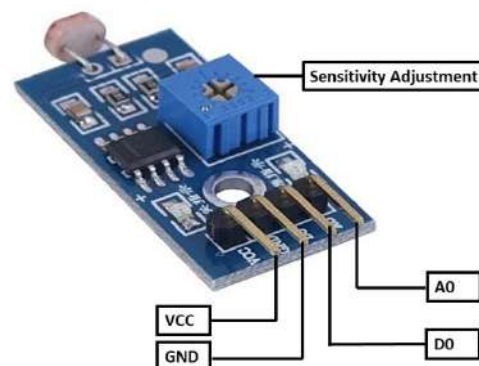


Figure 2.6: LDR Module Pin



## **2.5 Passive Infrared Sensor Module**

The Passive Infrared Sensor (PIR) sensor module is used for motion detection. It is often referred to using "PIR", "Pyroelectric", "Passive Infrared" and "IR Motion" sensors [11]. The module has an onboard pyroelectric sensor, conditioning circuitry, and a dome-shaped Fresnel lens. It is used to sense the movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically activated lighting systems [12].

Features:

- Wide range of input voltage varying from 4.V to 12V (+5V recommended)
- The output voltage is High/Low (3.3V TTL)
- Can distinguish between object movement and human movement
- Has two operating modes - Repeatable(H) and Non- Repeatable(H)
- Cover distance of about 120° and 7 meters
- Low power consumption of 65mA
- Operating temperature from -20° to +80° Celsius

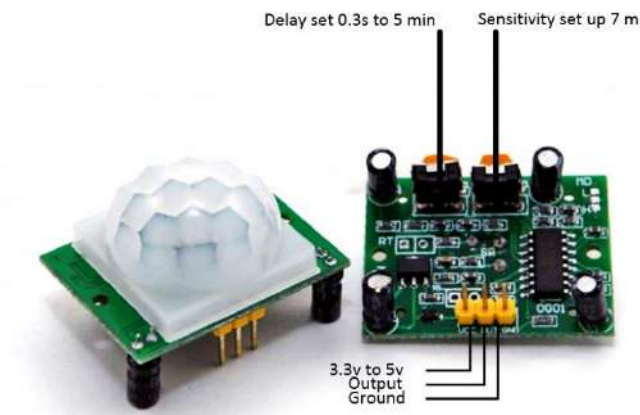


Figure 2.7: PIR Module Pin

## 2.6 5V Relay Module

The 2-Channel 5V Relay Module is a relay interface board, it can be controlled directly by a wide range of microcontrollers such as Arduino, AVR, PIC, ARM, and so on. It uses a low-level triggered control signal (3.3-5VDC) to control the relay. Triggering the relay operates the normally open or normally closed contacts. It is frequently used in an automatic control circuit. To put it simply, it is an automatic switch to control a high-current circuit with a low-current signal. 5V relay signal input voltage range, 0-5V. VCC power to the system. JD-VCC relay in the power supply. JD-VCC and VCC can be shorted [13].

Features:

- Trigger Voltage (Voltage across coil): 5V DC
- Trigger Current (Nominal current): 70mA
- Maximum AC load current: 10A @ 250/125V AC
- Maximum DC load current: 10A @ 30/28V DC
- Compact 5-pin configuration with plastic molding
- Operating time: 10msec Release time: 5msec
- Maximum switching: 300 operating/minute (mechanically)

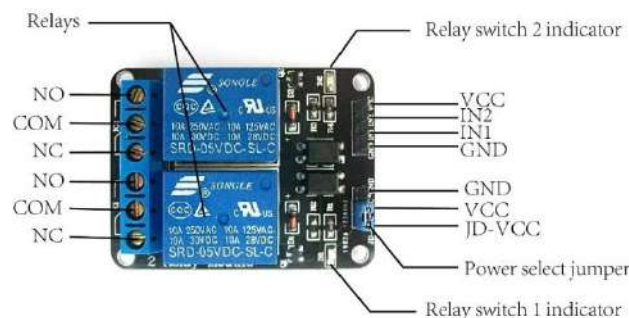


Figure 2.8: 5V Relay Module Pin ayout

## Chapter three: Practical Work

### 3.1 Design Flowchart

To better understand the programming side of the project and how each sensor is used , we will be using a flowchart to illustrate the sequence of tasks required for the project to work properly.

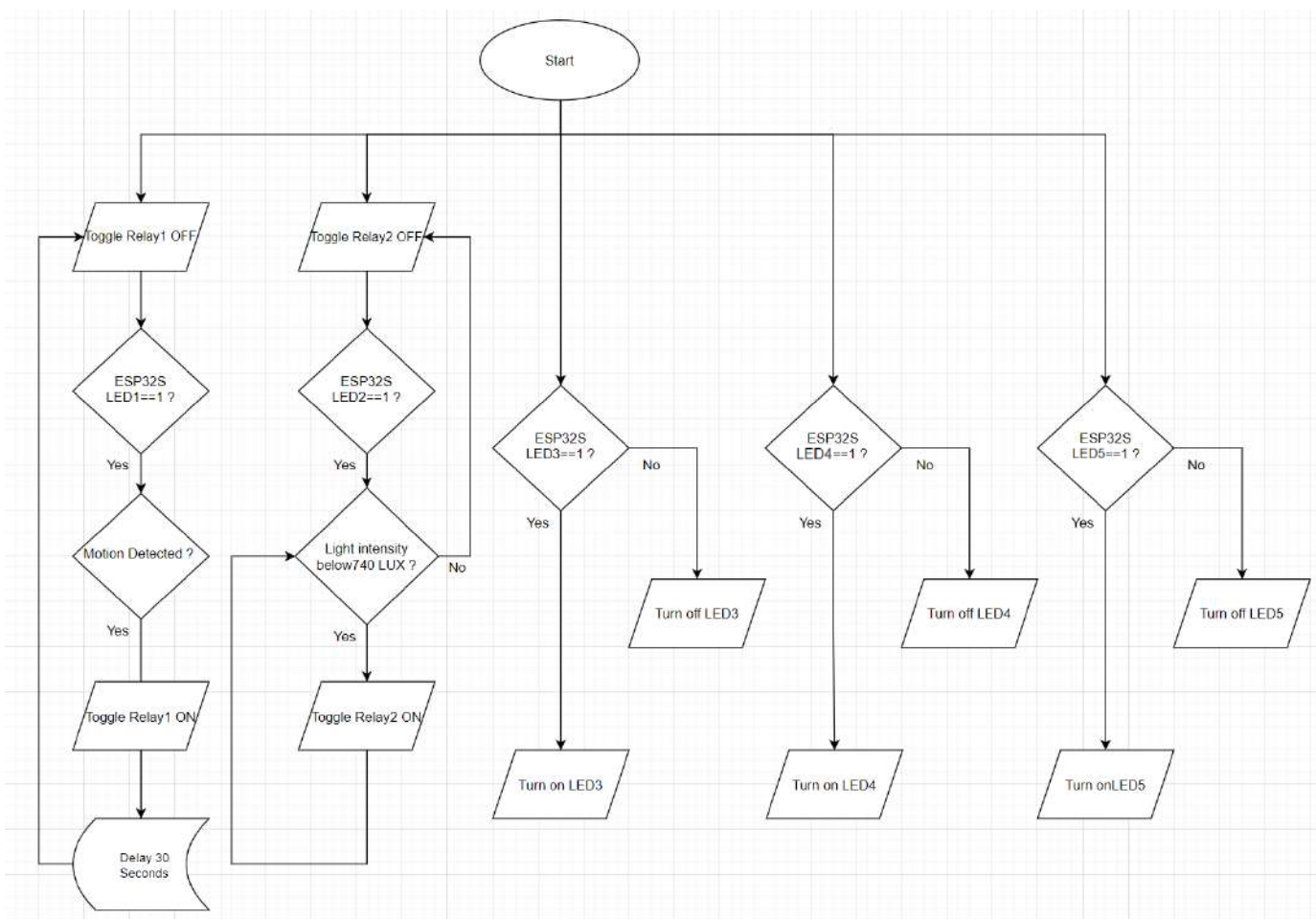


Figure (3.1) Design Flowchart

### 3.2 Circuit Design

To build this project, we need to split it into two parts (Software, Hardware) to make it easier to implement the schematic.

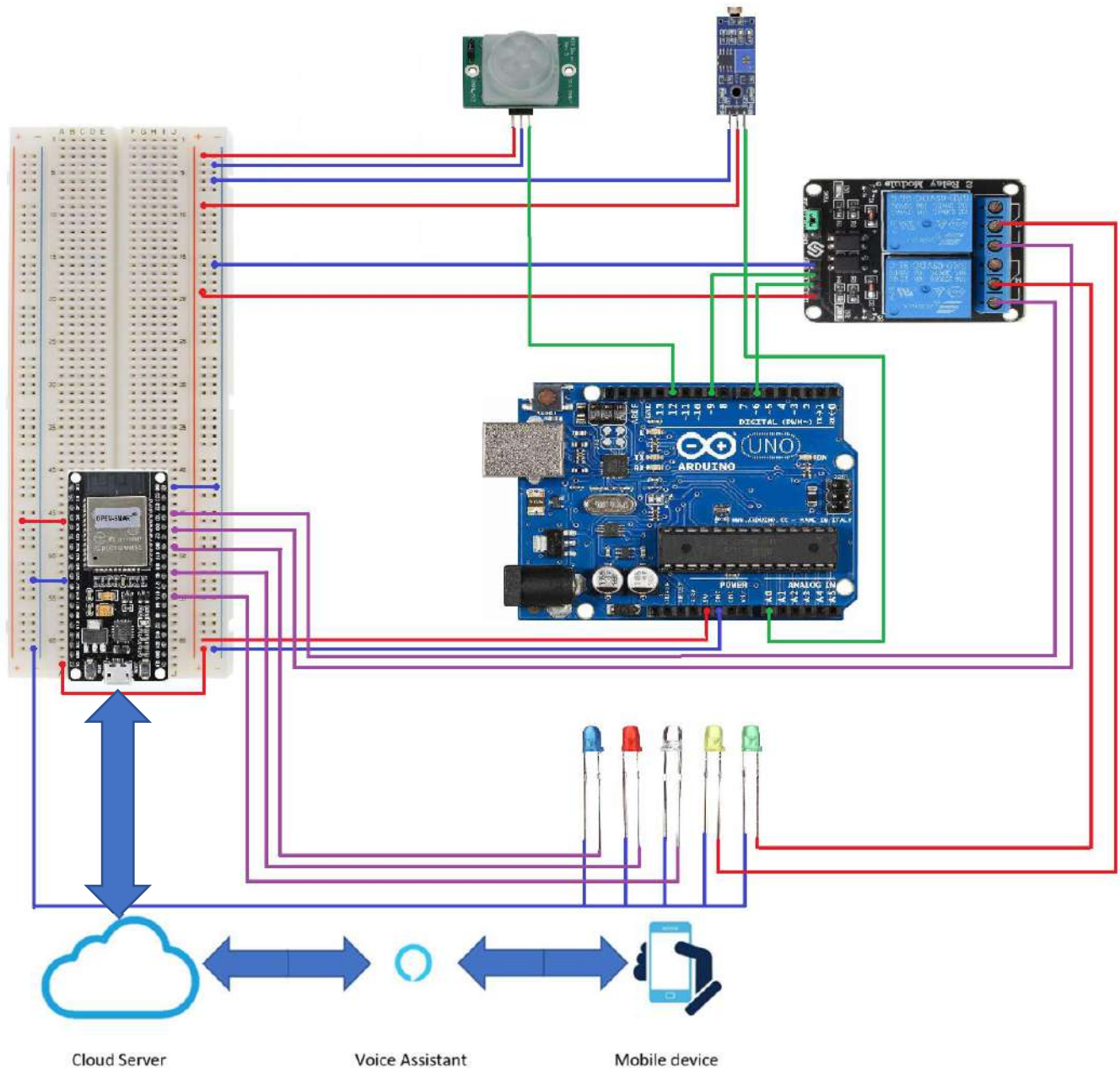
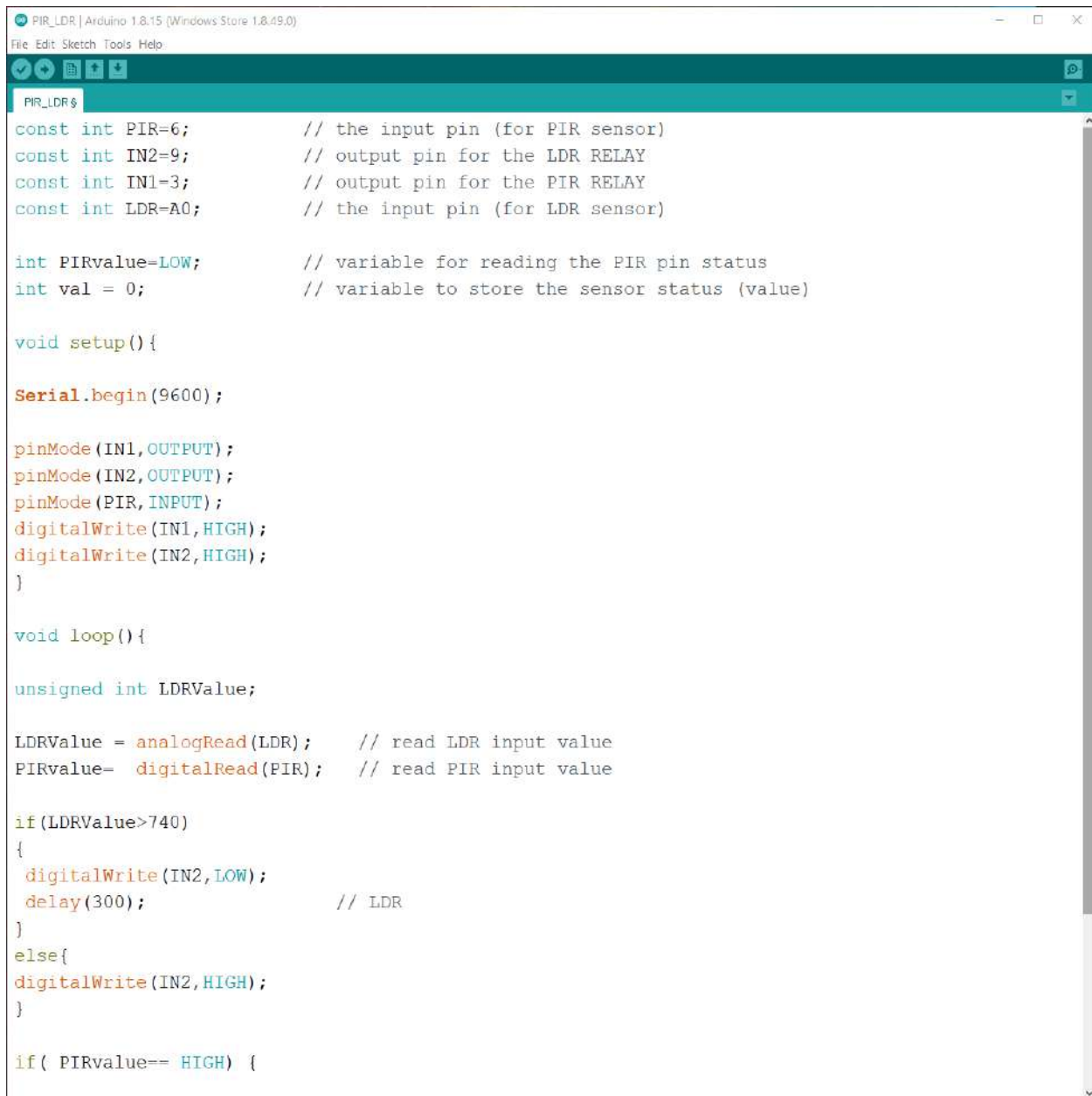


Figure (3.2) Project schematic

### 3.3 Programming the Arduino UNO

The programming of this project is going to be done in two steps.

First is the Arduino UNO microcontroller side:



```
PIR_LDR$
const int PIR=6;           // the input pin (for PIR sensor)
const int IN2=9;           // output pin for the LDR RELAY
const int IN1=3;           // output pin for the PIR RELAY
const int LDR=A0;         // the input pin (for LDR sensor)

int PIRvalue=LOW;          // variable for reading the PIR pin status
int val = 0;              // variable to store the sensor status (value)

void setup() {
  Serial.begin(9600);

  pinMode(IN1,OUTPUT);
  pinMode(IN2,OUTPUT);
  pinMode(PIR,INPUT);
  digitalWrite(IN1,HIGH);
  digitalWrite(IN2,HIGH);
}

void loop(){
  unsigned int LDRValue;

  LDRValue = analogRead(LDR);    // read LDR input value
  PIRvalue= digitalRead(PIR);    // read PIR input value

  if (LDRValue>740)
  {
    digitalWrite(IN2,LOW);
    delay(300);                // LDR
  }
  else{
    digitalWrite(IN2,HIGH);
  }

  if( PIRvalue== HIGH) {
```

Figure (3.3) Arduino UNO programming

```

digitalWrite(IN1,LOW);    // turn ON the PIR Relay
delay(5000);              //wait 5 seconds
}
else {
digitalWrite(IN1,HIGH);  // turn OFF the PIR Relay
delay(3000);             //wait 3 seconds
}
}
}

```

Figure (3.4) Cont. Arduino UNO programming

### 3.4 Programming the ESP32S (Node MCU)

Second is the ESP32S MC side:

```

sketch_may29a | Arduino 1.8.15 (Windows Store 1.8.49.0)
File Edit Sketch Tools Help

sketch_may29a$
#include <Arduino.h>
#include <WiFi.h>
#include "SinricPro.h"
#include "SinricProSwitch.h"

#include <map>

#define WIFI_SSID      "LoLz"
#define WIFI_PASS      " "
#define APP_KEY        "6df4e3e2-5a69-4fb8-8d49-5fc766bb1225"
#define APP_SECRET     "e9687d44-0ac2-4a37-ba76-0d6a99608ae7-a5fa0348-e16f-4520-aa3e-8ea6bf05cc9f"

#define device_ID_1    "60a52fa6fefed505e79271a3"
#define device_ID_2    "60a52fb69bcd7705d2a5c570"
#define device_ID_3    "60a52f7efefed505e79271a1"
#define device_ID_4    "60a52f7efefed505e79271a1"
#define device_ID_5    "60a52f7efefed505e79271a1"

#define RelayPin1 13    //GPIO 13
#define RelayPin2 16    //GPIO 16
#define RelayPin3 19    //GPIO 19
#define RelayPin4 22    //GPIO 22
#define RelayPin5 25    //GPIO 25

```

Figure (3.5) ESP32S programming

```

#define wifiLed 2 //GPIO2

#define BAUD_RATE 9600

#define DEBOUNCE_TIME 250

typedef struct {
    int relayPIN;
} deviceConfig_t;

std::map<String, deviceConfig_t> devices = {

    {device_ID_1, { RelayPin1, SwitchPin1 }},
    {device_ID_2, { RelayPin2, SwitchPin2 }},
    {device_ID_3, { RelayPin3, SwitchPin3 }},
    {device_ID_4, { RelayPin4, SwitchPin4 }},
    {device_ID_5, { RelayPin5, SwitchPin5 }}
};

void setupRelays() {
    for (auto &device : devices) { // for each device (relay, flipSwitch combination)
        int relayPIN = device.second.relayPIN; // get the relay pin
        pinMode(relayPIN, OUTPUT); // set relay pin to OUTPUT
        digitalWrite(relayPIN, LOW);
    }
}

bool onPowerState(String deviceId, bool &state)
{
    Serial.printf("%s: %s\r\n", deviceId.c_str(), state ? "on" : "off");
    int relayPIN = devices[deviceId].relayPIN; // get the relay pin for corresponding device
    digitalWrite(relayPIN, state); // set the new relay state
    return true;
}

#endif

flipSwitch.second.lastFlipSwitchState = flipSwitchState;
}
}
}

void setupWiFi()
{
    Serial.printf("\r\n[Wifi]: Connecting");
    WiFi.begin(WIFI_SSID, WIFI_PASS);

    while (WiFi.status() != WL_CONNECTED)
    {
        Serial.printf(".");
        delay(250);
    }
}

```

Figure(3.6) ESP32S programming



```
digitalWrite(wifiLed, HIGH);
Serial.printf("connected!\r\n[WiFi]: IP-Address is %s\r\n", WiFi.localIP().toString().c_str());

void setupSinricPro()

for (auto &device : devices)
{
    const char *deviceId = device.first.c_str();
    SinricProSwitch &mySwitch = SinricPro[deviceId];
    mySwitch.onPowerState(onPowerState);
}

SinricPro.begin(APP_KEY, APP_SECRET);
SinricPro.restoreDeviceStates(true);

void setup()

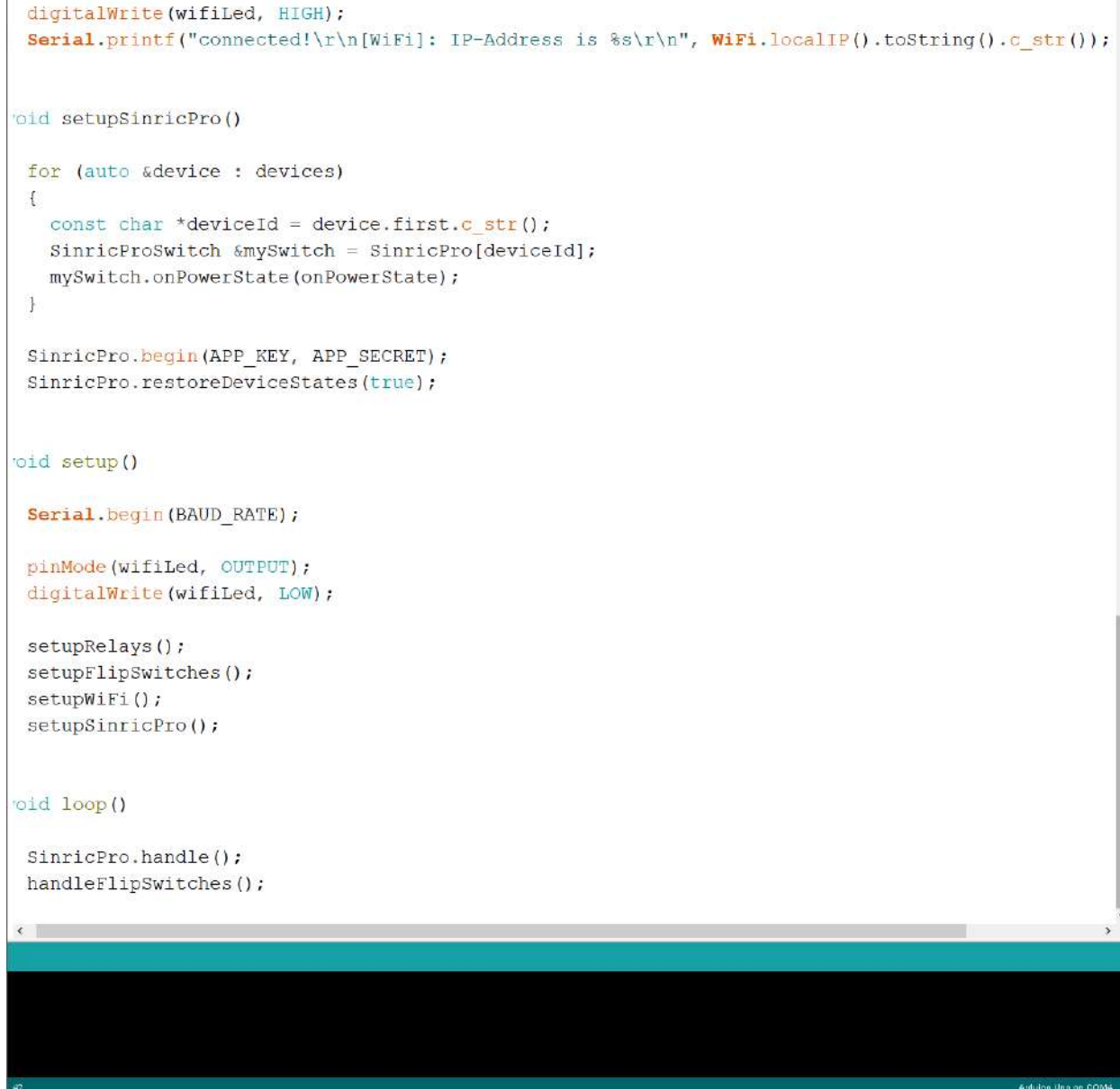
Serial.begin(BAUD_RATE);

pinMode(wifiLed, OUTPUT);
digitalWrite(wifiLed, LOW);

setupRelays();
setupFlipSwitches();
setupWiFi();
setupSinricPro();

void loop()

SinricPro.handle();
handleFlipSwitches();
```



Figure(3.7) ESP32S programming



### 3.5 Integrating Sinric

After creating an account, we need to configure the devices we are going to be controlling then copying their unique IDs into the IDE.

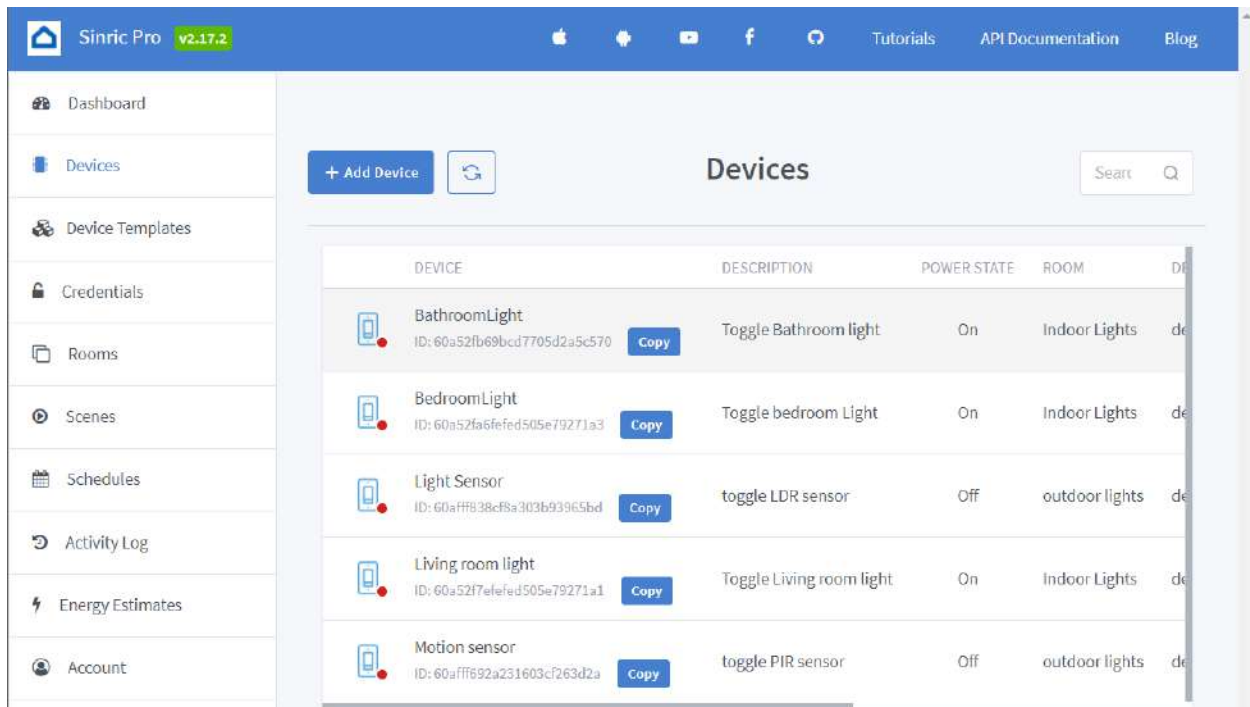


Figure (3.8) Adding devices on Sinric

Now we need to connect our Sinric account to our voice assistant which is done by copying the (APP KEY) and (APP SECRET) into the assistant.

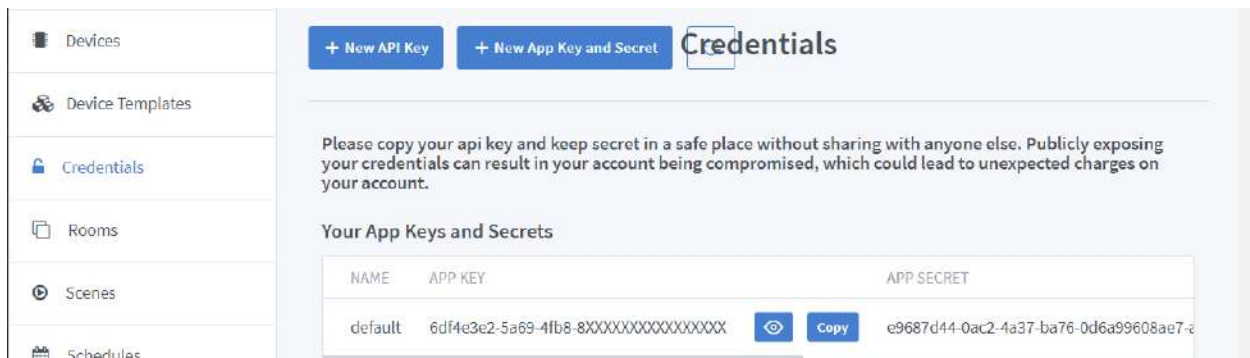


Figure (3.9) Adding devices on Sinric

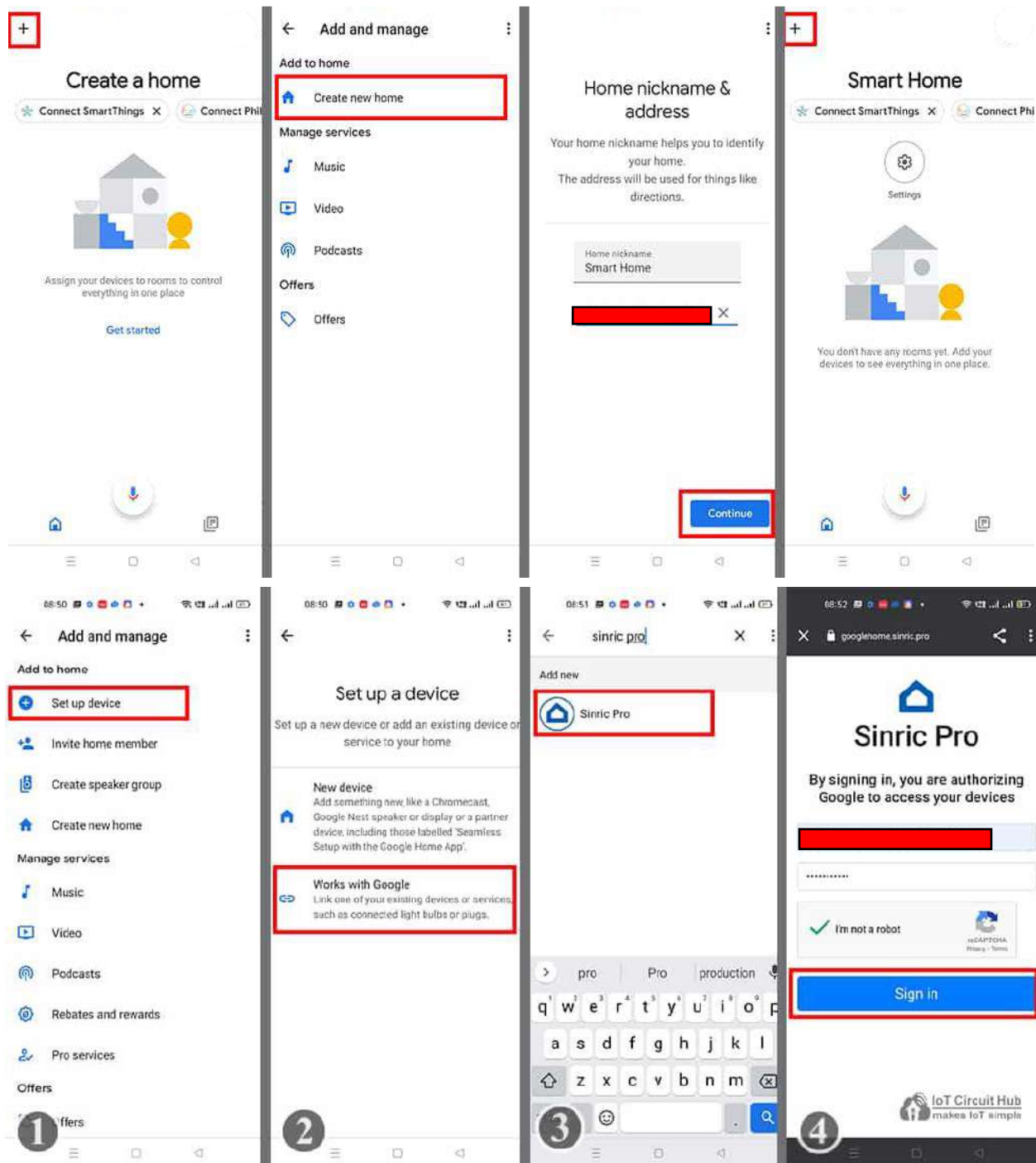


Figure (3.10) Connecting Sinric Pro with Google home App

### **3.6 Building the Project**

after finishing programming the microcontrollers, now we move on to building the project we'll need a slab of wood and a sandwich panel.

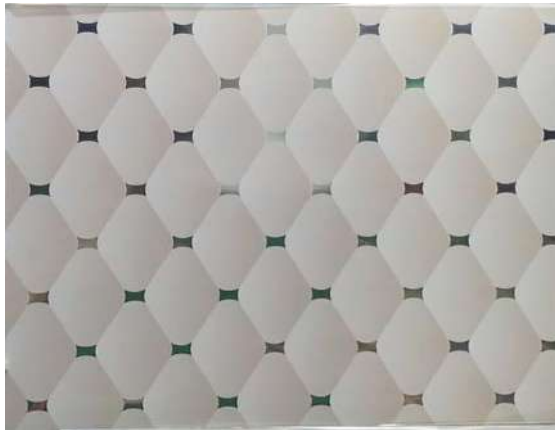


Figure (3.11) Objects used to build the project

We will be using a junction box to store our components as shown in figure (3.12).



Figure (3.12) junction box

Laying wires beforehand to make installing components easier as shown in figure (3.13).

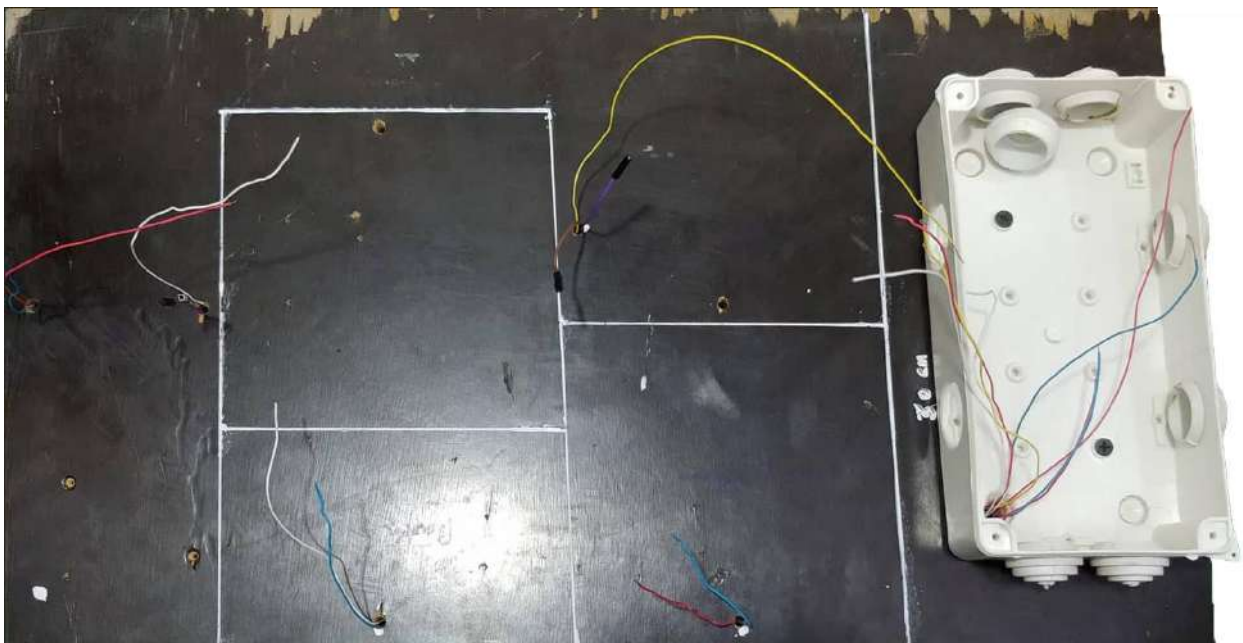
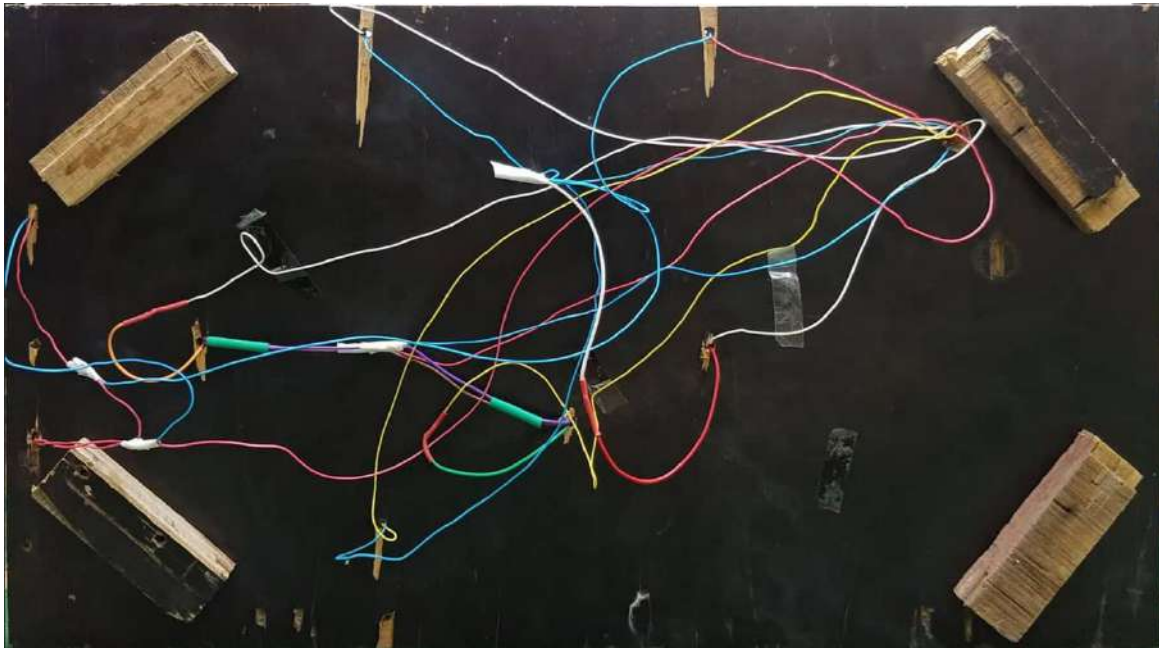


Figure (3.13) Project wiring



Installing all the components needed, loading the sketches into the microcontrollers, and completing the circuit wiring as shown in Figures (3.14) and (3.15).

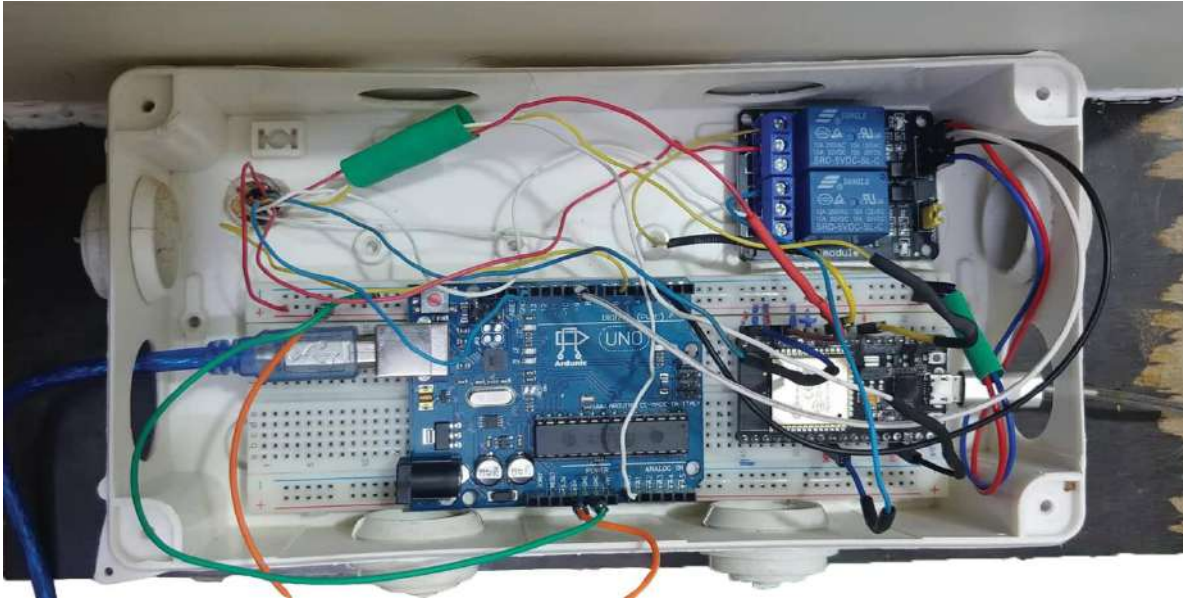


Figure (3.14) Main circuit



Figure (3.15) before applying final touches

After applying the final touches this is what the completed project looks like.



Figure (3.16) Completed project (turned off)

Using Google Home to control all the lights individually as shown in figure (3.16).

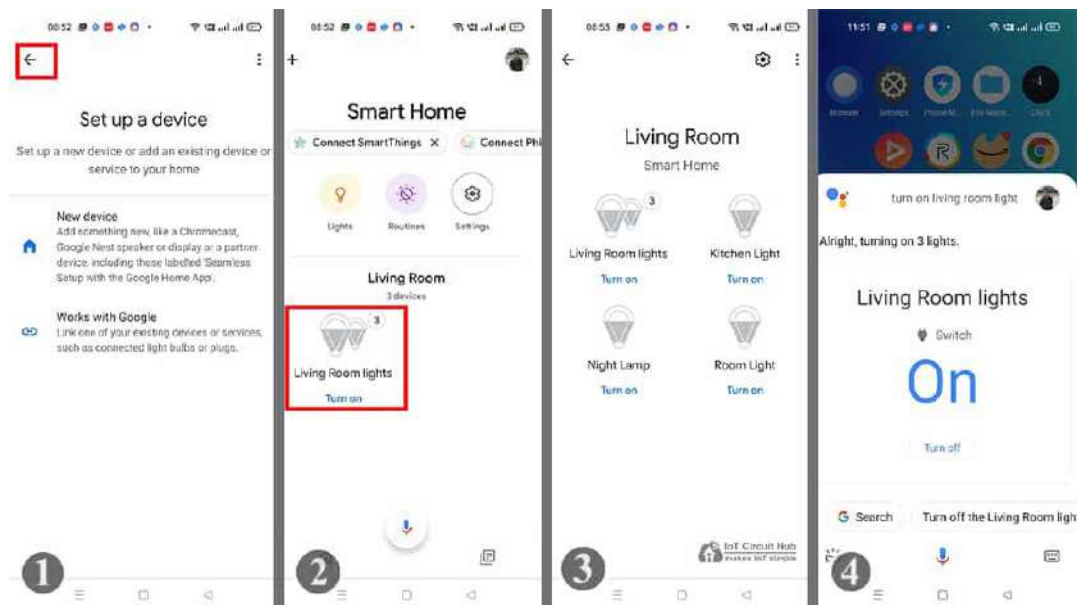


Figure (3.17) controlling lights via Google Home App

The practical work is successful and gives the desired results as shown below.



Figure (3.18) Finalized project

## Chapter Four: Results and Discussion

### 4.1 Results and Discussion

As we can see the results we have from the sensor-controlled lights (PIR and LDR) and the GPIO controlled lights :

- when the light level is low the resistance of the LDR is high and vice versa as shown in figure (4.1). in our experiment, we have the actuation point at 740 LUX which is the trigger point. Thus, activating the light. We can also use the Google Home app or voice commands to manually control the light's state.

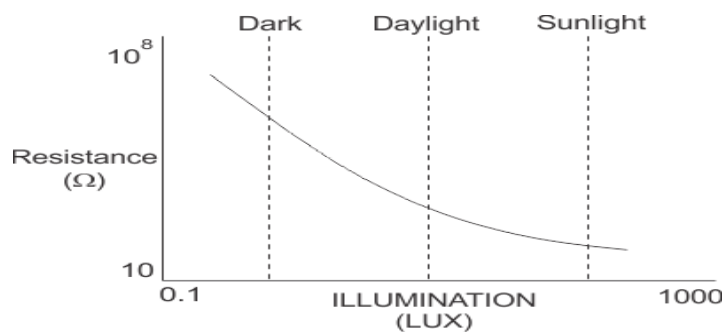


Figure (4.1) LDR and its characteristics

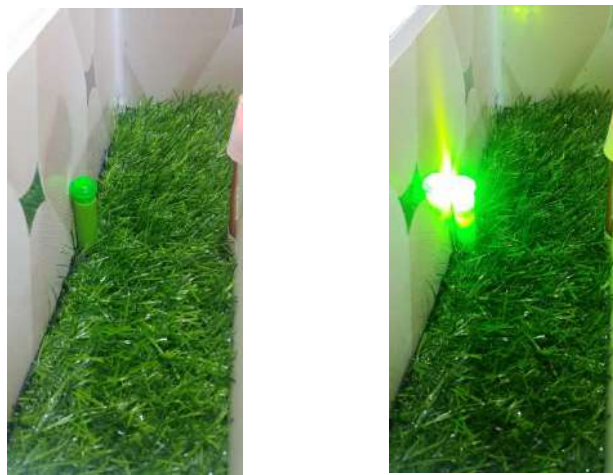


Figure (4.2) LDR switch controlled individually



- when the PIR detects motion, Its output pin will go from “LOW” to “HIGH” and activate the Relay as shown in figure (4.3). Just as the LDR Sensor the PIR relay can also be manually controlled via either the Google Home app or voice commands.

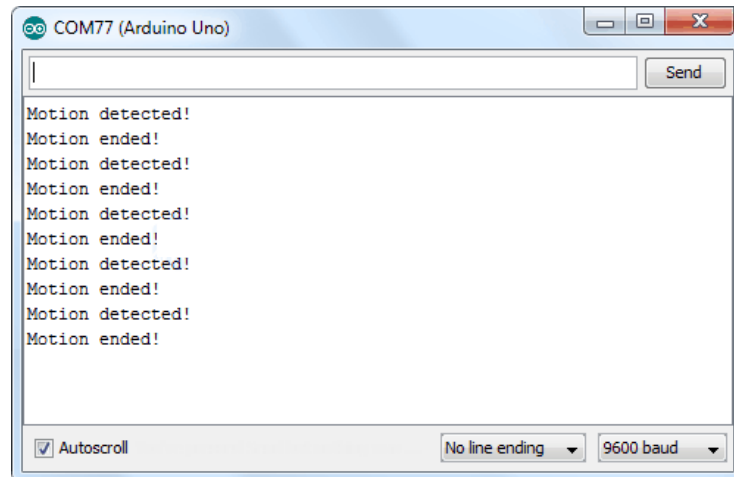


Figure (4.3) PIR Sensor output on serial monitor

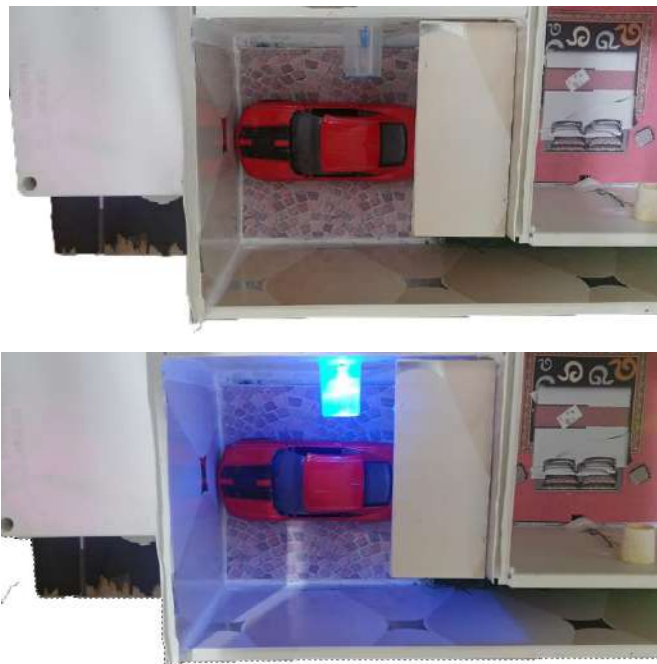


Figure (4.4) PIR switch controlled individually

- The remaining lights are each controlled individually via either the google home app or voice commands as shown in the figures below:



Figure (4.5) LDR switch controlled individually



Figure (4.6) LDR switch controlled individually



Figure (4.7) LDR switch controlled individually

## **Chapter Five: Conclusion and Future Work**

### **5.1 Conclusions**

In this project, a microcontroller-based automated home lighting system is presented theoretically and practically. The conclusions of the project are summarized as follows:

- A relay module can be easily controlled with an Arduino UNO development board using the hardware approaches.
- The Arduino controls the status (ON/OFF) of Relay depending on the day's light intensity.
- The design and implementation of the project's circuits successfully give the desired results.
- The main features of this system are easy to operate, inexpensive, simple and efficient to use, requires small power, and simple electronics elements.
- Every single light can be controlled via the internet. Or by using voice commands
- As this is an IOT project which we are working with 5V Relay modules, we can control any household appliances through the internet not only just lights.

### **5.2 recommendations for Future Work**

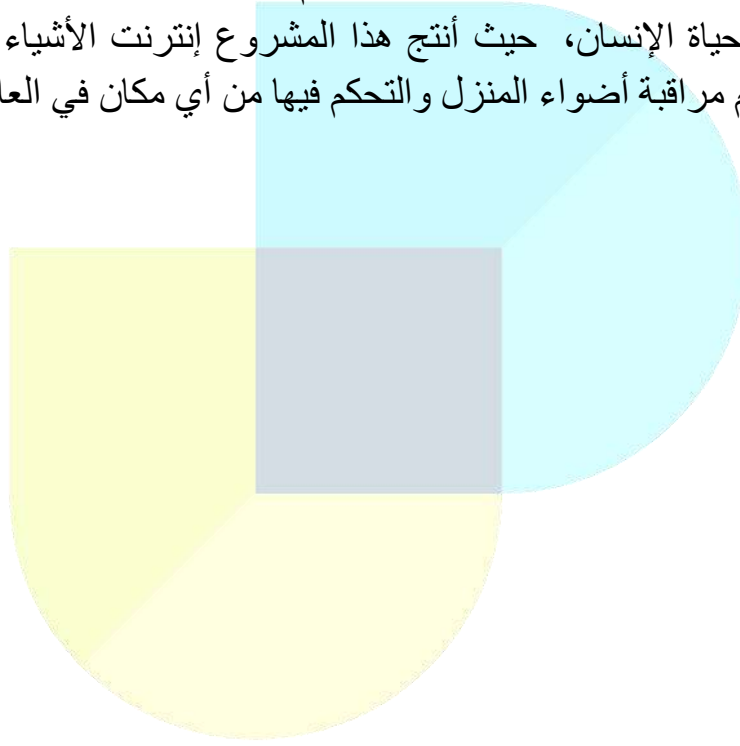
- Building the components ourselves instead of buying them prebuilt modules would make it even cheaper.
- By using and Logic Level Converter we can eliminate the need for an Arduino UNO board thus reducing the overall cost.
- We can opt. for using Solid State Relays (SSR) instead of Contact Relays which has no moving parts thus making it less prone to fail and makes less noise.
- The same infrastructure could be used to implement any automated system based on microcontrollers e.g. (irrigation system).

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## الخلاصة

في السنوات الأخيرة, أصبح من الحاجة بناء نظام آلي منزلي بشكل كامل لزيادة الأمن ولتقليل الجهود البشرية, حيث يهدف المشروع إلى تصميم نظام أكثر قوة لجعل حياة الإنسان أكثر سهولة, لتنفيذ فكرة المشروع تم استخدام متحكم الأردوينو(UNO) مع (ESP32S), مستشعر الحركة (PIR) بالإضافة الى متحسس الضوء (LDR), وتكمن الوظيفة الرئيسية للنظام هي التشغيل الآلي لأضواء المنزل مما يعطي المشروع المقترح نتيجة جيدة بكفاءة عالية من حيث جعل المهام اليومية أكثر بساطة من خلال تطبيق الإنترنت في حياة الإنسان, حيث أنتج هذا المشروع إنترنت الأشياء (IOT), وبهذا يمكن للمستخدم مراقبة أضواء المنزل والتحكم فيها من أي مكان في العالم.





تصميم مصابيح منزلية تلقائية مبني على الاردوينو اونو مع قابلية  
التحكم الصوتي عبر الانترنت باستخدام ال(ESP32S)

مشروع مقدم إلى قسم هندسة تقنيات الحاسوب  
في جامعة دجلة كجزء من متطلبات نيل درجة البكالوريوس في هندسة  
تقنيات الحاسوب

من قبل

1. لواء علي فؤاد
2. أحمد ناصر عبد الواحد
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بإشراف

الأستاذ . محمد حسين هويدي

حزيران 2021



وزارة التعليم العالي والبحث العلمي

كلية ديحلا الجامعة

DIJLAH UNIVERSITY COLLEGE



# Design and Simulation of Mobile Transceiver under Gaussian Noise

Research submitted to the Dujlah University College - Department of Computer  
Techniques Engineering

As part of the requirements for awarding a Bachelor of Engineering degree in  
Computer Techniques

By:

- 1- Ali Khalid Hassan Zamil
- 2- Ahmed Alaa
- 3- Nawras sabah
- 4- Sajad haidar

**SUPERVISOR**

**Asst. Prof. Dr. Maijd S. Naghmash**

**2021**

# **Design and Simulation of Mobile Transceiver under Gaussian Noise**

**Dijlah University College**

**Department of Computer Engineering Techniques**

**2021**



## **DEDICATION**

**To**

**My parents.**

**For their love, patience and sacrifice during my study.**

## **ACKNOWLEDGMENT**

First of all, we thank The Almighty God “Allah”, the most gracious and the most merciful, for the whole thing he has given to me.

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# **Design and simulation of mobile transceiver under Gaussian Noise**

## **ABSTRACT**

The main aim of this research is the design and simulation of GSM mobile transceiver under Gaussian noise. The transmitter and receiver baseband section of GSM transceiver has been designed and running under channel noise to verify the receiver performance in the mobile system under channel noise. The input and output signals are analysed and evaluated on a simulation basis using SIMULINK in MATLAB block set. The simulation results show that the proposed model provide an important development efficient transceiver performance against channel noise. These results confirm the validity of the proposed algorithms and the techniques used are promising to support the mobile requirements of new 5G wireless communication system.

## INTRODUCTION

## 1.1 General Overview

The GSM is simply defined as “radio in which some or the entire physical layer functions are software defined” by the SDR Forum. This implies that the architecture is flexible such that GSM may be configured in real time to adapt itself to various wireless standards and waveforms, frequency bands, bandwidths, and modes of operation. A data rate conversion section is the most important process in the technology of mobile system as show in Figure 1.

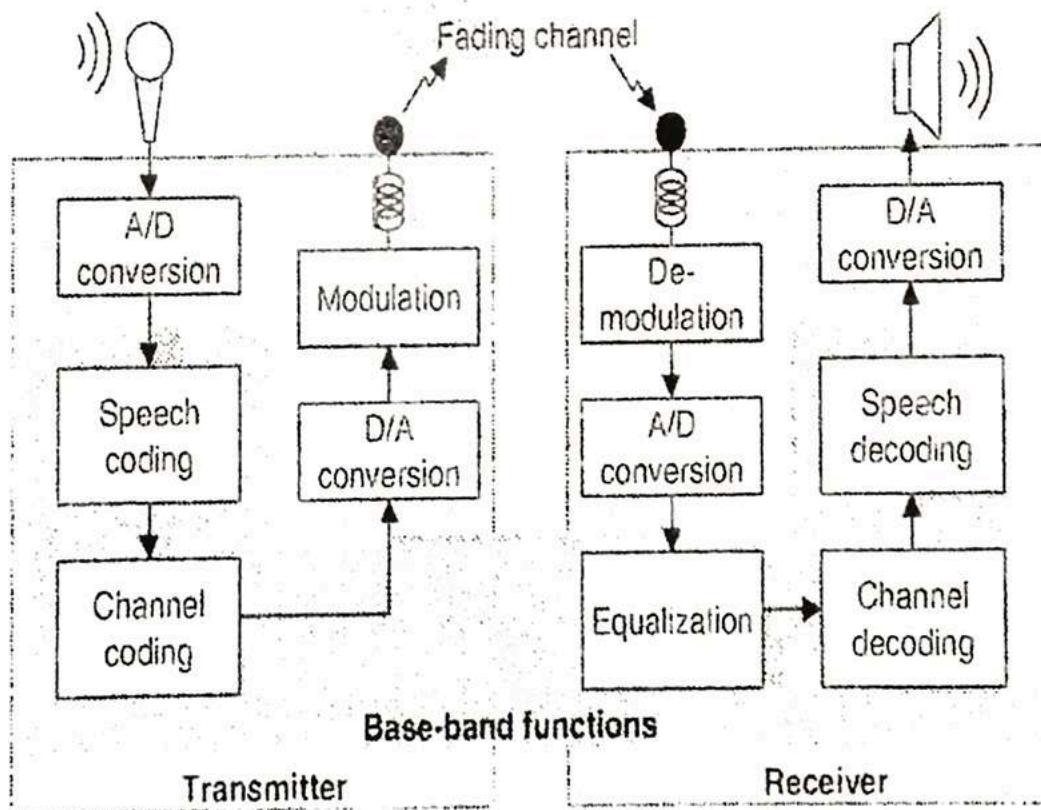


Figure 1-1 GSM Transceiver



## **1.2 Motivation to the Research**

The widespread of mobile communication devices requires more efficient system in signal processing in terms of size and energy saving. The energy consumption in a communication system depends on the technology of the processor and the number of processing stages. Programmability in the decimation filter, allows it to adapt to the different channel bandwidths, interferers requirements of the different standards, while maintained the power consumption at a minimum. The appearance of various standards in communication technologies in the world requires a good technique that able to provide a compatible standard replacing any part of the system by the GSM receiver technology

## **1.3 Problem Statement**

A lot of researches have been done in introducing an efficient GSM system under software defined radio technology. This will be done by optimizing the FIR filter design based on software defined radio. The noise effect in the GSM receiver could be reduced by design an efficient FIR filter in the receiver section.

## **1.4 Research Objectives**

The main goal of this project is to design a GSM mobile transceiver. Align to the main goal; there will be few objectives to be achieved such as stated below:

- 1, To design and run the GSM transceiver using MATLAB
2. To decrease the noise effect in the mobile receiver

## **1.5 Thesis Layout**

**Chapter 1:** A necessary background, motivation, objectives of project are the major subjects of chapter one.

**Chapter 2:** A literature review of GSM initially exists, which includes the general environment in sequence of GSM transmitter and receiver.

**Chapter 3:** The design and simulation of GSM system using MATLAB and SIMULINK block set is the first section in this chapter.

**Chapter 4:** The simulation results of GSM system is explained in this chapter.

**Chapter 5:** Lastly, brief summary will highlight the contribution of the project including the novelty of the designs and the advantage of each model.



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

the GSM system needs to connect with Internet through WLAN, it may be helpful to use this type of converter designs using SDR technology to change the specifications of this filter by only changing the filter programming without affecting the complete hardware in this case with minimum noise [1].

#### 2.2 Overview of GSM Wireless Communication System

A general structure of GSM contains a transmitter, channel and a receiver path in the wireless communication system as shown in Figure 2.1. This system is divided into three sections, RF, IF and baseband. In the IF section, the sample rate of the signal has converted from low rate to high rate within the transmitter by using so called digital up-converter (DUC) while from high to low rate in the receiver path by using digital down converter (DDC) [2].

in the receiver path the FIR is used to convert the intermediate frequency (IF) to the baseband for more processing and isolate the desired signal. The sampling rate conversion of the received signal has to be optimizing to protect this signal from interference and undesired signal as well as to avoid any aliasing phenomena during sampling process. In addition, the power consumption by the sampling rate process is more important factor to satisfy the user requirements [3]

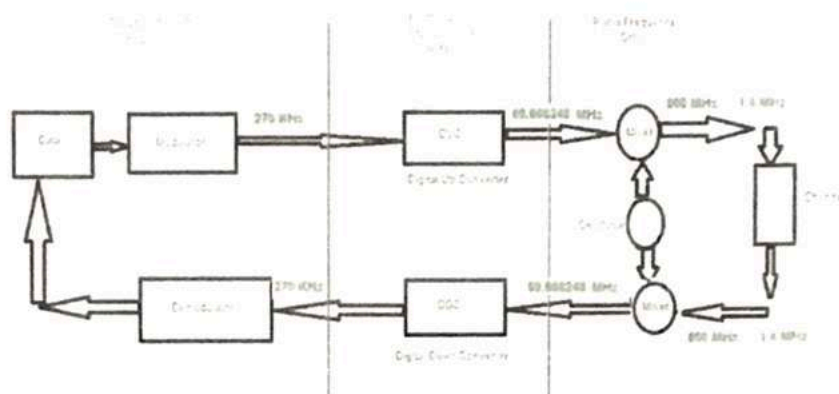


Figure 3-1. Practical structural of GSM mobile system

### 2.3 SDR Front-end Receiver Architectures

According to the application of GSM receivers, the RF front-end can be divided into three main architectures [3-5]. In the first architecture, as shown in Figure 2.2., the ADC is located at baseband. The signal traverses two down conversion stage with filter and is improved at RF by a LNA. The purpose is to shift the desired signal to the baseband. Such architecture is now adopted mainly in radio receivers. The benefit of this receiver architecture is obtained from the availability of low-price narrowband RF and IF components with small power spending. Though, due to its narrowband future, it has the disadvantage that design of major components is made to an exact channel and is hard to increase the receiving band (i.e. digitalize the IF band processing give more flexibility to increase the frequency band and provide exact channel without distortion). and Figure 2.2 is the filtering process at IF band, digitalize or non-digitalize [6]

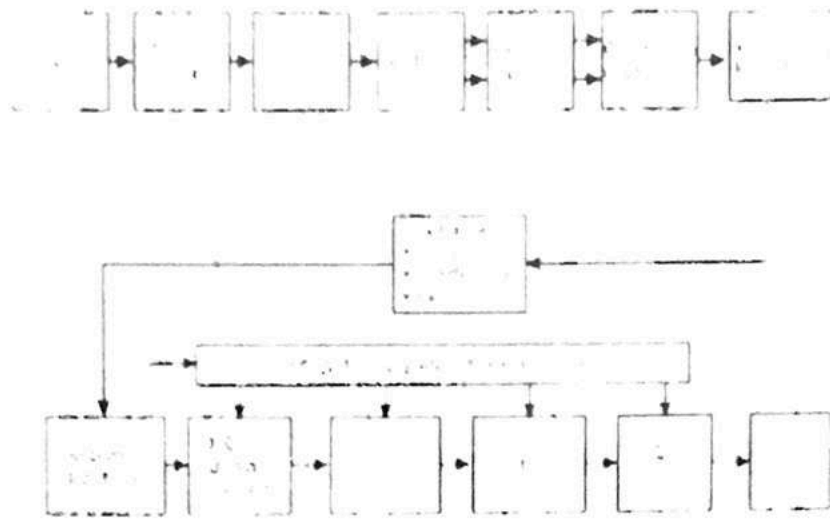


Figure 3-2. Simple super-heterodyne front-end architecture

The second architecture considers the ADC in the IF section, preceded by a RF filter, LNA and a mixing stage as shown in Figure 2.3. Compared with the previous architecture, this could be designed to operate over a wider bandwidth because of following the down conversion. The entire bandwidth can be filtered and digitized allowing digitally processing of same channel. Thus, one advantage is the possibility to receive more than one channel and then isolate each one using digital filtering. This architecture is an approximation of the ideal GSM receiver configuration. Furthermore, this architecture can be realizable with actual available components but without covering a high bandwidth of reception.



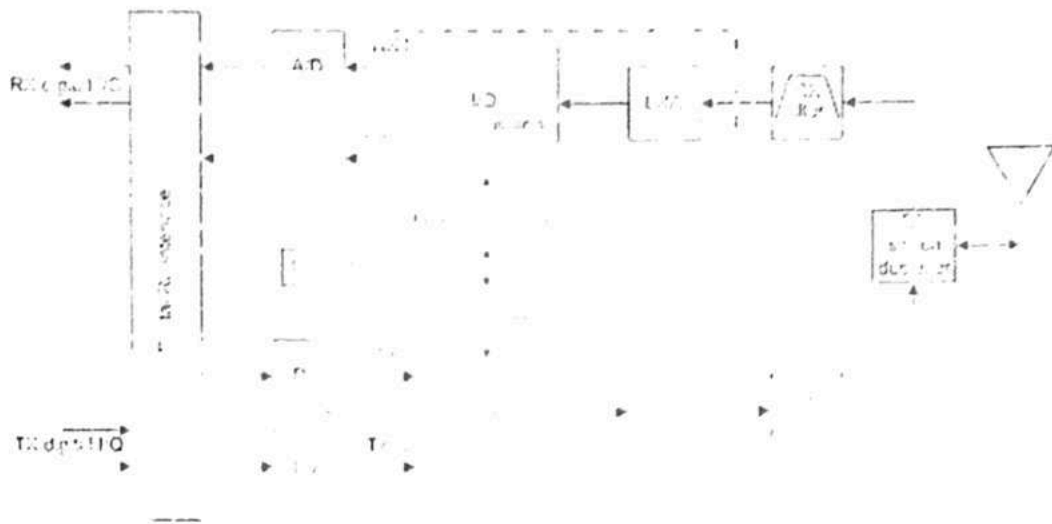


Figure 3-4. Direct digitization front-end architecture

## 2.4 GSM Receiver Architectures

GSM receiver architecture is mostly used the digital down converter to convert the intermediate frequency band to baseband. Figure 2.5.a shows the functional diagram of SDR receiver. After radio frequency mixing, the signal is changed to a digital signal via a high speed ADC, and then converted to baseband via DDC for more processing via DSP process. Figure 2.5.b illustrates the DDC filter stages. In order to get the baseband signals, the digital signal after ADC and Numerical Control Oscillator (NCO) is multiplied to generate the required signals. Normally less multiplier filter implementation is desired for their rate and hardware competence. Digital down converter has to convert the received signals from high to low frequency by sufficient function and conditioning performance to reduce the error in the band of interest and power consumption [8].

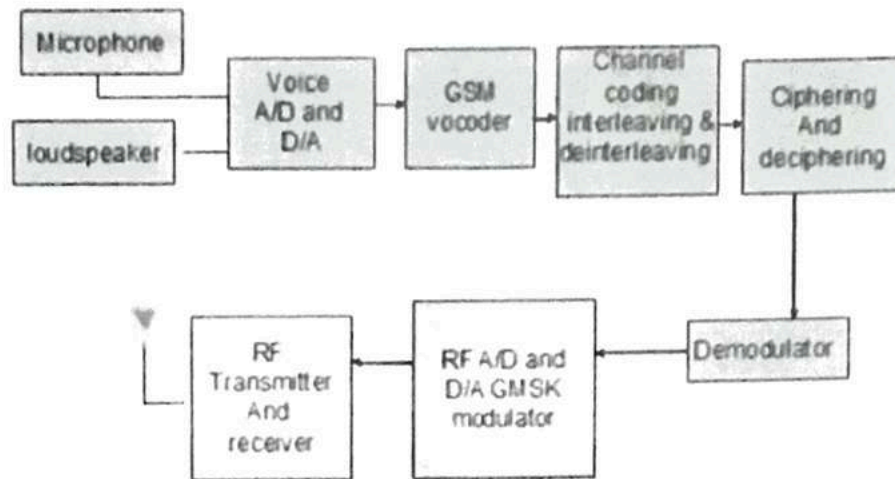


Figure 3-5. Mobile receiver fundamental

## 2.5 Related Work

Several designs and implementations of GSM for software defined radio shown in Figure 2.5 (b) are presented in recent research. The performance of SDR is greatly influenced by the FIR filter. Many researchers have attempted to improve the performance of FIR filter by addressing the following issues:

1. The noise effect of the filter to be minimum, while maintaining high efficiency.
2. Minimizing attenuation to avoid the distortion within the received signal.

### 2.5.1 Low noise received Filter

A low pass-band error FIR filter to be work along with GSM mask frequency was reported by Ricardo (2008). A three stage FIR filter for GSM system is contains in MATLAB. Using this design the filter provide noiseless The filter structure is shown in Figure 2.14.

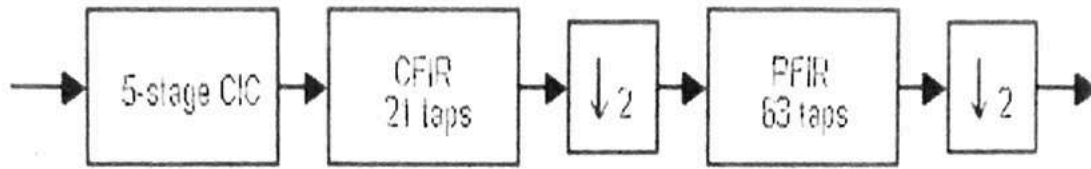


Figure 3-6 DDC filter structure

The designer used to put two different weights in the FIR filter in different band of frequency, but he selected an inappropriate place for this weight in the operating frequency at 120 KHz 130 KHz, such that the resulting response of combined filter did not satisfy the modern GSM receiver in term of pass-band ripple and band rejection, hence this design needs more tuning and rearranging of the weighted function to give better pass-band ripple and rejection requirements as well as the blocker conditions. The filter response with GSM mask frequency is illustrated in Figure 2.15.

### 2.5.3 Receiver Filter Design Using MATLAB

New toolbox using Matlab programs for FIR filter design was presented by [9]. The designed tools in Matlab window could be used to design the FIR filter for many standard communication systems. One may choose a necessary standard rate to provide the equivalent multi-stage conversion filter design by toolbox. This toolbox assists in providing a fast design and facilitates study of decimation filter for a lot of standard without doing large computation on the fundamental procedures. In this proposal, the Cascaded integrated comb may be used in the primary phases. By means of a half-band filter, with about half of the coefficients “zero” in the subsequent phase, gives additional decrease in filter complication. The preceding phase is a finite impulse response filter which provides the usual standard



requirement but it work to decrease the frequency variety. Decreasing the quantity of coefficients in every filter part enhanced synthesis result in situation of circuit density with energy consumption. The presented multistage decimation filter is shown in Figure 2.16 [10].

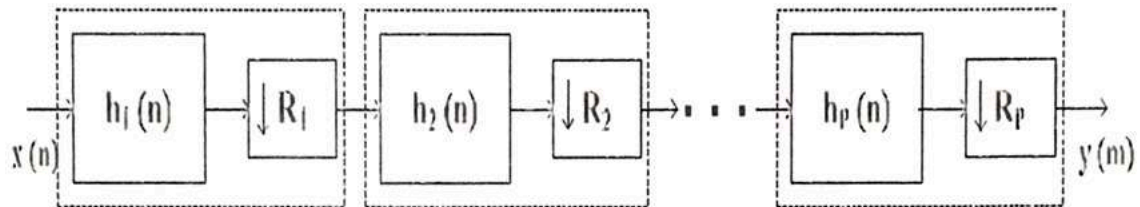


Figure 3-7 Multistage FIR filter

### 2.5.5 Multi Standards FIR Filter

A new design of receiver FIR filter is available to work with GSM, IS-95 and WCDMA was produced by (Texas Instrument, 2009). This production contains three filter stages combined and this filter could convert the 69.33 MHz to 270 KHz. The input IF signal is multiplied by sine and cosine in the tow channel (I/Q) and the resulting signals is down converted from high to low baseband by three stage filtering to be processed in DSP processor. The filter chain provides the -0.03dB in the pass-band ripple and -25dB in adjacent band rejection with -105dB in the blocker region. These results are not enough to satisfy SDR requirements and need to be more efficient in terms of ripple and power consumption. The design of FIR filter is shown in Figure 2.17 and the pass-band filter response is shown in Figure 2.18. The adjacent band rejection and blocker requirements of this filter are illustrated in Figure 2.19 .



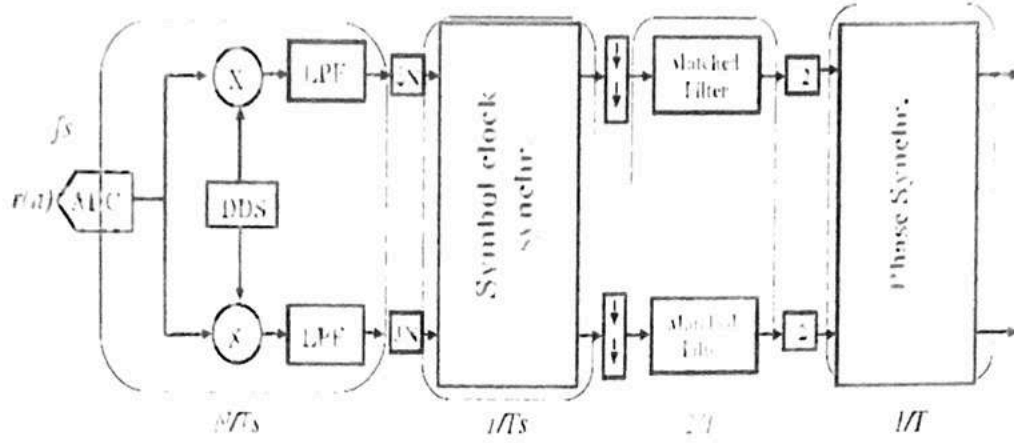


Figure 3-9 Receiver architecture

### 3 Efficient Receiver Filter

An efficient decimation and channel selecting filter which optimized both GSM and UMTS radio principles was presented by [13]. The filter is depending on two parts and is fitting after sigma-delta converter. The first part is collection of a customized cascaded integrated comb that enhances the result out of the range and permits the frequency rate to decrease down to just twice of the Nyquist frequency speed. The improved filter is cascaded to the customized cascaded integrated comb filter and improves reduction in the incoming signal range. The next stage collects finite impulse response filter which decrease the effective frequency by 2 and permits for the channel choice.

The designed filter works in very low frequency up to 1KHz and SNR is 14.65 for GSM mode and this band not provide the SDR requirements and SNR is very low may be giving high distortion in band of interest. A two part digital filter is

shown in Figure 2.21 and the improvement attitude of this filter is shown in Figure 2.22.

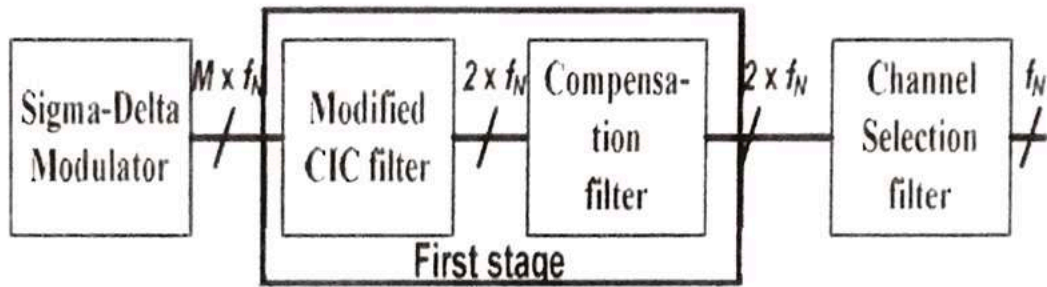


Figure 3-10 The FIR filter structure

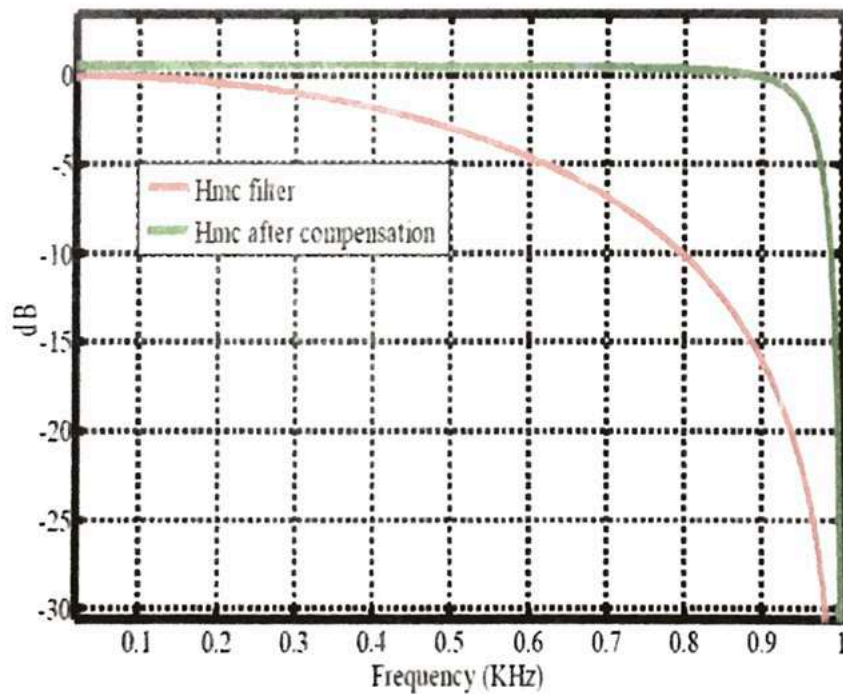


Figure 3-11 The filter response improvement

#### 4 Hardware Co-Simulation Filter Design

Efficient hardware co-simulation of digital down converter for GSM applications has been designed by [14] The design was optimized System Generator

based hardware co-simulation method which existed to realize GSM base digital down converter for software defined radios. Equiripple based polyphase decomposition method was used to optimize the proposed DDC implementation in term of rate and device utilization. The implementation of this filter needs 967 slices and 819 LUTs in a single channel and this will need more power, and more space area. The digital down converter is shown in Figure 2.23 and the FIR hardware co-simulation module is shown in Figure 2.24.

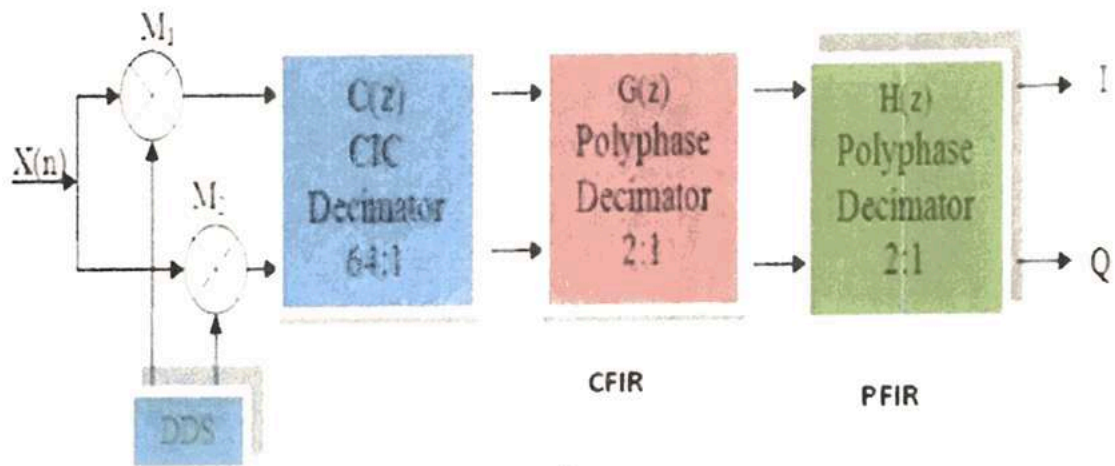


Figure 3-12 FIR filter structure

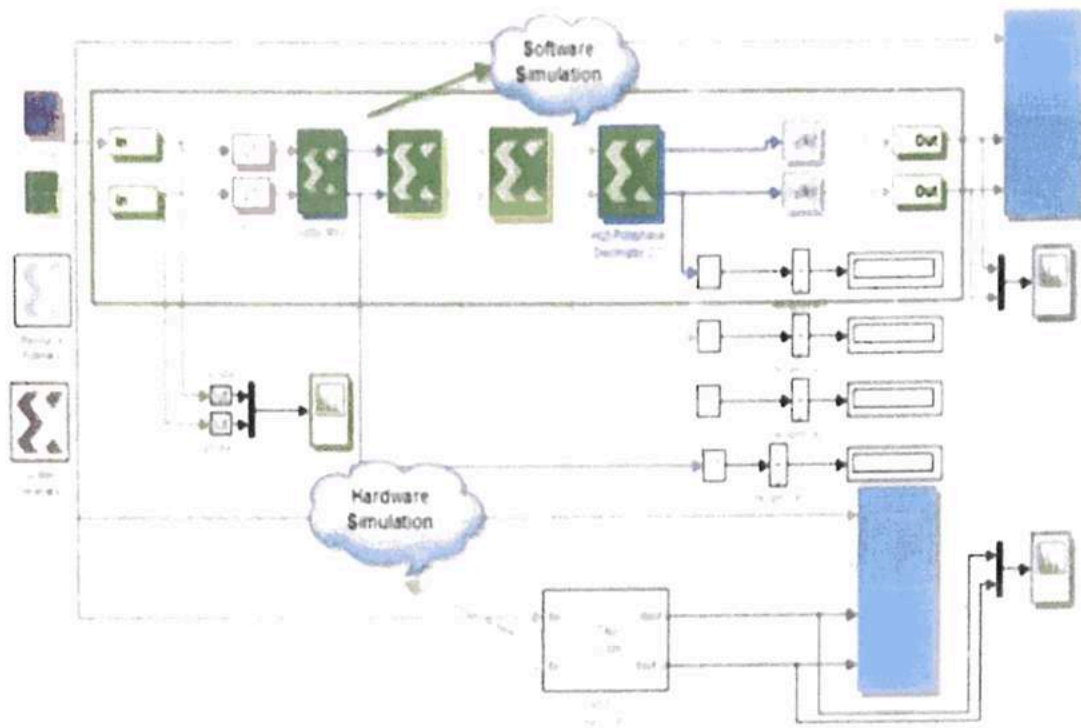


Figure 3-13 FIR Hardware Co-simulation Model

## 5 Multi Standard Filter Design

The total SRC filter system for current and future GSM system has been designed by [15]. The main goal for this design is to decrease the complication in the decimated block by optimizing the hardware area contribution. To get this, a realistic analysis algorithm was evolved, mapped, and partial SRC ratio to be capable of multi-speed filtering design with no telling time consuming optimization. In addition, a combined system of scheming CIC recompense filter inside the interpolator was introduced with no extra computational rate. By this design, they illustrate the SRC filter implementation that their aid decreases any additional computational complication with feature which doubles the increases in presentation for UMTS signals. The ideas were established by simulations using arithmetical example as of accepted industrial principles. At the same time, the designer centred on decreasing the computational complication though maintaining the performance of the filter.

The SRC architecture is shown in Figure 2.25 and the response of this filter is illustrated in Figure 2.26.

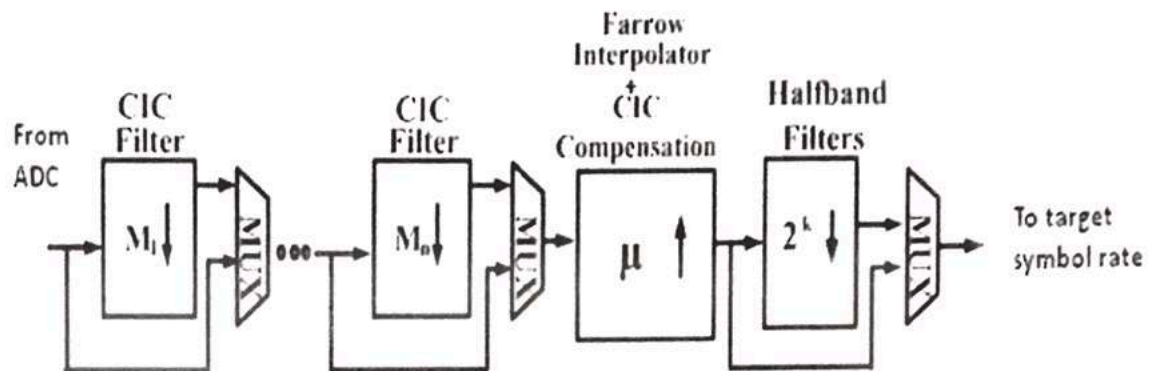


Figure 3-14 SRC architecture

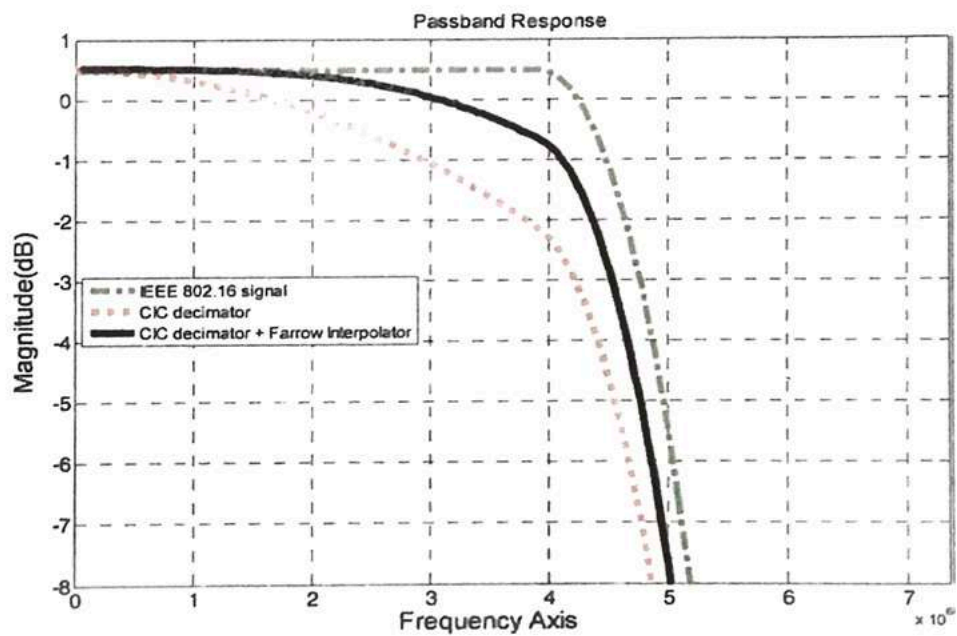


Figure 3-15 Filter response



## 6 Flexible and Efficiency FIR Filter

Design and simulation of Flexible and Efficiency Digital down Converter were designed by [16]. In this design, the logic resources is incresded because the filter structure contains three stages of FIR filter and this will increase the multiplication process in the system with many DSP processors. Due to this type of structures, the scheme needs 10998 slices and 5933 LUTs to implement in form and this could need high power. The design of FIR filter is illustrated in Figure 2.27 with 3-stage FIR filters. The major characteristic of the FIR designed for this work is that the achievement of two clock scopes and the filter response illustrated in Figure 2.28.

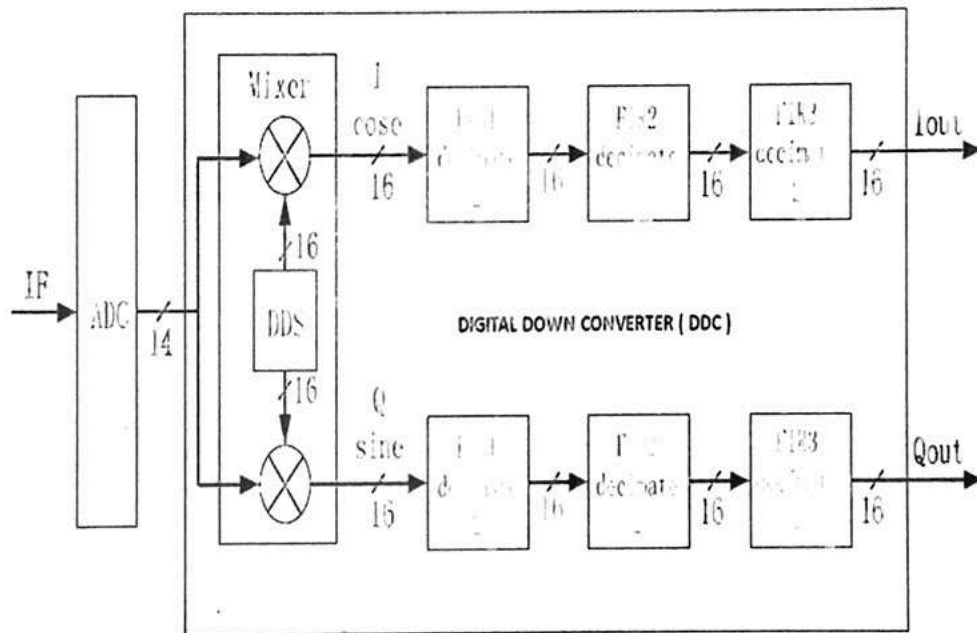


Figure 3-16 Proposed DDC functional block diagram.

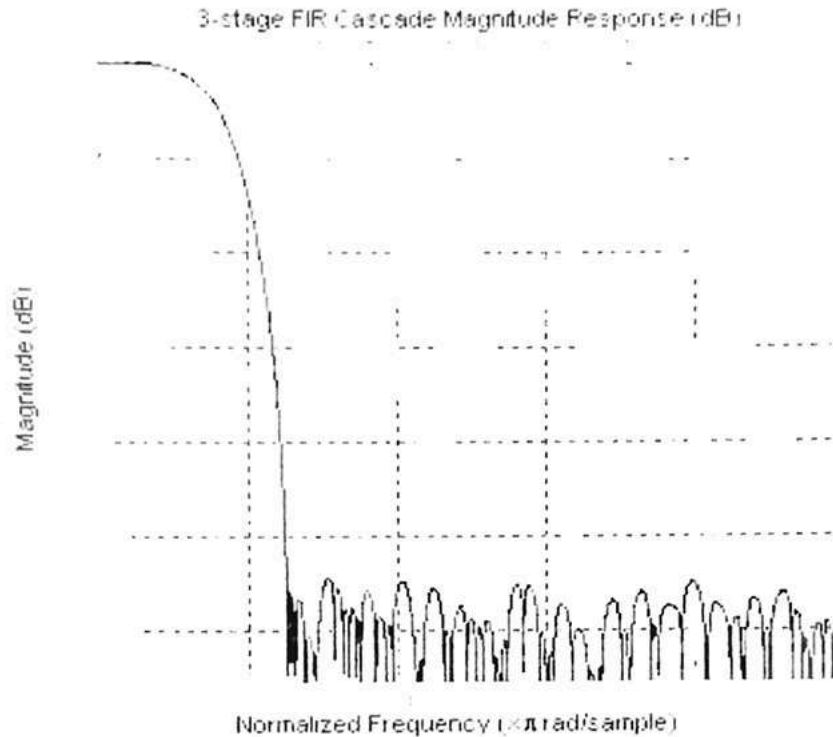


Figure 3-17 Magnitude responses of 3-stage FIR filter

## 7 GSM Transceiver

A practical design of GSM transceiver for wireless digital modem systems has been designed by [17]. In this design, the baseband section of GSM consists of BPSK modulation demodulation, filtering, and sample rate conversion which has been designed in MATLAB. The capability of this system to transmit and receive data with 30 MHz bandwidth has been achieved. The functional block diagram of transceiver is shown in Figure 2.29.





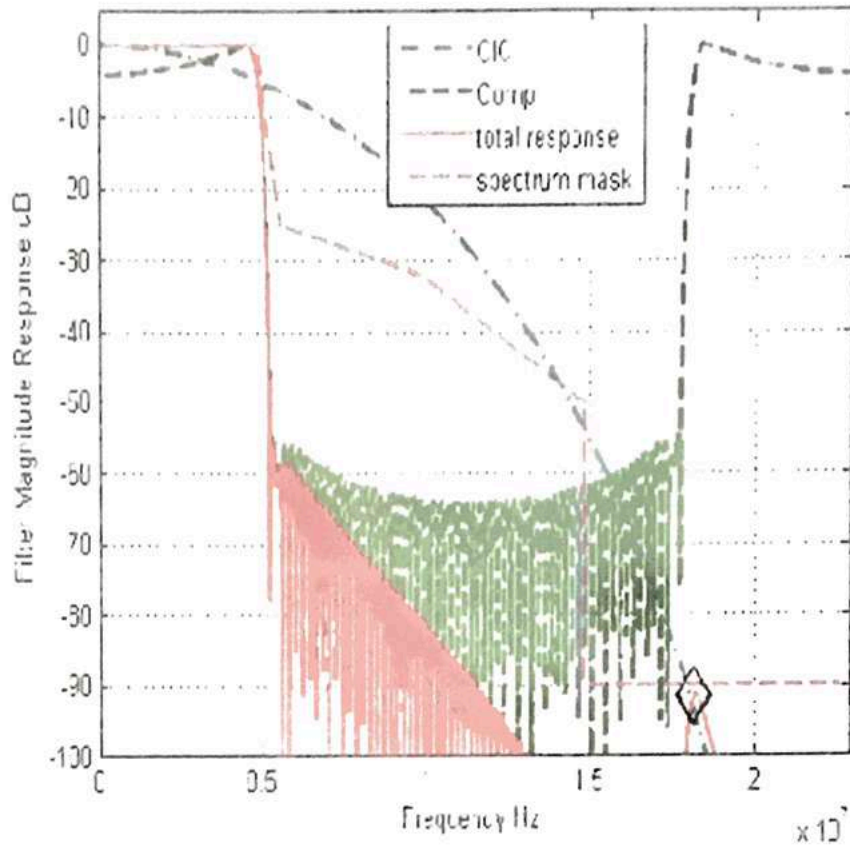


Figure 3-19 FIR filter response

## 9 Linear-Phase FIR Filters Using MATLAB

The method of designing Equiripple linear-phase FIR filters using Remez function is introduced by [20]. The FIR filter design is simulated based on MATLAB. The result of simulation satisfies the designing requirements, and this method is proved to be an optimum design method. The length of FIR filter with this method is shorter than them with WINDOW function method and frequency sampling method. The FIR filters type (I) is used to minimize the filter order with high stop band attenuation.

The minimum stopband attenuation of the designed filter is 51.0857dB, which meets the GSM requirements. The iteration process is finished.  $L=47$ (the degree

$N=46$ ) which is shorter than, the length obtained by the window function ( $L=61$ ) and the frequency sampling ( $L=60$ ).

Numerous researchers have been proposed in this field such as [21-35].

## 2.6 Summary

In this chapter the general overview of GSM is illustrated. Some of relevant works in the field were reviewed. The FIR filter proposed by [17] and the commercial GC4016 multi standard quad FIR presented by Texas Instruments [18] were capable to some extent, to meet the low pass band ripple, adjacent band rejection and blocker requirements. However, there is enough scope for further improvement.

## CHAPTER 3

### DESIGN AND SIMULATION OF GSM MODEL

#### 3.1 SIMULINK Model of GSM

The IF and baseband sections of the transmitter and receiver have been designed and simulated using the MATLAB SIMULINK block set to facilitate the analysis of the performance of the proposed GSM under channel noise. In the first step, the transmitter part consists of modulation, up-sampling, and pulse-shaping filter, and the receiver part comprises pulse shaping, down-sampling, and demodulation, which have been designed and simulated according to the model shown in Figure 3.1. The proposed model specifications are presented in Table 3.1.

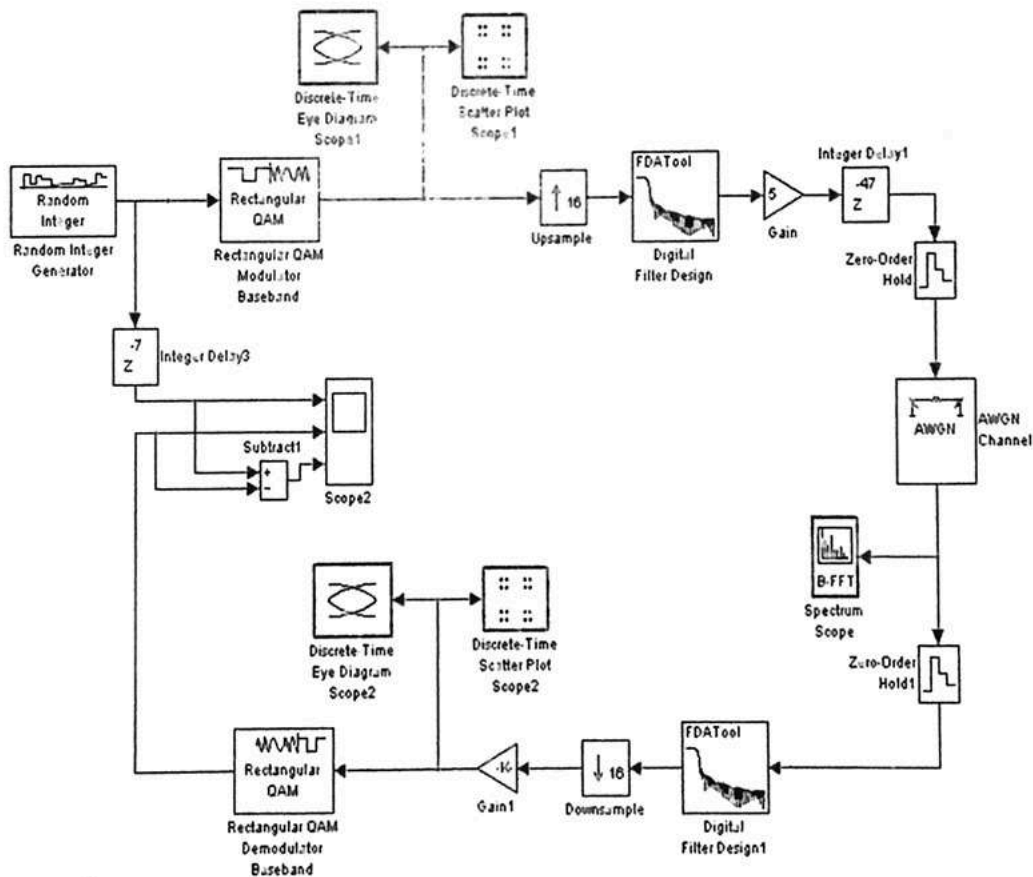


Figure 3.1: SIMULINK Model of GSM Tx/Rx

Table 3.1 The proposed SIMULINK Model specifications

Modulation scheme	16-QAM
Symbol Rate	2.5 M symbol / second
Interpolator and decimation Factor	16
Noise effect	AWGN
Receiver sample rate	40 Hz

### 3.2 Transmitter Design

In the transmitter, the generated signal from the random integer generator is modulated by the 16-QAM modulator, which has a symbol rate of 2.5 M symbol/s. The ideal eye figure of the generated 16-QAM baseband signal is shown in Figure 3.2, whereas the constellation diagram is shown in Figure 3.3. The modulated signal is subsequently up-converted by a factor of 16 and pulse-shaped by the Root Raised Cosine (RRC) filter.

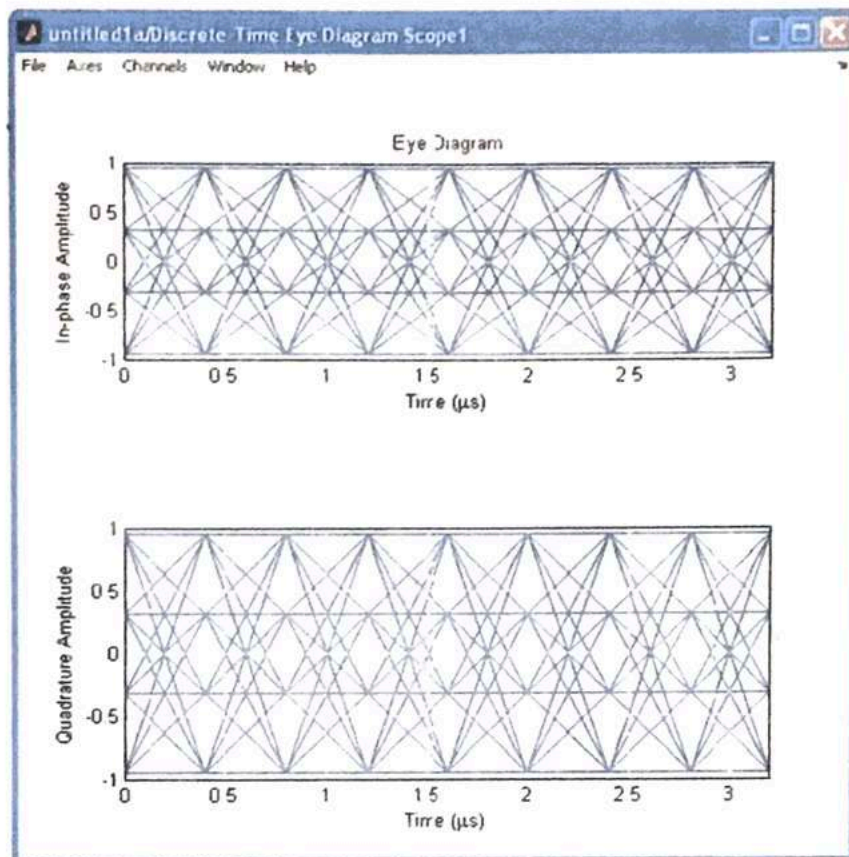


Figure 3.2 Eye diagram of the generated Baseband Signal

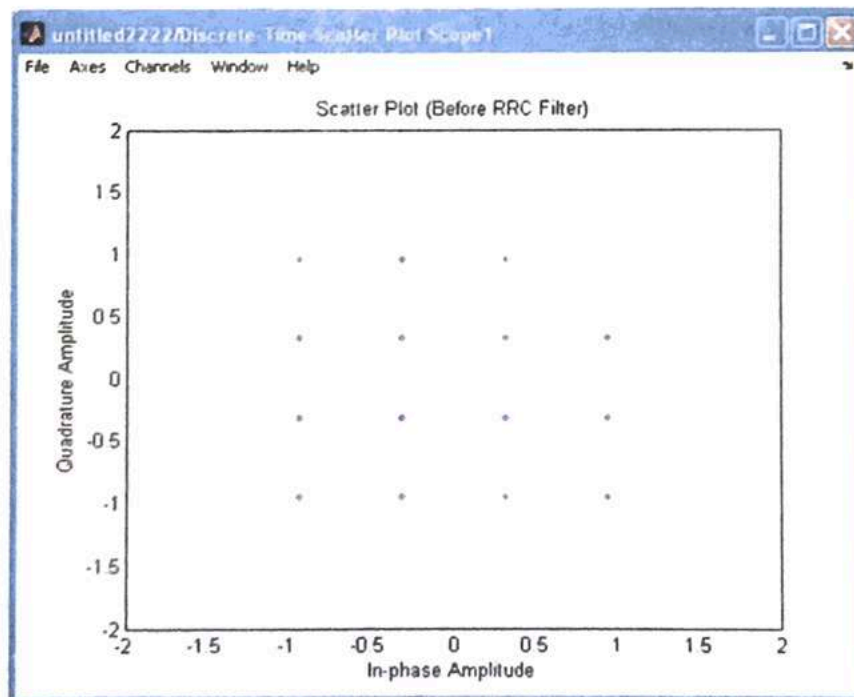


Figure 3.3 Constellation diagram of the generated Baseband Signal

### 3.3 Interpolation (Up-Sampling)

Generally, it is useful to modify the effective variety speed of an existing sampled signal. A sample rate of a signal is increased by interpolation. Conceptually, interpolation comprises the generation of a continuous curve passing through old samples, followed by sampling the curve at the new sample rate to obtain the interpolation sequence. To increase a given sample rate or up-sample, a factor of  $M$ ,  $M-1$  intermediate values between each samples in the old signal, has to be calculated. The interpolation increases the sampling frequency ( $F_s$ ) to:

$$f_s = f_{new} = M f_{old} \quad (3.1)$$

For the proposed system, the 16-QAM baseband signal is up-sampled by a factor of 16 to produce a new sample rate of 40 M symbol/s. The interpolation process produces inherent amplitude loss factor of  $M$ . This loss factor is compensated by adding gain stage in the system to achieve unity gain between the old and the new sequences.

### 3.3 Pulse Shaping (Root Raised Cosine Filter)

The core of any wireless communication system is the use of transmitter and receiver pulse shaping filters. The requirements of Root Raised Cosine filter (RRC) is shown in Table 3,2 .

Table 3.2 Design Requirement of Root raised cosine Filter

Centre frequency $f_{centre}$	2.5 MHz
Sampling rate	40 MHz
Stop-band attenuation	-40 dB
Roll-off factor $\beta$	0.35
Phase Response	Linear
Stability status	Stable

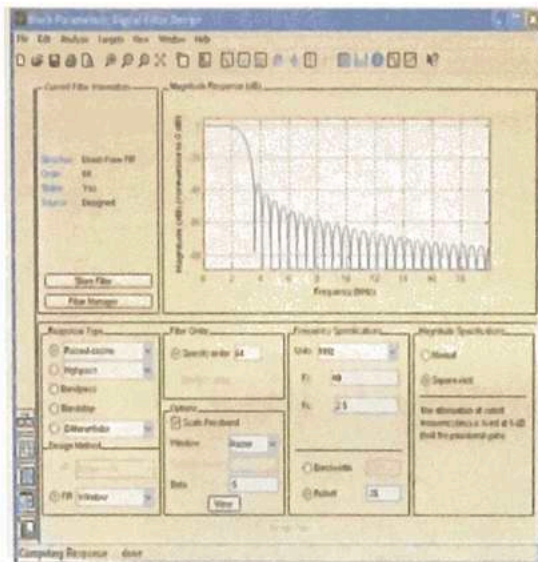


In order to achieve these requirements, a FIR filter using Kaiser Window is chosen to design the filter. There are three significant frequency points associated with the raised cosine response. The first is known as the (1) Nyquist frequency, which is equal to the centre frequency. The second significant frequency point is the (2) stop band frequency ( $f_{stop}$ ), defined as the frequency at which the response first reaches zero magnitude. The third, and the final significant frequency point is the (3) pass band frequency ( $f_{pass}$ ) defined as the frequency at which the response first begins to depart from its peak magnitude.

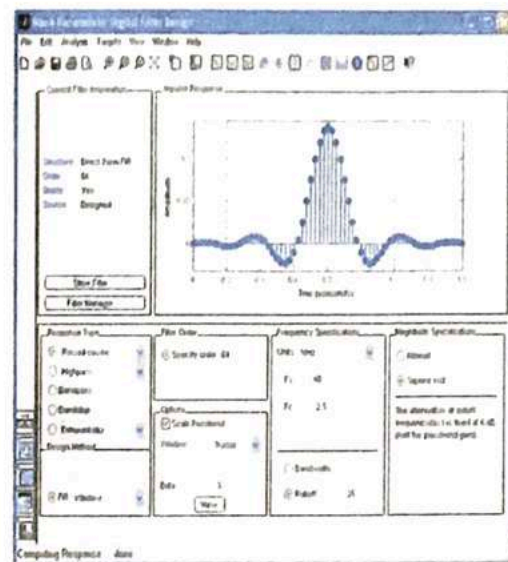
$$f_{stop} = (1 + \beta)f_{center} = (1 + 0.35) \times 2.5MHz = 3.375MHz \quad (3.2)$$

$$f_{pass} = (1 - \beta)f_{center} = (1 - 0.35) \times 2.5MHz = 1.625MHz \quad (3.3)$$

The magnitude and impulse responses of RRC filter are shown in Figure 3.4. The characteristics of the filter indicate that the filter is non-distorting.



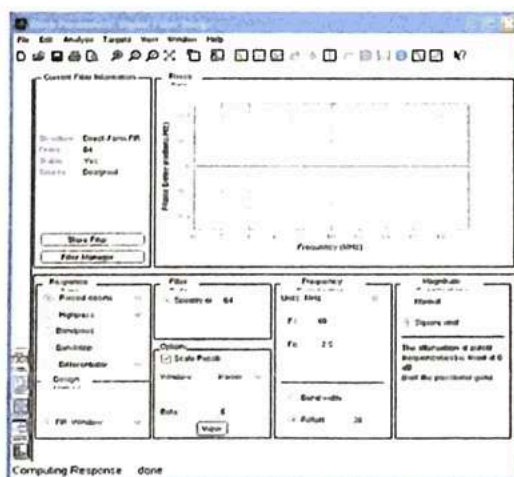
(a)



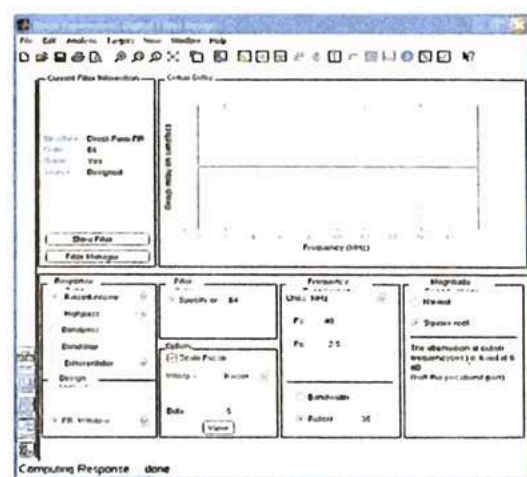
(b)

Figure 3.4 (a): Magnitude response RRC filter, (b): Root Raised Cosine Filter impulse response

The phase response is linear within the bandwidth of interest and the group delay is constant within the bandwidth as shown in Figure 3.5. Linear phase refers to the condition where the phase response of the filter is linear (straight line) function of the frequencies. This results in the delay though the filter being the same at all frequencies. Therefore, the filter does not cause phase distortion or delay distortion.



(a)



(b)

Figure 3.5 (a): Root Raised Cosine Filter phase delay, (b): Group delay response



The original spectrum of the baseband signal is processed under the 20dB AWGN channels as shown in Figure 3.6. The power of the baseband magnitude signal is 2.5dB.

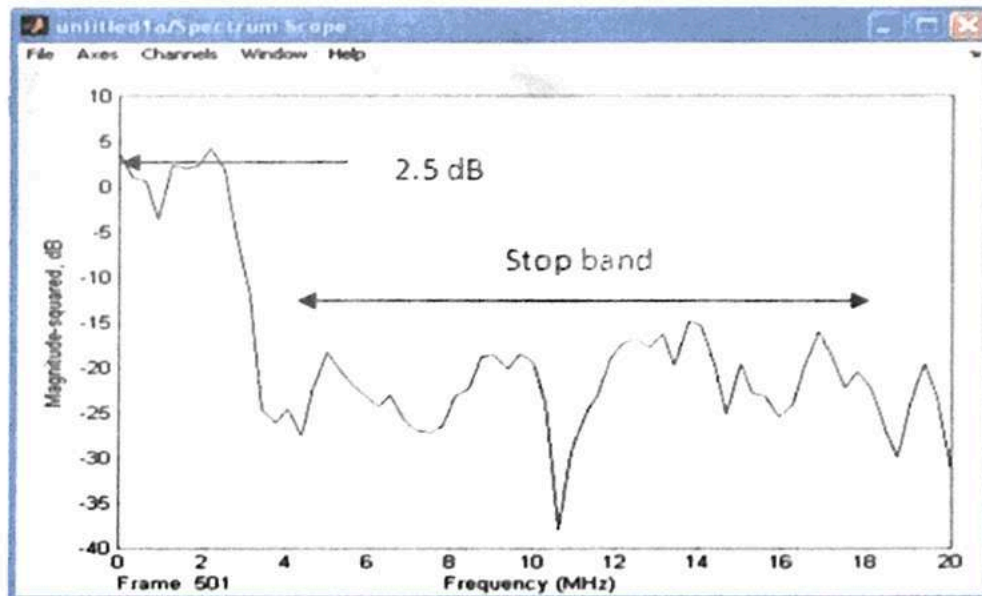


Figure 3.6 Original Baseband Signal

### 3.5 Receiver Design

After the signal is tainted by noise, its down converted to IF in the receiver path. The receiver link accepts data streams from AWGN channel which are processed under the 20-dB SNR. The IF received signal is pulse shaped when using RRC filter with sample rate of 40MHz, and the received signal is decimated by a factor of 16. The decimation process produces an inherent amplitude loss from the received signal, and this loss is compensated by adding gain stage in the system to achieve unity gain between new and old sequence. The filtered and fine-gained signals are down-sampled to become symbol-pairs before demodulation. The eye and constellation diagram of received signal is shown in Figure 3.7.

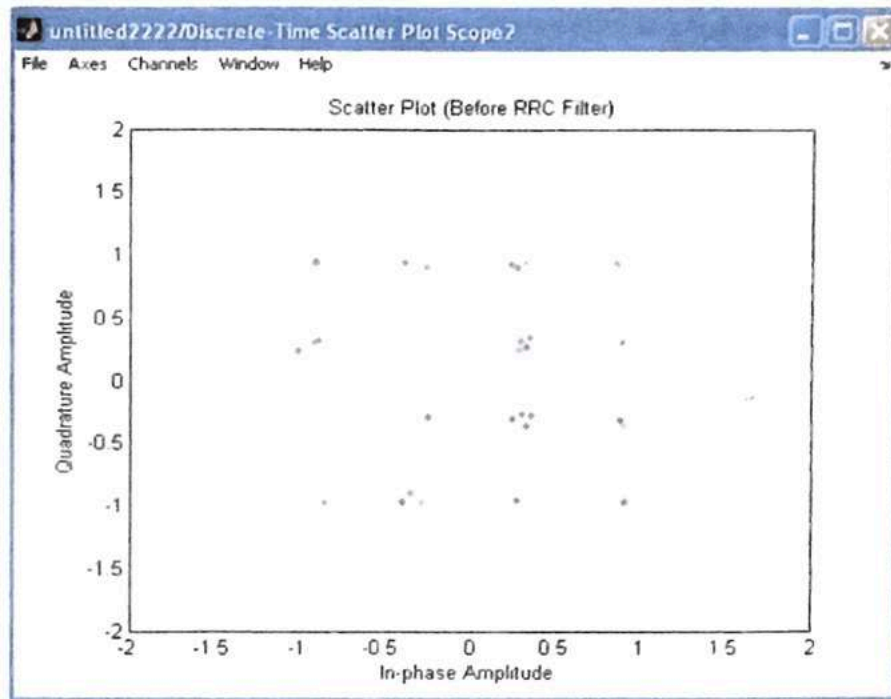


Figure 3.7 Constellation diagram of 16QAM Received signal with 20 dB

If one makes a look at the received signal, the signal is affected by noise effect with SNR of 20 dB. When the SNR increased to 30 dB, the noise margin start to close out and the error is decreased in eye diagram. Since, the SNR decrease to 10 dB, the eye diagram has more distortion in the system. The eye and constellation diagrams of the receiver signal when SNR = 30 dB. The eye diagram reveals less distortion given that the eye opening is more defined. The correct eye results and less bit error and hence, less transmission error. Comparison between Figure 3.8 demonstrates clearly that the cause of the difference is the increase of SNR in the channel.

The input and output waveforms of the transmitter and receiver model. The received IQ signals are filtered and fine-gained to convert them into refined IQ

signals. Subsequently, the signals are synchronized and down-sampled by a factor of 16 to become baseband IQ symbols (2.5mega-baud). After demodulation, the recovered 4-bit integers (2.5mega-baud) are compared with the transmitter input to confirm all system functions. The difference between the original message 4-bit integer and receiver output 4-bit integer is zero.

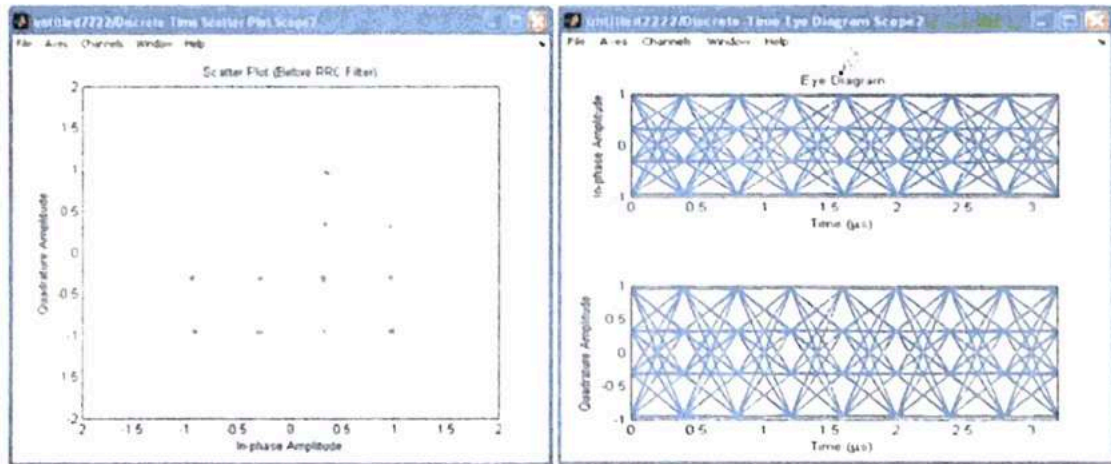


Figure 3.8 Eye and Constellation diagram of the received signal at 30 dB

### 3.6 Filter Simulation Based GSM Transceiver

The performance of proposed filter has been verified in GSM receiver, which is processed under 20 dB AWGN. A simple 16-QAM GSM transmitter and receiver model is designed in MATLAB/SIMULINK environment as shown in Figure 3.9.

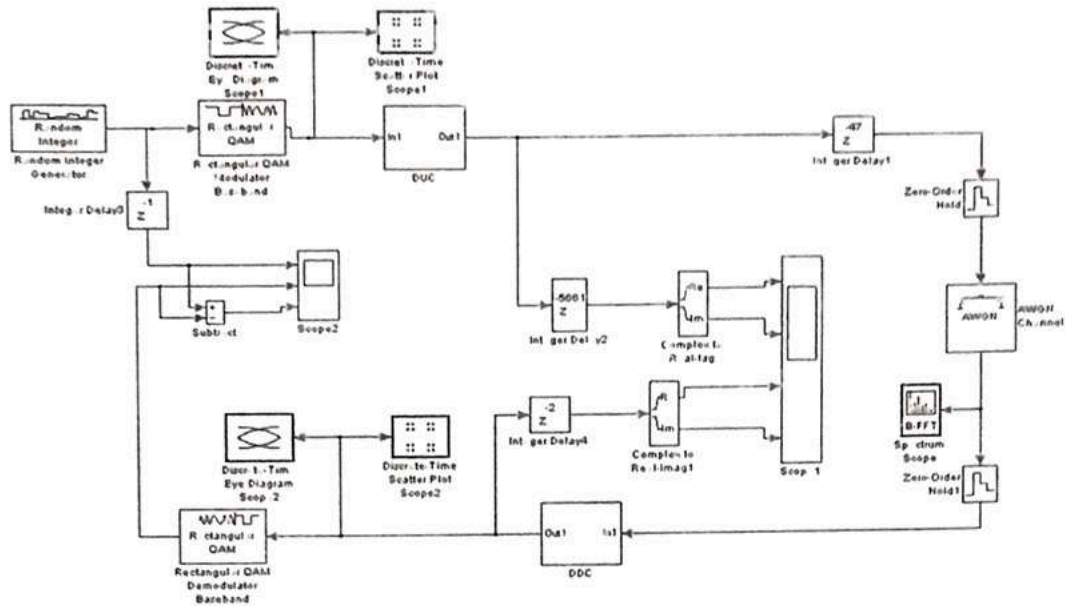


Figure 3.9 GSM transceiver

The 16QAM signal of 2.166 Mega-baud is up-converted by FIR filter consisting of CIC interpolation filter and two FIR filters to become an intermediate frequency of 69.333248MHz and subsequently transmitted under 20 dB AWGN which down-sampled the received signal to 270.332 KHz and subsequently demodulated via the 16-QAM demodulator.

The receiver link accepts the IQ data streams from the AWGN channel (5 dB SNR) and converts the received signal into baseband by the three-stage FIR filters. The filtered and fine-gained IQ signals are down-sampled to transform them into IQ symbol pairs before demodulation. The received IQ signals (at 69.333 Msps sample rate) are filtered and fine-gained to convert them into refined IQ signal. Subsequently, the refined IQ signals will be synchronized and down-sampled by 2 to baseband IQ symbols with 2.166 Mega-baud. The transmitted modulated IQ signals after the FIR and the pulse-shaped (refined) received IQ signals after the proposed



FIR filter. It can be seen that the proposed FIR filter can maintain the performance of removing channel noises with SNR above 5 Db as show in Figure 3.10

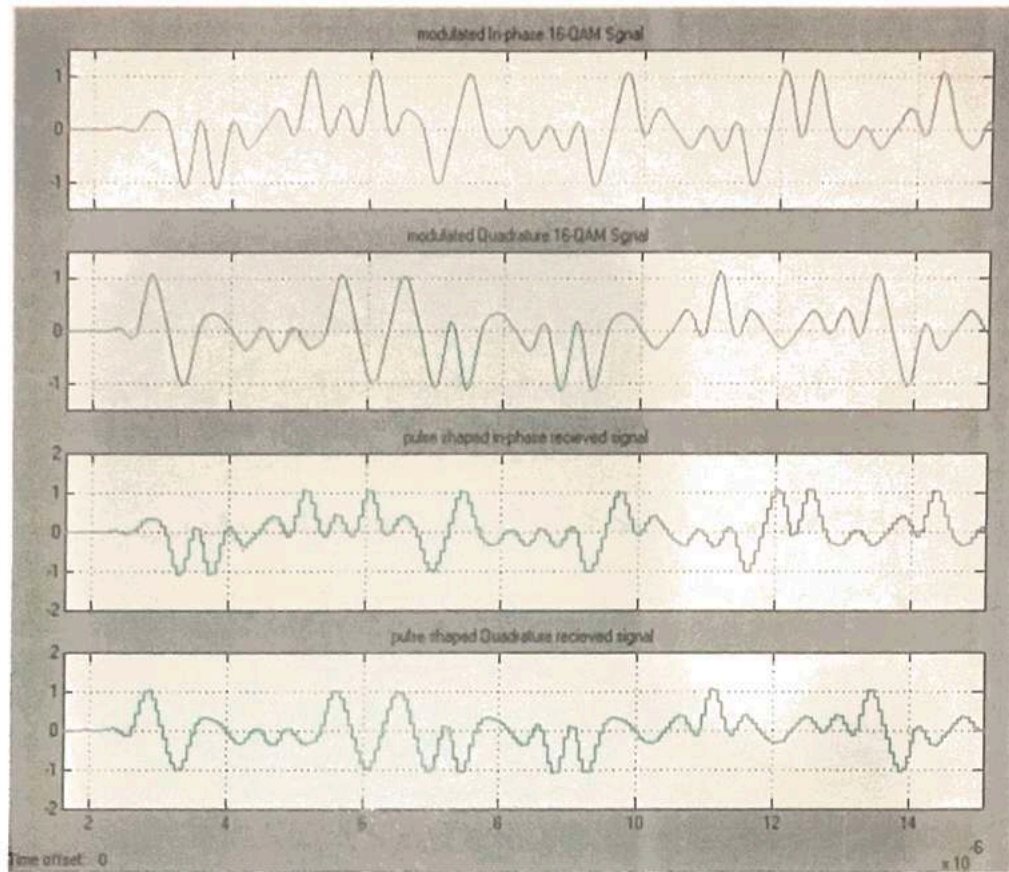


Figure 3.10 Transmitted and Refined Received (IQ) Signals at 69.333 MHz

The receiver input mixing signals and the filter responses at each consecutive stage of the FIR filter, starting from the stages of normalized gain Synchronization includes imposing group delay and latency at each stage, where 1 unit sample time =  $(69.333248 \times 10^6)^{-1} \text{ ns} = 14.423095 \text{ ns}$ .

The FIR response resembles either the upper or the lower envelope of the mixed signal. However, it is down-sampled by 256 because the envelope is extracted first by the filter with a decimation factor of 64 and normalization gain of  $2^{30}$ , subsequently by the FIR filter with a down sampler of 2, and finally by FIR with a down sampler of 2. However, the sample rate of the FIR filter response is 256 times lower than the sampling frequency of 69.333248 MHz.

## **CHAPTER 4**

### **RESULTS AND DISCUSSION**

#### **1.1 Introduction**

The results and discussion of design, simulation, and implementation of GSM system in the abstraction level (simulations using MATLAB SIMULINK are presented in this chapter.

#### **4.2 Simulation Results Using MATLAB-SIMULINK Block set**

The proposed GSM model is also designed and simulated in SIMULINK block set environments. The GSM signal is generated by chirp block set and filtered down from 69.333248 MHz to 270.833 kHz to cover the GSM mask. The signal is shaped and filtered according to GSM specifications and appears exactly the same as the original GSM signal.

#### **4.3 GSM Simulation Results**

The MATLAB SIMULINK block set has been used to design and simulate the GSM as a first step. The results have been analyzed and presented as eye and constellation diagrams of the modulated and demodulated signals. These diagrams show transmitted and received signal processing step as pulse shaped and the channel distortion effect in the system. The constellation diagram of the transmitted signal is shown in Figure 4.1. The constellation points in the receiver appear distorted around the centre point and become separated when the noise increases in the channel. However, they are clear and clouded around the centre point when the SNR is

increased. This means that the error increases with the increase of the noise in the channel. The noise effect in the receiver is shown in Figure 4.1 and Figure 4.2.

The accurate synchronization between the transmitter and receiver is optimized by means of timing recovery as explained. The synchronization between the transmitted 16-QAM and received 16-QAM represents the important problem for the original signal fineness. If the pseudo-noise arbitrary bit series is used, the most excellent option could be synchronization timing recovery. This technique is used to reduce the complication of synchronization. After an important tuning and increasing of SNR, the synchronizations check the maximum probability of the filtered signal to find the best sample time. The receiver output becomes similar to the transmitted signal as shown by the eye and constellation diagrams .

The input and output waveforms of the transmitter and receiver model. The received IQ signals are filtered and fine-gained to become refined IQ signals. Subsequently, the signals are synchronized and down-sampled by 16 to transform them into baseband IQ symbols (2.5 megabaud). After demodulation, the recovered 4-bit integers (2.5 megabaud) are compared with the transmitter input to confirm all system functions. The difference between the original message 4-bit integer and receiver output 4-bit integer is zero. These results show that the timing synchronization of the GSM model of the transmitter and receiver has satisfied the timing constraints of the model. Additionally, optimum synchronization has been achieved.



### 4.3 Transmitter Output Waveform

The real-time waveform characteristics of the transmitted signal are compared with simulation waveform characteristics such as pulse interval and lower/higher amplitude peak. The pulse interval of the real-time signal is 160 ns, and the pulse interval of simulated signal is also 160 ns. This indicates the absence of error difference between them and that the timing error is satisfied because of accurate timing adjustment. In contrast, errors of 4%–9.09% are found between the amplitude of real-time 16QAM (I/Q) signal and the amplitude of simulated signal because of hardware constraints related to wiring, chip, and printed circuit board (PCB). Nevertheless, these errors are acceptable.

## 5

### 4.6 Receiver Output Waveform

The real-time waveform characteristics of the receiver are compared with simulation waveform characteristics such as pulse interval (ns) and lower/higher amplitude peak. The pulse interval of the real-time signal is 100 ns and the pulse interval of the simulated signal is likewise 100 ns. This means that no error difference is found between them. The timing error is satisfied because of accurate timing adjustment, whereas errors of 5% are found between the amplitude of real-time signal and the amplitude of simulated signal because of hardware constraints related to wiring, chip, and PCB. However, the errors are acceptable. The real-time and simulated results for transmitted signal and receiver output in the time domain show equivalence in shape. It should be noted that the empirical (real-time) result is similar to the simulated result.

#### 4.4 Summary

The simulation and implementation results of the proposal GSM system is discussed and compared with conventional design in details in this chapter. The results proof that the validity of the proposed algorithms and the techniques used are promising to support the GSM requirements of wireless communication system due to finding in the power reduction of the FIR filter that will support the GSM transceiver to be more efficient in terms of SNR and dynamic range. The improvement of adjacent band rejection and blocker requirements could be support the GSM transceiver in terms of adaptation with multi standards and avoid the effect of spectral replicant that will generate from succeeding stages.

The simulation and implementation of GSM transceiver results shows the capability of the system to transmit and receive a signal of 40 MHz under channel noise of 20dB. The efficient synchronization between transmitters I/Q signals and receiver I/Q signals provide zero difference between original and recovered message using peak search technics at matched filter output.

## **CHAPTER 5**

### **CONCLUSION AND SUGGESTIONS FOR FUTURE WORKS**

#### **5.1 Conclusions**

In this project, the GSM model has been developed and improved to work with mobile system and 5G receivers. The techniques used are promising, and also develops the sample conversion of GSM and new generation of wireless communication system.

In this research, GSM system is present. Additionally, Finite Impulse Response Filter at 100kHz and 108kHz, to provide the GSM system requirements by means of pass-band ripple and adjacent band rejection. The observations of computation, simulation and implementation of the designs FIR filter states that the filter is practical and efficient. Efficient FIR filter has been developed to improve the performance GSM receivers to avoid the interference in the received signal by minimizing the deviation in a decimation block is introduced. The development enhances the GSM transceiver in terms of SNR and dynamic range.

#### **5.2 Suggestions for Future Works:**

As the FIR and GSM model has been designed and studied in this project, the following recommendations are suggested for future works in this field.

1. The design of FIR filter could be further tuned to provide a smaller transition width at the expense of larger peak to peak pass-band ripple and/or lesser adjacent band rejection.

2. The GSM system in this thesis, is not fully complete. Only the IF and baseband stage of the wireless communication system has been implemented. Therefore, further research could focus on an end-to-end implementation of a wireless communication system in software defined radio.
3. The channel is considered to have only additive white Gaussian noise. Doppler shift, phase error, multipath fading, etc., can be added to the channel, in order to closely simulate real life systems.



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## تصميم ومحاكاة جهاز الإرسال والاستقبال للهاتف المحمول تحت تأثير الضوضاء

### الملخص

الهدف الرئيسي من هذا البحث هو تصميم ومحاكاة جهاز الإرسال والاستقبال المتنقل GSM تحت تأثير الضوضاء. تم تصميم قسم النطاق الأساسي لجهاز الإرسال والاستقبال لجهاز الإرسال والاستقبال GSM وتشغيله تحت ضوضاء القناة للتحقق من أداء المستقبل في النظام المتنقل تحت ضوضاء القناة. يتم تحليل إشارات الإدخال والإخراج وتقييمها على أساس المحاكاة باستخدام SIMULINK في برنامج MATLAB. تظهر نتائج المحاكاة أن النموذج المقترح يوفر أداءً هاماً للتطوير الفعال لجهاز الإرسال والاستقبال ضد ضوضاء القناة. تؤكد هذه النتائج صحة الخوارزميات المقترحة والتقنيات المستخدمة واعدة لدعم متطلبات الأجهزة المحمولة لنظام الاتصالات اللاسلكية للجيل الخامس.





وزارة التعليم العالي والبحث العلمي

كلية دجلة الجامعة

DIJLAH UNIVERSITY COLLEGE



## تصميم ومحاكاة جهاز الإرسال والاستقبال للهاتف المحمول تحت تأثير الضوضاء

بحث مقدم إلى كلية دجلة الجامعة – قسم هندسة تقنيات الحاسوب

كجزء من متطلبات منح درجة بكالوريوس هندسة في تقنيات الحاسوب

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**Dijlah University**  
Think Beyond



**Computer Techs. Eng. Dept.**

## **Design and Analyze Comparative Protocols for Internal and External Network Connectivity**

**A Project Submitted to the Department of Computer Techniques  
Engineering**

**Dijlah University College**

**In partial Fulfillment of the Requirement for the  
Degree of B. Eng.**

**In  
Computer Techniques.**

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**1442**

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I certify that this Project entitled (**Design and Analyze Comparative Protocols for Internal and External Network Connectivity**) was prepared under my supervision at the Department of Computer Techniques Engineering, Dijlah University College - Baghdad, in partial fulfillment of the requirements for the degree of B. Eng. in Computer Techniques.

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# Abstract

In computer network, routers are used for the purpose of moving the data or packets in a network. The working of router is controlled by using routing protocols which are mainly divided into two types: interior gateway routing protocols and exterior gateway routing protocols. Routing is a vital part of a communication network that enables data transmission over a local and wide area networks. Each routing protocol has different features, performance, architecture, and algorithms to achieve the data communication and reliability. The data is moved around different network topologies and handled by different protocols within and outside different Autonomous Systems (AS). A reliable, secure and scalable communication platform relies on a correct combination of protocols. In this project the design and the environment chosen to implement two project, the first consist of three scenarios for configure the Interior Gateway Protocols (IGP) which is (Routing Information Protocol (RIP), Enhanced Interior Gateway Routing Protocol (EIGRP) and Open Shortest Path First (OSPF)) and the finally for configure the Exterior Gateway Protocols (EGP) which is Boarder Gateway Protocol (BGP). Simulation results shows Route redistribution provide important role to redistributed one route to another network. OSPF is better than other in large networks where its hierarchical nature increases scalability. And RIPv2 is useful in local and small area network. BGP routing protocol is the best choice to use over the Internet. BGP table can carry huge number of updates and routes, its scalability is a wide to carry the full Internet routing table. As BGP is designed to route between different AS routing protocols.

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# Chapter One

## Introduction

### 1.1 Background

Communication is a method of sharing information to each other. Thousand years back, sharing information was very complicated. In early life of mankind man and women used body language and speech for talk to each other, but inventions made it easy for the people to communicate with each other very easily. In a petite time, mankind developed a rules and languages to communicate with each other. Combination of these rules and languages are called protocols. Now a day's telephone, internet, is use to communicate with each other. Inventions became very essential that life without them is stiff. Today the communication between computers has increased and it is poignant the heights of sky. Users sitting in one place of word can communicate to other place of the word by using a variety of communication channels [1].

In today's era, communication technologies growing rapidly to accommodate the increasing demand of high-speed applications and networks. Therefore, technological inventors are expected to design and develop efficient solutions and applications to support the end user high speed network requirements. The Network is a combination of multiple connected hosts over cables or via wireless media to exchange information or data.

The Open Systems Interconnection (OSI) reference model was created, to determine the compatibility of various connected devices for communication [2].

Routing is the process of selecting paths in a network. In packet switching networks, routing directs traffic forwarding of logically addressed packets through intermediate nodes from their source to their ultimate destination. Routing protocols are designed to select and determine the best path to each router in the network. Routers should learn the next hop to send the packets. Forwarding data should be efficient and effective.

Consequently, the routing decision of a protocol is very important for network performance [3].

Routing protocols are based on routing algorithms, which rely on various metrics to find the best path to transmit data across networks. Metrics include cost, bandwidth, maximum transmission unit (MTU), packet delay, and hop count. Routing protocols utilize a routing table to store the results of these metrics [2]. Based whether the routing is within an Autonomous System (AS) or between ASs, there are two types of routing protocols: Interior Gateway Protocols (IGP) and Exterior Gateway Protocol (EGP). RIP, EIGRP, and OSPF are three commonly used IGPs. A typical EGP is the Border Gateway Protocol (BGP) [3].



## 1.2 Literature Survey

Over the past two decades, a lot of research has been published on the comparative performances of IGPs. BGP is advisable when multi-homing to multiple ISP's or when trying to communicate with an alternate AS [4].

**Mirzahosseini, K., et al, in 2013 [5]** Concluded that OSPF has the best detection mechanism but is practically more suitable for limited networks because of the higher possibility for packets to drop from different areas while EIGRP is better suited for scalable networks.

**Waqas, A. in (2009) [6]** Suggests that EIGRP is more suitable for topologies with few routers while IS-IS is ideal for complex topologies because of its higher scalability feature.

**Sendra, S., et al. in (2010)[7]** Studied their implementation with varying sizes of topologies and suggested that EIGRP is better suited for networks with the critical delivery that cannot tolerate errors while OSPF is more suitable for networks with bandwidth constraints.

**S., Farhangi, et al, in (2012)[8]** Suggested that implementation of multiple IGPs within a single topology, so as to be able to use the best of all the protocols for higher throughput and lower bandwidth utilization, would be a more effective approach to gain higher throughput while minimizing bandwidth utilization.

**K. Varadhan, et al, in (1999) [9]** discussed the possibility of persistent route oscillations in BGP for varying complexities of topologies. Their research showed that the cause of this oscillation was not necessarily confined to the policy configuration of one AS alone, but more likely occurs due to the policies of several different AS. They also highlighted that these

anomalies can actually occur even without misconfigurations, which makes them difficult to detect and correct.

**H. Gobjuka, in (2003) [10]** Studied forwarding loops caused by BGP misconfigurations. His work agreed with the findings of [9] that forwarding loops in iBGP networks are inherently difficult to detect. He proposed a polynomial-time algorithm for clustering AS's and showed that the AS are configured using his method results in a forwarding-loop free network.

**Labovitz, C, et al in (2000)[11]** Proved that the routing system will converge to a stable path when service providers can set rankings and filters autonomously.

### **1.3 Aim of the Project**

1. Designing and comparison the simulation of networks containing different Interior Gateway Protocol IGP and one Exterior Gateway Protocol (EGP) routing protocols.
2. Configuration of all routing protocols implemented in the networks.

### **1.4 Project Organization**

Project strategy starts in chapter one with the introduction of different routing protocols and the most related work in this field. Chapter two describes the concepts of different routing protocols and its features. Routing protocols with this type of network are explained. Chapter three introduces the design of the proposed networks with different routing protocols of IGP and one protocol with EGP. Simulation results of the design and performance analysis are presented in chapter four. Finally, chapter five contains the conclusions of this work and some suggestions for future work.

# **Chapter Two**

## **Routing Protocols in Networks**

### **2.1 Routing Protocols:**

The primary purpose of routing protocols is to deliver packets from source to destination. To quickly adapt changes which occur in network the routing protocol uses various algorithm, process and message [12].

### **2.2 Types of Routing:**

#### **1. Static routing: -**

In static routing network is fixed. Because fixed routing provides quick and reliable services and it does not work with complex algorithm and mechanism. Static routers are manually configured by network administrators. No extra node can be added or deleted after creating such network. It is basically used for building small network where the requirement of routes is less [12].

#### **2. Dynamic routing: -**

Dynamic routing protocols play an important role in today's networks. They are used to facilitate the exchange of routing information between routers. They dynamically share information between routers, automatically update routing table when topology changes, and determine the best path to a destination. Compared to static routing, dynamic routing protocols have better scalability and adaptability and require less administrative overhead. Dynamic

routing protocols allow routers to dynamically advertise and learn routes, determine available routes and identify the most efficient routes to a destination. Dynamic routing protocols have the capability to maintain the network operation in case of a failure or when network configuration or topology change [13]. The most important features of Dynamic protocol If the router discovers any change in the condition or topology, then router broadcast this information to all other routers in network.

## **2.3 Classification of Routing Protocols**

**All routing protocols can be classified into the following:**

- Distance Vector or Link State Protocols
- Interior Gateway Protocols (IGP) or Exterior Gateway Protocols (EGP)
- Classful or Classless Protocols

### **❖ Distance Vector and Link State Protocols**

Distance vector routing protocols are protocols that use distance to work out the best routing path for packets within a network.

### **❖ Link State Routing Protocols**

Link state protocols take a different approach to finding the best routing path in that they share information with other routers in proximity. The route is calculated based on the speed of the path to the destination and the cost of resources.

### ❖ **Interior Gateway Protocols (IGPs)**

Routing protocols that exchange routing information with other routers within a single autonomous system (AS). An AS is defined as one network or a collection of networks under the control of one enterprise. The company AS is thus separate from the ISP AS. **Each of the following is classified as an IGP:**

- Open Shortest Path First (OSPF)
- Routing Information Protocol (RIP)
- Enhanced Interior Gateway Routing Protocol (EIGRP)

### ❖ **Exterior Gateway Protocols (EGPs)**

On the other hand, **EGPs** are routing protocols that are used to transfer routing information between routers in different autonomous systems. These protocols are more complex and BGP is the only EGP protocol that you're likely to encounter. However, it is important to note that there is an EGP protocol named EGP. **Examples of EGPs include:**

- Border Gateway Protocol (BGP)

### ❖ **Classful Routing Protocols**

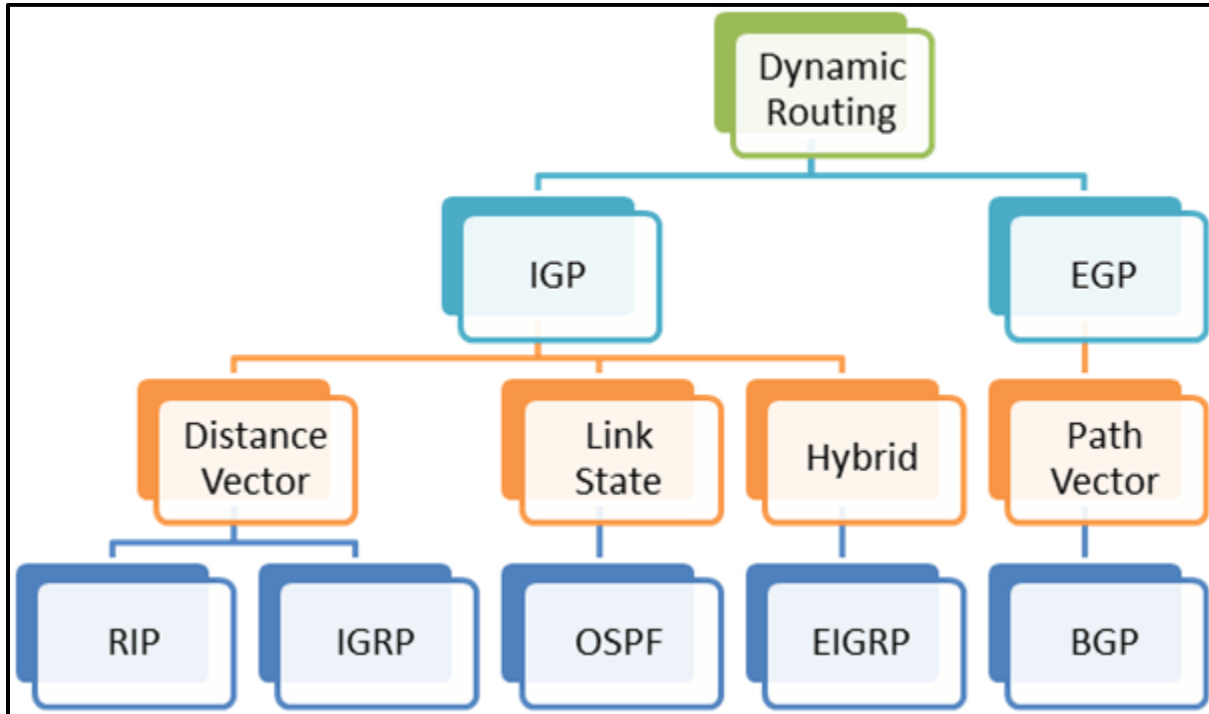
Classful routing protocols don't send subnet mask information during routing updates but classless routing protocols do. **RIPv1** and **IGRP** are considered to be classful protocols. These two are classful protocols because they don't include subnet mask information in their routing updates. Classful routing protocols have since become outdated by classless routing protocols.

## ❖ Classless Routing Protocols

As mentioned above, classful routing protocols have been replaced by classless routing protocols. Classless routing protocols **send IP subnet mask information during routing updates**. RIPv2, EIGRP, OSPF, and IS-IS are all types of class routing protocols that include subnet mask information within updates.

## 2.4 Types of Dynamic Routing Protocols:

Figure (2.1) showed how routing protocols can be classified according to various characteristics. This section gives an overview of the most common IP routing protocols.



**Figure (2.1)** Routing Protocol Classification

An **autonomous system (AS)** is a collection of routers under a common administration such as a company or an organization. An AS is also known as a routing domain. Typical examples of an AS are a company's internal network and an ISP's network. The Internet is based on the AS concept; therefore, two types of routing protocols are required:

- **IGP:** Used for routing within an AS. It is also referred to as intra-AS routing. Companies, organizations, and even service providers use an IGP on their internal networks. IGPs include RIP, EIGRP, OSPF, and IS-IS.
- **EGP:** Used for routing between autonomous systems. It is also referred to as inter-AS routing. Service providers and large companies may interconnect using an EGP. The Border Gateway Protocol (BGP) is the only currently viable EGP and is the official routing protocol used by the Internet.

#### **2.4.1 Routing Information Protocol (RIP)**

Routing Information Protocol (RIP) is a true distance-vector routing protocol. RIP sends the complete routing table out of all active interfaces every 30 seconds. It relies on hop count to determine the best way to a remote network, but it has a maximum allowable hop count of 15 by default, so a destination of 16 would be considered unreachable. RIP works okay in very small networks, but it's super inefficient on large networks with slow WAN links or on networks with a large number of routers installed and completely useless on networks that have links with variable bandwidths! RIP version 1 uses only classful routing, which means that all devices in the

network must use the same subnet mask. This is because RIP version 1 doesn't send updates with subnet mask information in tow. RIP version 2 provides something called prefix routing and does send subnet mask information with its route updates. This is called classless routing [15].

### **2.4.2 Open Shortest Path First (OSPF)**

Open Shortest Path First is an open standard routing protocol that's been implemented by a wide variety of network vendors, including Cisco. And it's that open standard characteristic that's the key to OSPF's flexibility and popularity.

Most people opt for OSPF, which works by using the Dijkstra algorithm to initially construct a shortest path tree and follows that by populating the routing table with the resulting best paths [15].

Here's a list that summarizes some of OSPF's best features:

- Allows for the creation of areas and autonomous systems
- Minimizes routing update traffic
- Is highly flexible, versatile, and scalable
- Supports VLSM/CIDR
- Offers an unlimited hop count
- Is open standard and supports multi-vendor deployment

Because OSPF is the first link-state routing protocol that most people run into, it's a good idea to size it up against more traditional distance-vector protocols like RIPv2 and RIPv1. Table 2.1 presents a nice comparison of all three of these common protocols.



OSPF has many features beyond the few listed in Table 2.1 and all of them combine to produce a fast, scalable, robust protocol that's also flexible enough to be actively deployed in a vast array of production networks. One of OSPF's most useful traits is that its design is intended to be hierarchical in use, meaning that it allows us to subdivide the larger internetwork into smaller internetworks called areas.

Here are three of the biggest reasons to implement OSPF in a way that makes full use of its intentional, hierarchical design:

- To decrease routing overhead
- To speed up convergence
- To confine network instability to single areas of the network.

Let's start by checking out Figure 2.3, which shows a very typical, yet simple OSPF design. Really want to point out the fact that some routers connect to the backbone—called area 0—the backbone area. OSPF absolutely must have an area 0, and all other areas should connect to it except for those connected via virtual links, which are beyond the scope of this book. A router that connects other areas to the backbone area within an AS is called an *area border router (ABR)*, and even these must have at least one of their interfaces connected to area 0.

Table (2.1) OSPF and RIP comparison [15]

Characteristic	OSPF	RIPv2	RIPv1
Type of protocol	Link state	Distance vector	Distance vector
Classless support	Yes	Yes	No
VLSM support	Yes	Yes	No
Auto-summarization	No	Yes	Yes
Manual summarization	Yes	Yes	No
Noncontiguous support	Yes	Yes	No
Route propagation	Multicast on change	Periodic multicast	Periodic broadcast
Path metric	Bandwidth	Hops	Hops
Hop count limit	None	15	15
Convergence	Fast	Slow	Slow
Peer authentication	Yes	Yes	No
Hierarchical network requirement	Yes (using areas)	No (flat only)	No (flat only)
Updates	Event triggered	Periodic	Periodic
Route computation	Dijkstra	Bellman-Ford	Bellman-Ford

OSPF runs great inside an autonomous system, but it can also connect multiple autonomous systems together. The router that connects these ASs is called an autonomous system boundary router (ASBR). Ideally, your aim is to create other areas of networks to help keep route updates to a minimum, especially in larger networks. Doing this also keeps problems from propagating throughout the network, affectively isolating them to a single area [15].

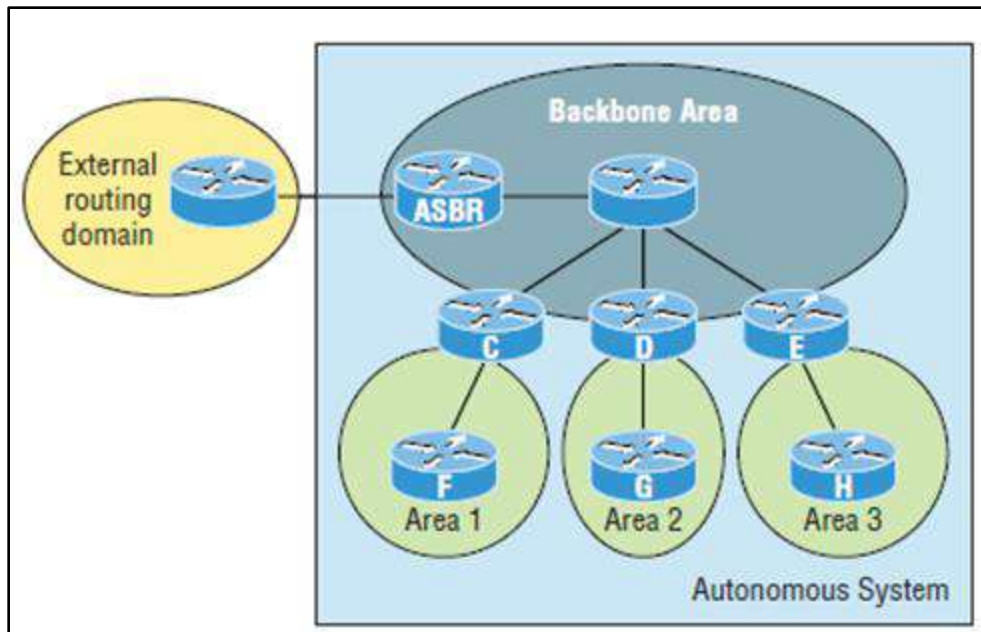


Figure (2.2) OSPF design example.

An OSPF hierarchical design minimizes routing table entries and keeps the impact of any topology changes contained within a specific area.

### 2.4.3 Enhanced Interior Gateway Routing Protocol (EIGRP)

EIGRP is a hybrid of the Link-State and the Distance-Vector routing protocol. EIGRP is a Cisco proprietary routing protocol. It is based on a new route calculation algorithm called the *Diffusing Update Algorithm* (DUAL). It has features of both distance vector and link state protocols. EIGRP metrics are based on reliability, MTU, delay, load, and bandwidth. Delay and bandwidth are the basic parameters for calculating metrics [17]. EIGRP collects data from three tables. The first is the neighbors' table, which stores data about neighboring routers that are directly accessible through interfaces that are connected. The second is the topology table, which contains the aggregation of the routing tables that are gathered from all neighbors that are directly connected.

It contains a list of destination networks in the EIGRP routed network and their respective metrics. The third routing table stores the actual routes to all destinations. EIGRP differs from most distance vector protocols because it does not rely on periodic route dumps. Hence, it is capable of maintaining its topology table. Information that is to be routed is only exchanged when the new neighbors' adjacencies is established. The EIGRP router maintains its own routing table and tables of its neighbors [18].

**Characteristic:**

- Advanced distance-vector algorithm.
- Full routing information only exchanged once upon neighbor establishment, after which only partial updates are sent.

#### **2.4.4 Border Gateway Protocol (BGP)**

Border Gateway Protocol (BGP) are the core routing protocol of the internet and responsible to maintain a table of Internet protocol networks which authorize network reaching capability between AS. The Border Gateway Protocol (BGP) expressed as path vector protocol. It doesn't employ conventional IGP metrics but making routing judgment based on path, network policies. It is created to replace the Exterior Gateway Protocol (EGP) routing protocol to permit completely decentralized routing in order to permit the removal of the NSF Net which consent to internet to turn into a truly decentralized system.

### Characteristic:

- Path Vector.
- Routes IP.
- Routing Advertisements: Partial When Route Changes Occur.
- Metrics: Weight, Local Preference, Local Originated, As Path, Origin Type.
- Hop Count: 255
- Variable Length Subnet Masks
- Keep alive Timer: 60 seconds
- Hold down Timer: 180 seconds

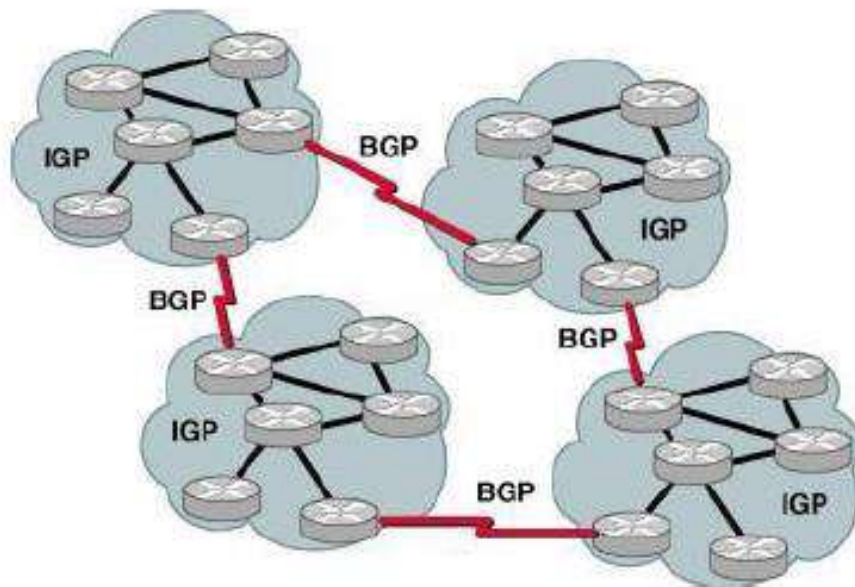


Figure (2.3) Border gateway protocol [12].

Table (2.2) Comparative study among RIPv1, RIPv2, OSPF, EIGRP, IGRP, BGP.

Features	RIPv1	RIPv2	OSPF	EIGRP	IGRP	BGP
Algorithms	Distance Vector.	Distance Vector.	Link state.	Both distance vector & link State.	Distance vector.	Best path Algorithm.
Metric	Hop count	Hop count	Cost, bandwidth	Delay, bandwidth, reliability, and load.	Delay, bandwidth, reliability, and load.	Hop count
Maximum no of hops	15	15	Autonomous system is Treated as single Subsystem.	Maximum 255	Maximum 255 (default 100)	255
Subsystem segmentation	Autonomous system is treated as single Subsystem.	Autonomous system is treated as single Subsystem.	Breaks the Autonomous system in areas.	System is not divided in Areas.	No segmentation of AS.	Partial When Route Changes Occur.
Integrity	No authentication In RIP-1.	Authentication is added to RIP-2	Supports authentication	Supports authentication	No authentication	Supports authentication
Complexity	Simple	Simple	Relatively complex	Highly complex	More complex than RIP	complex
Protocols/port	UDP 520	UDP 520	IP 89	IP 88	IP 9.	TCP 179
Convergence	Slow convergence	Slow convergence	Generally faster than RIP	Fast convergence	Slow convergence	Average

## 2.5 OPTIMIZATION OF ROUTE USING ROUTE REDISTRIBUTION

For simplicity and ease of management a single routing protocol is employed in an internetwork environment. Redistribution is the adaptation of a routing protocol to announce routes that are accomplished by some other means, for instance by another routing protocol, static routes, or directly connected routes. Running one routing protocol throughout your entire IP internetwork is desirable, multi-protocol routing is common for variety of reasons, such as company mergers, multiple departments managed by multiple network administrators and multi-vendor environments.

Redistribution is required for the environment of having multiple protocols. Through the router redistribution routes from one routing protocol will be revealed into another routing protocol. Received redistributed routes are marked as external in the routing protocol. Logically-originated routes are usually more preferred than external routes. Route redistribution can be one-way (that is, one protocol receives the routes from another) or two-way (that is, both protocols receive routes from each other). Routers that perform redistribution are called boundary routers.

# Chapter Three

## Designing and Configuration of Network with Different Routing Protocols

### 3.1 Introduction

This chapter describes the design and the environment chosen to implement Routing Protocols, the first consist of three scenarios for configure the Interior Gateway Protocols (IGP) which is (Routing Information Protocol (RIP), and Open Shortest Path First (OSPF)) and the Enhanced Interior Gateway Routing Protocol (EIGRP) then second the configure for Route Redistribution among RIP, EIGRP & OSPF Routing Protocols and finally configure the only protocol within Exterior Gateway Protocols (EGP) which is Boarder Gateway Protocol (BGP).

### 3.2 Simulation Tool

Simulation Tool defines a sequence of simulation and is used to specify input/output options, simulation duration, simulation attributes, runtime options such as parallel simulation, etc. Simulation is an important part of research not only for the study of communications networks, but for the study of any system which is costly to build (as a test bed) and restricted in terms of flexibility. Network simulators provide researchers with a virtual and reproducible environment where they can design, configure, run and analyze different kinds of networks without getting their hands dirty with real-life hardware [19].



### **3.3 Choice of Packet Tracer**

There are several software applications that can simulate designing and analyzing computer networks. These include Boson NetSim, Boson RouterSim both of which are commercial, the free Graphical Network Simulator (GNS3) and Wireshark, a free network protocol analyzer. However, Packet Tracer's growing popularity can be attributed to the fact that it is an open source freely available software; it is supported and maintained by the major vendor in networking hardware; it supports many core technologies and protocols required to build a small to complex network; it provides a visual connection between OSI model protocols of each network layer helpful in teaching; and it is lightweight in terms of not making excessive demands on the host PC's memory and CPU resources[23].

### 3.4 Design and Implementation of Network Topology

The first project that are designed consist of three scenarios for configuring Routing protocols which is Interior Gateway Protocols (IGP) and External Gateway Protocols (EGP)

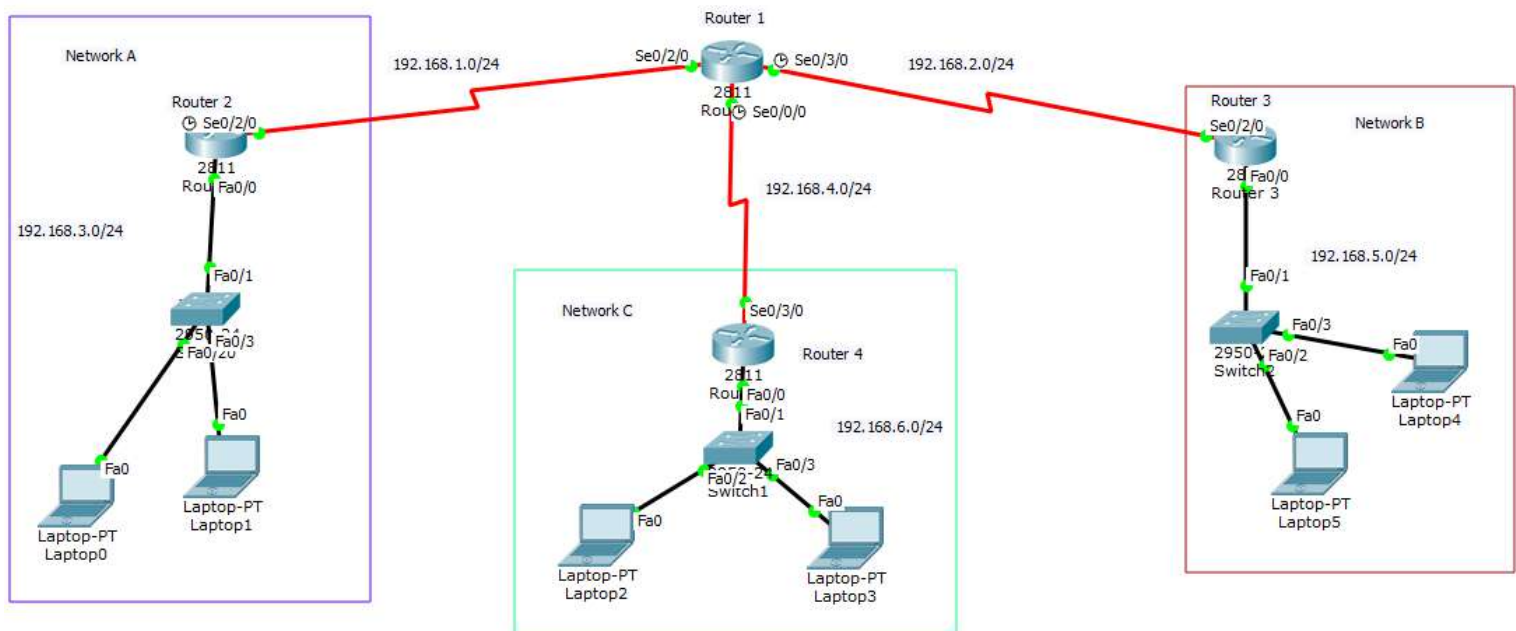


Figure (3.1) Network Topology.

#### 3.4.1 IP addressing

The network that are designed using cisco packet tracer consist of the following devices

1. Six end devices (host).
2. Three generic switches.
3. Four generic routes.
4. Six Networks

IP addressing is the very important and essential step in designing any network so in our design we have six networks and the designed ip address that are using is class C addressing. The network address is 192.168.4.0 and the subnet mask is 255.255.255.0 so the address is 192.168.4.1/24.

After finding the Sub netting of the whole network the IPs will be like as table (3.1)

Table (3.1) Subnetting of the Network

Devices	Interfaces	Ip Addresses	Subnet Mask	Network IP
Router 1	s0/0/0	192.168.4.1	255.255.255.0	192.168.4.0
	s0/2/0	192.168.1.1	255.255.255.0	192.168.1.0
	s0/3/0	192.168.2.1	255.255.255.0	192.168.2.0
Router 2	s0/2/0	192.168.1.2	255.255.255.0	192.168.1.0
	Fa0/0	192.168.3.1	255.255.255.0	192.168.3.0
Router 3	s0/2/0	192.168.2.2	255.255.255.0	192.168.2.2
	Fa0/0	192.168.5.1	255.255.255.0	192.168.5.0
Router 4	s0/3/0	192.168.4.2	255.255.255.0	192.168.4.0
	Fa0/0	192.168.6.1	255.255.255.0	192.168.6.0
Laptop 0	Fa0	192.168.3.3	255.255.255.0	192.168.3.1
Laptop 1	Fa0	192.168.3.2	255.255.255.0	192.168.3.1
Laptop 2	Fa0	192.168.6.2	255.255.255.0	192.168.6.1
Laptop 3	Fa0	192.168.6.3	255.255.255.0	192.168.6.1
Laptop 4	Fa0	192.168.5.3	255.255.255.0	192.168.5.1
Laptop 5	Fa0	192.168.5.2	255.255.255.0	192.168.5.1



### 3.4.3 Configuring the routers (RIP)

In this section we configure the routers with the following steps:

1. The first command that we configure in CLI is to rename the routers as the topology.
2. Configure each side of the serial by giving it an individual address  
Then run the first protocol (RIP) in all routers as shown in the figure

```
R1(config)#router rip
R1(config-router)#network 192.168.1.0
R1(config-router)#network 192.168.2.0
R1(config-router)#network 192.168.4.0
R1(config-router)#exit
R1(config)#
```

Figure (3.3) RIP configuration in R1

3. After that, apply the OSPF to all routers in the network, As shown in following figure the programming of OSPF in the first router in the design.

```
R1(config)#router ospf 100
R1(config-router)#network 192.168.1.0 0.0.0.255 area 0
R1(config-router)#network 192.168.2.0 0.0.0.255 area 0
R1(config-router)#network 192.168.4.0 0.0.0.255 area 0
R1(config-router)#exit
R1(config)#
```

Figure (3.4) OSPF configuration in R1.

4. The process is repeated by executing EIGRP protocol as shown in the following figures

```
R1(config)#router eigrp 100
R1(config-router)#netwo
R1(config-router)#network 192.168.1.0
R1(config-router)#network 192.168.2.0
R1(config-router)#network 192.168.4.0
R1(config-router)#exit
```

Figure (3.5) EIGRP configuration in R1.

### 3.4.4 Route Redistribution among RIP, EIGRP & OSPF Routing Protocols.

In order to redistribute routes from one routing protocol to another routing protocol, there must be at least one redistribution point (device). The redistribution device will run between routing protocols such as on Router1 and execute the following commands to configure RIP, OSPF and EIGRP routing that shown in the following figure.

```
R1#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#router rip
R1(config-router)#network 192.168.1.0
R1(config-router)#exit
R1(config)#router eigrp 100
R1(config-router)#network 192.168.2.0
R1(config-router)#exit
R1(config)#router ospf 100
R1(config-router)#network 192.168.4.0 0.0.0.255 area 0
R1(config-router)#exit
R1(config)#
```

Figure (3.6) configure RIP, OSPF and EIGRP routing in R1.

**A.** Redistributing in RIP is redistributed in OSPF and EIGRP using following commands:

```
R1(config)#router rip
R1(config-router)#redistribute eigrp 100 metric 1
R1(config-router)#redistribute ospf 100 metric 1
R1(config-router)#exit
R1(config)#
```

Figure (3.7) Route Redistribution of RIP in EIGRP & OSPF Networks.

**B.** Redistributing in EIGRP is redistributed in RIP and OSPF using following commands:

```
R1(config)#router eigrp 100
R1(config-router)#redistribute rip metric 1 1 1 1 1
R1(config-router)#redistribute ospf 100 metric 1 1 1 1 1
R1(config-router)#exit
R1(config)#
```

Figure (3.8) Route Redistribution of EIGRP in RIP & OSPF Networks.

C. Redistributing in OSPF is redistributed in RIP and EIGRP using following commands:

```

R1(config)#router ospf 100
R1(config-router)#redistribute rip subnets
R1(config-router)#redistribute eigrp 100 subnets
R1(config-router)#exit
R1(config)#

```

Figure (3.9) Route Redistribution of OSPF in RIP & EIGRP Networks

### 3.5 Design of Network with Boarder Gateway Protocol (BGP)

The network that are designed using cisco packet tracer are the same network in the previous and all the parameters of devices, cabling, and IP addressing except the configuration of the routers (BGP).

In BGP the networks will be divided into different autonomous system and the network will be look like in figure (3.10)

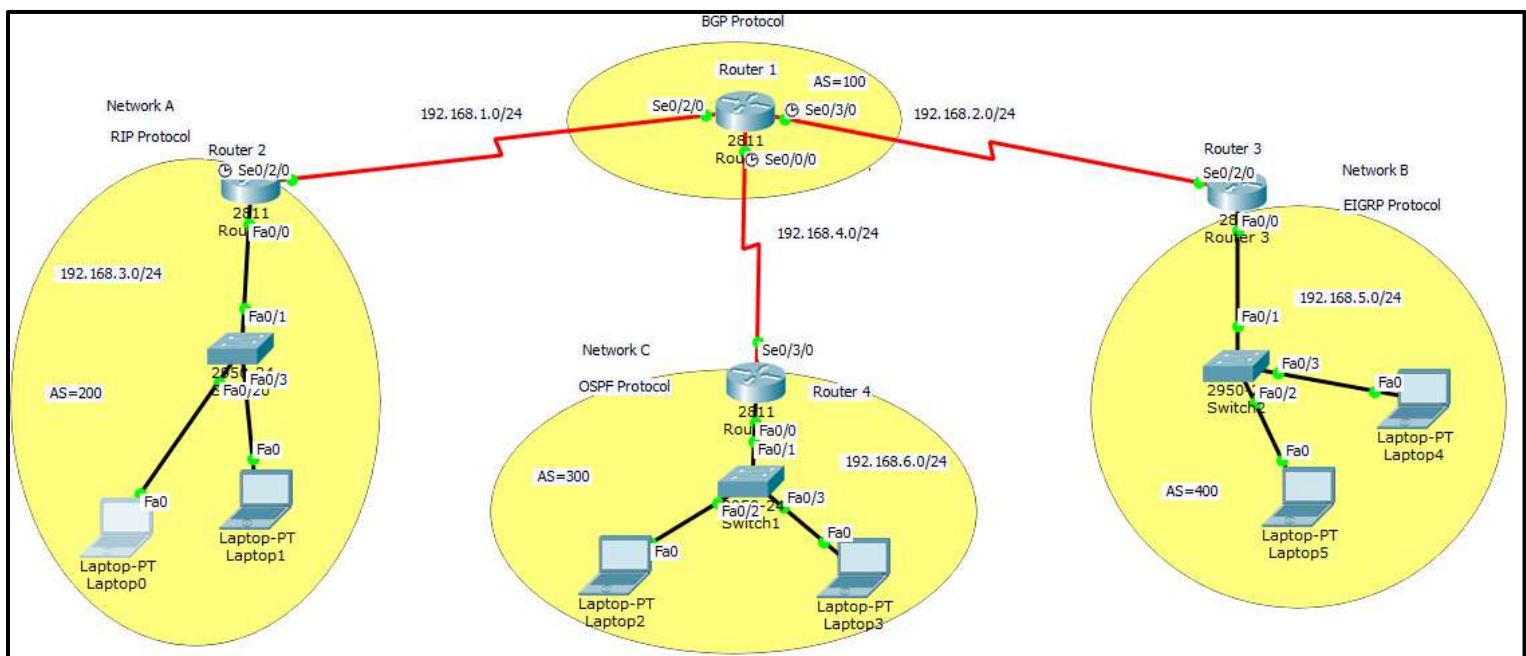


Figure (3.10) Designed network after configuration (BGP)

### 3.5.1 Configuring the BGP

Configuration of the BGP for Network routers as shown in the following figures for each router

```
R2>enable
R2#config t
R2#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#router bgp 200
R2(config-router)#network 192.168.3.0 mask 255.255.255.0
R2(config-router)#network 192.168.1.0 mask 255.255.255.0
R2(config-router)#nei
R2(config-router)#neighbor 192.168.1.1 rem
R2(config-router)#neighbor 192.168.1.1 remote-as 100
R2(config-router)#exit
R2(config)#%BGP-5-ADJCHANGE: neighbor 192.168.1.1 Up
```

Figure (3.11) configuration BGP in R2 with AS=200

Where two networks are defined within R2 (192.168.3.0 & 192.168.1.0) that are in AS= 200 in addition to the neighbor that is within a different AS=100.

```
R3(config)#router bgp 400
R3(config-router)#network 192.168.5.0 mask 255.255.255.0
R3(config-router)#network 192.168.2.0 mask 255.255.255.0
R3(config-router)#nei
R3(config-router)#neighbor 192.168.2.1 re
R3(config-router)#neighbor 192.168.2.1 remote-as 100
R3(config-router)#exit
R3(config)#%BGP-5-ADJCHANGE: neighbor 192.168.2.1 Up
```

Figure (3.12) configuration BGP in R3 with AS=400.

Where also two networks are defined within R3 (192.168.5.0 & 192.168.2.0) that are in AS= 400 in addition to the neighbor that is within a different AS=100.

```
R4(config)#router bgp 300
R4(config-router)#network 192.168.6.0 mask 255.255.255.0
R4(config-router)#network 192.168.4.0 mask 255.255.255.0
R4(config-router)#nei
R4(config-router)#neighbor 192.168.4.1 re
R4(config-router)#neighbor 192.168.4.1 remote-as 100
R4(config-router)#exit
R4(config)#%BGP-5-ADJCHANGE: neighbor 192.168.4.1 Up
```

Figure (3.13) configuration BGP in R4 with AS=300.



Where also two networks are defined within R4 (192.168.6.0 & 192.168.4.0) that are in AS= 300 in addition to the neighbor that is within a different AS=100.

```
R1>enable
R1#config t
R1(config)#router bgp 100
R1(config-router)#netw
R1(config-router)#network 192.168.1.0 mask 255.255.255.0
R1(config-router)#network 192.168.2.0 mask 255.255.255.0
R1(config-router)#network 192.168.4.0 mask 255.255.255.0
R1(config-router)#nei
R1(config-router)#neighbor 192.168.1.2 rem
R1(config-router)#neighbor 192.168.1.2 remote-as 200
R1(config-router)#%BGP-5-ADJCHANGE: neighbor 192.168.1.2 Up

R1(config-router)#neighbor 192.168.2.2 remote-as 400
R1(config-router)#%BGP-5-ADJCHANGE: neighbor 192.168.2.2 Up

R1(config-router)#neighbor 192.168.4.2 remote-as 300
R1(config-router)#%BGP-5-ADJCHANGE: neighbor 192.168.4.2 Up

R1(config-router)#exit
```

Figure (3.14) configuration BGP in R1 with AS=100.

Where here in R1 Three networks are defined (192.168.1.0, 192.168.2.0 & 192.168.4.0) that are in AS= 100 in addition to have three neighbors that are in different ASs=200, 400 and 300.

# Chapter Four

## Simulation Results

### 4.1 Network Model

In the network model network topology been design in the network simulator which basically consist of Router, Switch, cable and End Nodes. In this work three different Network models were design where configured these routing protocols one by one in order to observe how these routing protocols actually works. The network model which is used to evaluate the time to travel the packet from one end device (PC) to other end devices is shown below Figure.

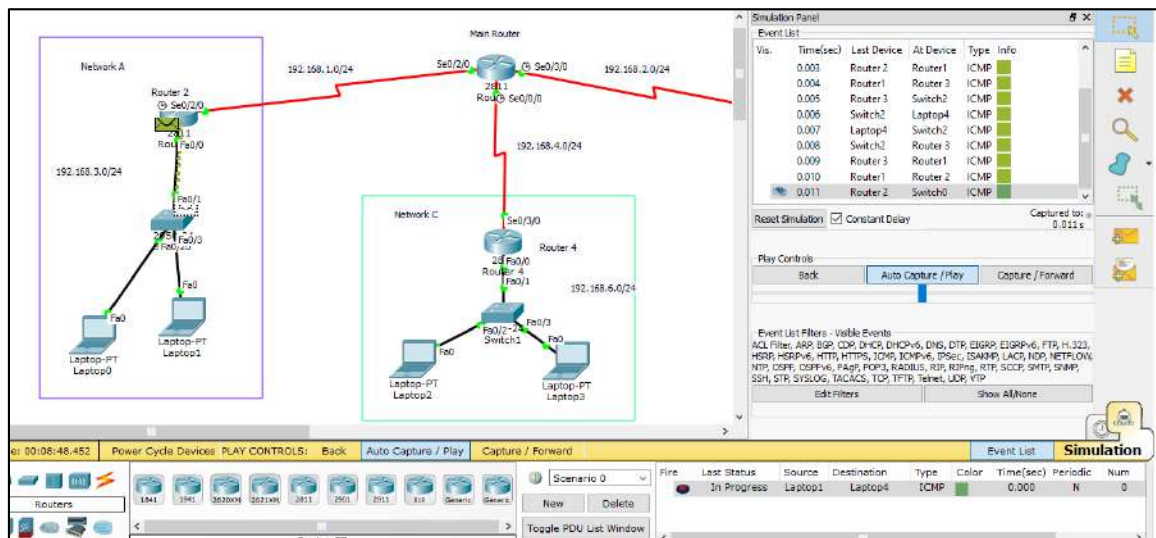


Figure (4.1) Network Model.

## 4.2 Data Collection

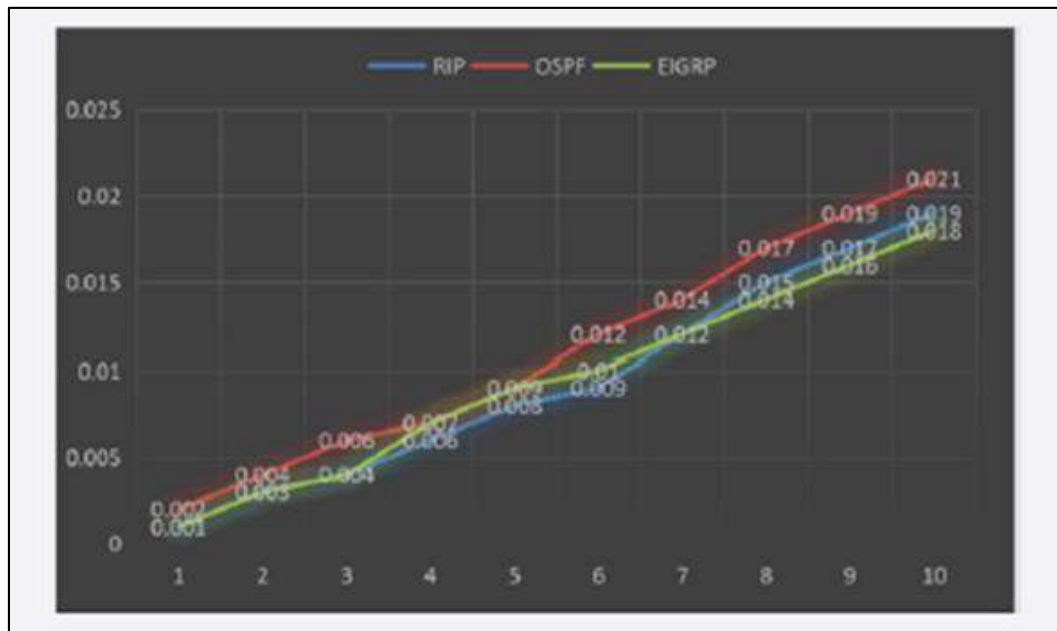


Figure (4.2) Comparison of three routing protocols with respect to time zone (from table 1,2, & 3) and the number of stations it travels while packet transfer.

The research was carried out using ping techniques: which is basically to check the connectivity to one node to other node connected in different routing protocols RIP, EIGRP, OSPF and network may be different so that packet can be send from source to destination.as shown in Figure 3 a network model been design for each routing protocols and calculate the time taken for the packet to send and receive to the destination node. These data were obtained while we run ping command from the traffic generator and run the simulation using Auto/Capture/Play button which show the time taken by the packet to travel from one station to other station and finally reaching to the destination. These data been noted down in Table 1-3 with their respective station which route the packet takes to reach the destination.

Table (4.1) Total time taken to travel from node to another while having RIP as routing protocol and ICMP as a reference message with no constant delay

Time(in sec)	Last Device	At Device	Type
0.001	PC 0	Switch 0	ICMP'
0.003	Switch 0	Router 1	ICMP'
0.004	Router 1	Router 2	ICMP'
0.006	Router 2	Switch 1	ICMP
0.008	Switch 1	PC 1	ICMP
0.009	PC 1	Switch 1	ICMP
0.012	Switch 1	Router 2	ICMP'
0.015	Router 2	Router 1	ICMP'
0.017	Router 1	Switch 0	ICMP'
0.019	Switch 0	PC 0	ICMP

Table (4.2) Total time taken to travel from node to another while having OSPF as routing protocol and ICMP as a reference message with no constant delay

Time(in sec)	Last Device	At Device	Type
0.002	PC 0	Switch 0	ICMP'
0.004	Switch 0	Router 1	ICMP'
0.006	Router 1	Router 2	ICMP
0.007	Router 2	Switch 1	ICMP'
0.009	Switch 1	PC1	ICMP
0.012	PC1	Switch 1	ICMP
0.014	Switch 1	Router 2	ICMP'
0.017	Router 2	Router 1	ICMP
0.019	Router 1	Switch 0	ICMP
0.021	Switch 0	PC 0	ICMP

Table (4.3) Total time taken to travel from node to another while having EIGRP as routing protocol and ICMP as a reference message with no constant delay

Time(in sec)	Last Device	At Device	Type
0.001	PC 0	Switch 0	ICMP
0.003	Switch 0	Router 1	ICMP
0.005	Router 1	Router 2	ICMP

### 4.3 Data Analysis

To measure and assess the impact of the traffic sent/received in the network, the simulator was run under Best effort and traffic generated through a ping method from PC0 to PC1 which show the connectivity and transfer of packet from one node to other and return the delivered message varying the simulation time with the observed parameters. Taking Figure (4.1) as a reference in ping method connectivity is checked from PC0 to PC4 from the network model which is done for each routing protocols and have different time simulation from sending and receiving packets done by the traffic generator and table is constructed from the simulation time as shown in Tables1-3. And from each table a graph is constructed as shown in Figure (4.2) and finally reveled how these routing protocols performs.

## 4.4 Optimization by Route Redistribution

### a) Redistributing In RIP

The RIP metric is composed of hop count, and the maximum valid metric for RIPv2 is 15. Metric of 2 is defined. It is necessary that the metric is neither too high, restraining it from being advertised to all the routers, or too low, guiding to routing loops when multiple redistribution points are presented.

```
R2#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.1.0/24 is directly connected, Serial0/2/0
R    192.168.2.0/24 [120/1] via 192.168.1.1, 00:00:06, Serial0/2/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
R    192.168.4.0/24 [120/1] via 192.168.1.1, 00:00:06, Serial0/2/0
R    192.168.5.0/24 [120/1] via 192.168.1.1, 00:00:06, Serial0/2/0
R2#
```

Figure (4.3) Route Redistribution of RIP in EIGRP & OSPF Networks.

The value [120/1] shows that RIP routes are successfully distributed in EIGRP & OSPF as AD of RIP is 120 and we have given metric 1.

### b) Redistributing In EIGRP

EIGRP is a hybrid routing protocol that, by default, uses a composite of bandwidth and delay as its distance metric in addition to reliability, load and MTU.

```

R3#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

D EX 192.168.1.0/24 [170/2560512000] via 192.168.2.1, 00:05:32, Serial0/2/0
C    192.168.2.0/24 is directly connected, Serial0/2/0
D EX 192.168.3.0/24 [170/2560512000] via 192.168.2.1, 00:05:32, Serial0/2/0
D EX 192.168.4.0/24 [170/2560512000] via 192.168.2.1, 00:05:32, Serial0/2/0
C    192.168.5.0/24 is directly connected, FastEthernet0/0
R3#

```

Figure (4.4) Route Redistribution of EIGRP in RIP & OSPF Networks.

AD of External EIGRP is 170. EX shows that external EIGRP routes are redistributed in RIP and OSPF networks.

### c) Redistributing In OSPF

Also, OSPF is a standardized Link-State routing protocol that uses cost, based on bandwidth, as its link-state metric. The OSPF metric is a cost value based on  $108 / \text{bandwidth of the link in bits/sec}$ . If a metric is not specified, OSPF puts a default value of 20 when redistributing routes from all protocols.

## 4.5 BGP is Just Like GPS for Packets

Let's draw an analogy from everyday life to make all of this a bit more understandable. You can think of an autonomous system in the computer world as a city with many streets. A network prefix is similar to one street with many houses. An IP address is like an address for a particular house in the real world, while a packet is the equivalent of a car travelling from one house to another using the best possible route.

Taking this comparison to its logical conclusion, the BGP routing protocol is analogous to your trusty GPS navigator. Like Google's Waze application, the best route is determined by different factors, such as traffic congestion, roads temporarily closed for maintenance, etc. The path is calculated dynamically depending on the situation of the network nodes, which are like roads and junctions on a GPS map.

Where the following figure shows the paths or best paths between each device in the design network after programming and activating the BGP protocol on each router, where each router is located in a different city (Different ASs).



```

R2>enable
R2#ping 192.168.2.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.2.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/13/28 ms

R2#ping 192.168.4.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.4.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 3/22/34 ms

R2#ping 192.168.6.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.6.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/16/36 ms

R2#ping 192.168.5.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.5.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/8/32 ms

R2#ping 192.168.5.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.5.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/14/26 ms

R2#ping 192.168.6.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.6.3, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 2/20/39 ms

```

Figure (4.5) Ping in R2 to other nodes in different AS.

# Chapter Five

## Conclusions and Suggestions for Future Works

### 5.1 Conclusions

The following points are concluded from this work:

1. The generated table show the different time zone(second) in each station while traveling from one node to other node with the path it follows that is the name of device where packet take one station to check the destination address (Tables 1- 3).
2. Plot these generated time zone in a graph to show the comparison between three different routing protocols (RIP, EIGRP, OSPF). Which show EIGRP is comparatively faster while other two protocols but in some respect and small connection could lead to RIP faster.
3. Route redistribution provide important role to redistributed one route to another network. OSPF is better than other in large networks where its hierarchical nature increases scalability. And RIPv2 is useful in local and small area network.
4. BGP routing protocol is the best choice to use over the Internet. BGP table can carry huge number of updates and routes, its scalability is a wide to carry the full Internet routing table. As BGP is designed to route between AS as it is AS to AS routing protocol.

## **5.2 Suggestions for Future Work**

The recommendations to the researchers for future work have been listed below:

1. Researcher could include expand the research calculating all the routing protocols in IPV6 which is currently running in different organization.
2. Only conducted on PING traffic generator could extend on different sector like HTTP, TELNET.

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# الخلاصة

في شبكة الكمبيوتر ، يتم استخدام أجهزة التوجيه لغرض نقل البيانات أو الحزم في الشبكة. يتم التحكم في عمل جهاز التوجيه باستخدام بروتوكولات التوجيه التي تنقسم بشكل أساسي إلى نوعين: بروتوكولات توجيه البوابة الداخلية وبروتوكولات توجيه البوابة الخارجية. يعد التوجيه جزءًا حيويًا من شبكة الاتصال التي تتيح نقل البيانات عبر شبكات محلية وشبكات واسعة. يحتوي كل بروتوكول توجيه على ميزات وأداء وهندسة وخوارزميات مختلفة لتحقيق اتصال البيانات والموثوقية. يتم نقل البيانات حول بنى الشبكات المختلفة ومعالجتها بواسطة بروتوكولات مختلفة داخل وخارج الأنظمة المستقلة (AS) المختلفة. تعتمد منصة اتصالات موثوقة وأمنة وقابلة للتطوير على مجموعة صحيحة من البروتوكولات. في هذا المشروع ، تم اختيار التصميم والبيئة لتنفيذ مشروعين ، الأول يتكون من ثلاثة سيناريوهات لتكوين بروتوكولات البوابة الداخلية (IGP) وهي (بروتوكول معلومات التوجيه (RIP) ، وبروتوكول توجيه البوابة الداخلية المحسن (EIGRP) وفتح أقصر المسار الأول (OSPF) وأخيرًا لتكوين بروتوكولات البوابة الخارجية (EGP) وهو بروتوكول بوابة الحدود (BGP). تظهر نتائج المحاكاة أن إعادة توزيع المسار توفر دورًا مهمًا لإعادة توزيع أحد المسارات على شبكة أخرى. تعد OSPF أفضل من غيرها في الشبكات الكبيرة حيث تزيد طبيعتها الهرمية من قابلية التوسع. و RIPv2 مفيد في الشبكات المحلية والصغيرة. بروتوكول توجيه BGP هو أفضل خيار لاستخدامه عبر الإنترنت. يمكن أن يحمل جدول BGP عددًا كبيرًا من التحديثات والمسارات ، وقابلية التوسع الخاصة به واسعة لتحمل جدول توجيه الإنترنت الكامل. نظرًا لأن BGP مصمم للتوجيه بين بروتوكولات توجيه AS المختلفة.

وزارة التعليم العالي والبحث العلمي



**جامعة دجلة**  
فَكَّرَ لِمَا بَعْدَ



قسم هندسة تقنيات الحاسوب

## تصميم وتحليل مقارنة البروتوكولات لاتصال الشبكة الداخلية والخارجية

بحث مقدم الى كلية دجلة الجامعة – قسم هندسة تقنيات الحاسوب  
كجزء من متطلبات منح درجة بكالوريوس هندسة في تقنيات الحاسوب  
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# **Design and Implementation of Arduino artificial intelligence using iot**

A Project  
Submitted to dijlah University college  
in Partial Fulfillment  
of the Requirements for the Degree of Bachelors computer  
engineering techniques

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**Mohammad-taqi abd-alrahman**

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We would like to thanks all of our friends for all encouragement during our studying .

## ***certification***

I certify that the preparation of this final year project entitled "**Design and Implementation of artificial intelligence using lot**" was prepared by **(thu-alfiqar Mohammadrashid , Ayman abd-abd-alwahabsalih, Abd- alrahmanMohammadhashim , Mohammad-taqi abdulrahman)** under my supervision at dijlal University college in partial fulfillment of the requirements for the degree of Bachelor of engineering computer techniques.

Signature:

Name: lecture ola hussein

(Supervisor)

Data:            /            /2021

Signature:

Name: **Asst. prof. Dr. Majid salal**

**(Head of Department)**

Data:        /        /2021

# **ABSTRACT**

In this work a artificial intelligence prototype using iot is designed and implemented based on Arduino Uno an open-source microcontroller board based on the Microchip ATmega328P microcontroller. Data is received from the sensors and then sent to the Arduino after that the results well be shown on the lcd screen.

Usually these kind of devices have one or two sensors separated and the results can only be shown on the lcd of the device

But our simple circuit has ability to collect the data process it by the wifi board that we implemented to the device and transfer it via wifi to one or multiple devices such as phones or laptops.

By having this said we well no longer need to be close to the Project to see the results, we well receive it on gauges or as a notification into our own devices by programming the phone and the project on the same network.

As we mentioned this project has multiple sensors we have implemented 5 different sensorsto make it even better and having a flexibility of usage the sensors are analog, and digital, we will be explaining them separately after this abstract.

All sensors can be working on the same time and place with no problems or complications noticed.

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# Chapter one

## Introduction

### **1.1 Introduction:**

Any digital object that could be connected to a global network (in our case the Internet) will be connected.

When a device is connected to the network, the information it collects from the environment through sensors, can and will be shared.

The latest advancements in computation have allowed us focusing in the use of Artificial Intelligence, yet another computation paradigm, to find the patterns in data at increasingly higher speeds. IoT is part of a transformative vision of our digital world. One that will help us having a much better way to collect, process, and thus understand our world. At the same time, it opens thousands of new opportunities for building businesses and reinvent our digital economy, optimize our resources, and minimize the impact that humans may have on the environment.

### **1.2-Relevant fields where IoT can be applied:**

Connected factories: adding sensors to machines allows for predictive maintenance, what minimizes the downtime of machinery and reduces the possible economic impact emerging from machines breaking down

Vehicle monitoring: the optimization of freely moving vehicles within fleets and help reduce the consumption of fuel, what will not just cut down expenses, but also contribute to the reduction of emissions to CO<sub>2</sub> to the atmosphere

Control of buildings: activate and deactivate different resources in buildings depending on the level of use of each one of them. E.g. reduce power

consumption by controlling the usage of lights, optimise the charging of batteries to happen when the grid is less busy, etc

### **1.3 Home security system:**

The future of healthcare: always connected self-monitoring devices can help understanding diseases, and preventing emergencies. Crossing data between realms becomes a very powerful tool, e.g. comparing environmental data with personal profiles can be useful to inform allergic people about the increase of a certain type of pollen in the air

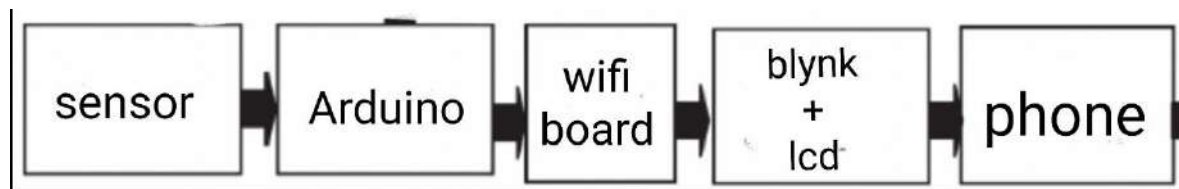


Fig : (1.1) system block diagram

### **1.4:- Aim of the work**

In this project a artificial intelligence prototype using iot is designed and implemented based on Arduino Uno an open-source microcontroller board based on the Microchip ATmega328P microcontroller. the system works First the sensor captures the data and then send it to the Arduino after that the Arduino will send the data to the Wi-Fi board the Wi-Fi board will collect the information and process it and Send to the blynk app and the LCD and from then the blynk app send it to the smart phone.

## **Chapter two**

# **Arduino artificial intelligence using Iot**

### **2.1 Introduction**

Internet of Things, in short IoT, is an upcoming technology that transforms the everyday objects into an ecosystem that would enrich our lives and make it simpler. IoT is the latest technology that can transform any electronic device into a smarter one. IoT uses the power of data and provides valuable insights to the users which can be used to improve operational efficiency and productivity.

From washing machines, ventilators, TV systems to vehicle garage, everything can be transformed into a smarter device with the help of IoT. IoT

technology is bringing a large number of day-to-day objects into the digital fold to make us live our lives smarter and efficient.

## **2.2 Blynk app designed for the Internet**

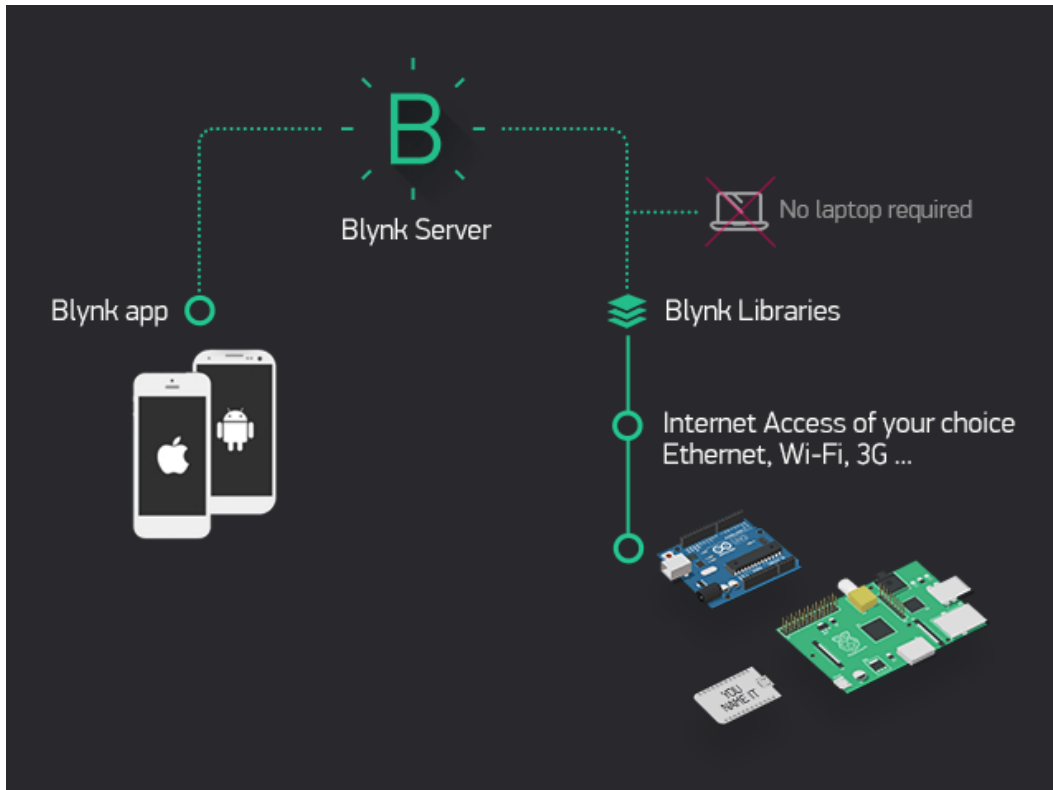
Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other things.

## **2.3 blynk components:**

There are three major components in the platform:

- ❖ Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.
- ❖ Server - responsible for all the communications between the smart phone and hardware.  
You can use theBlynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- ❖ Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and out coming commands.

Now imagine: every time you press a Button in the Blynk app, the message travels to space the Blynk Cloud, where it magically finds its way to your hardware. It works the same in the opposite direction and everything happens in a blynk of an eye.



---

Figure: 2.1 Blynk diagram

## **2.4 Features of blynk**

Similar API & UI for all supported hardware & devices

Connection to the cloud using:

- WiFi
- Bluetooth and BLE
- Ethernet
- USB (Serial)
- GSM
- Set of easy-to-use Widgets



- Direct pin manipulation with no code writing
- Easy to integrate and add new functionality using virtual pins
- History data monitoring via Super Chart widget
- Device-to-Device communication using Bridge Widget
- Sending emails, tweets, push notifications, etc

## **2.5 Blynk works over the Internet**

This means that the hardware you choose should be able to connect to the internet. Some of the boards, like Arduino Uno will need an Ethernet or Wi-Fi Shield to communicate, others are already Internet-enabled: like the ESP8266, Raspberri Pi with WiFi dongle, Particle Photon or SparkFunBlynk Board. But even if you don't have a shield, you can connect it over USB to your laptop or desktop (it's a bit more complicated for newbies, but we got you covered). What's cool, is that the list of hardware that works with Blynk is huge and will keep on growing.

### **2.5.1 Started With the Blynk App**

#### **1. Create a Blynk Account**

After you download the Blynk App, you'll need to create a New Blynk account. This account is separate from the accounts used for the Blynk Forums, in case you already have one.

We recommend using a real email address because it will simplify things later.

An account is needed to save your projects and have access to them from multiple devices from anywhere. It's also a security measure as showing in Fig 2.2

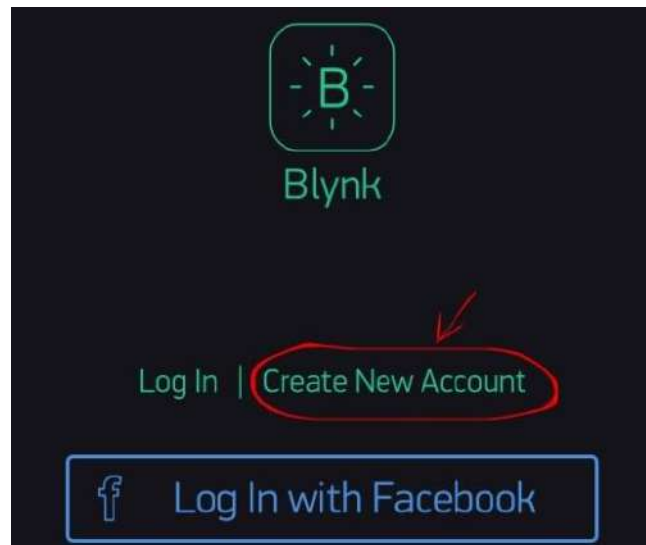


Figure : 2.2 account creation

---

## 2. Create a New Project

After you've successfully logged into your account, start by creating a new project as showing in Fig 2.3

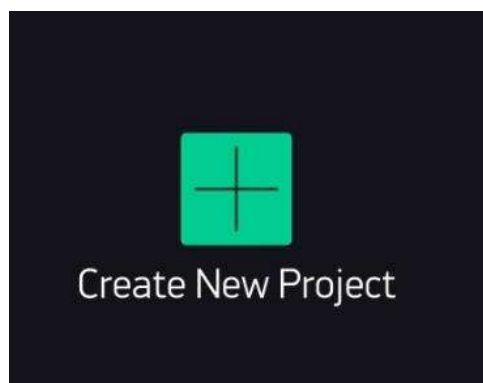


Figure : 2.3 project creation

## 3. Choose Your Hardware

Select the hardware model you will use. Check out the list of supported hardware as showing in Fig 2.4

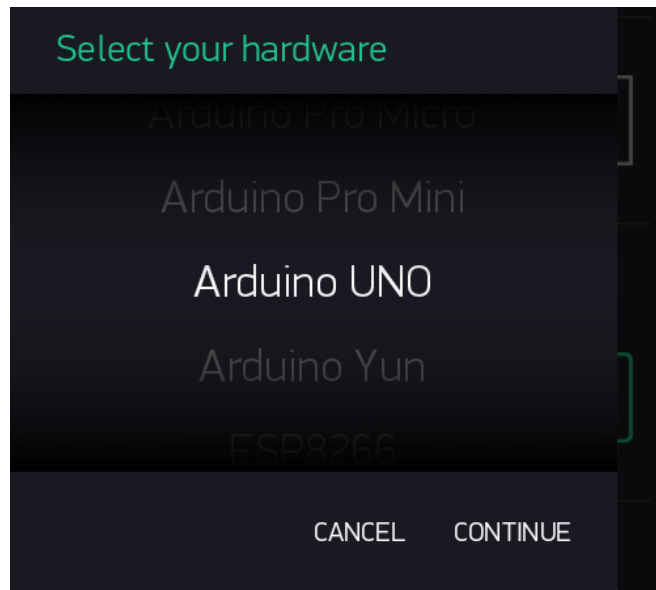


Figure :2.4 hardware selection

Now press the “Create” button As showing in Fig 2.5

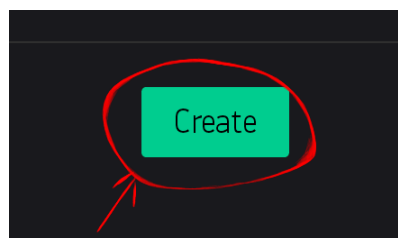


Figure : 2.5 create

## 5. Add a Widget

Your project canvas is empty, let's add a button to control our LED.

Tap anywhere on the canvas to open the widget box. All the available widgets are located here. Now pick a button. Widget Box As showing in Fig 2.6

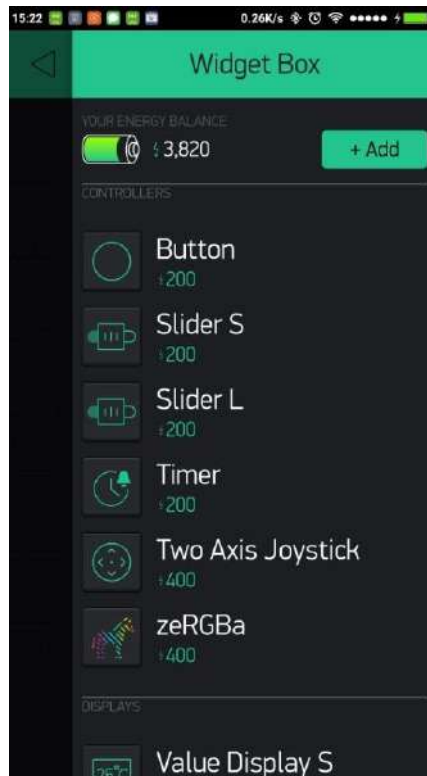


Figure : 2.6 widget box

Drag-n-Drop - Tap and hold the Widget to drag it to the new position.

Widget Settings - Each Widget has it's own settings. Tap on the widget to get to them As showing in Fig 2.7

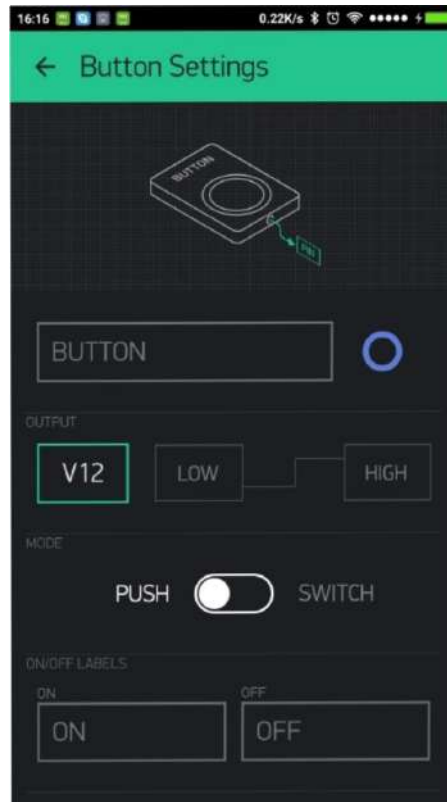


Figure : 2.7 button settings

The most important parameter to set is PIN .The list of pins reflects physical pins defined by your hardware. If your LED is connected to Digital Pin 8 - then select D8 (D - stands for Digital). As in Fig: 2.8

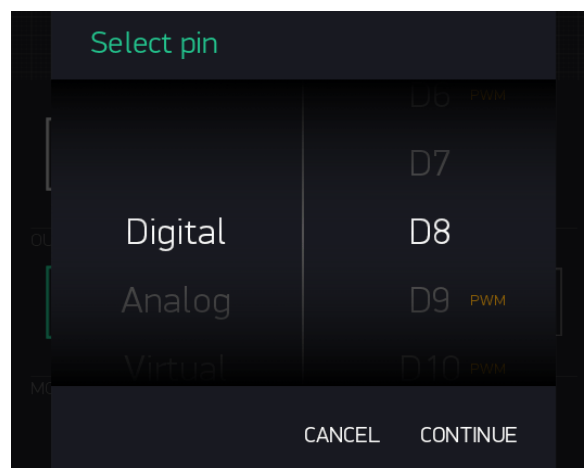


Figure : 2.8 pin selection

## 6. Run The Project

When you are done with the Settings - press the PLAY button. This will switch you from EDIT mode to PLAY mode where you can interact with the hardware. While in PLAY mode, you won't be able to drag or set up new widgets, press STOP and get back to EDIT mode as showing in Fig 2.9

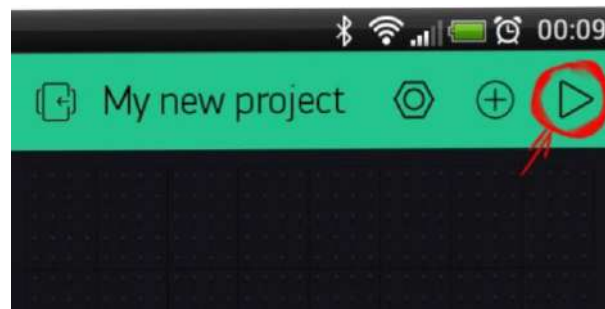


Fig: 2.9 project running

# Chapter three

# **System consideration and the practical implementation**

## **System consideration and the practical implementation**

### **3.1 Introduction**

This chapter will illustrates the complete hardware of the practical circuit including the Arduino uno interfacing circuit the software description including the port initialization, reading and writing programs.

### **3.2 Hardware description**

The design generally has many stages as shown in Fig which is the block diagrams of the system as showing in Fig 3.1

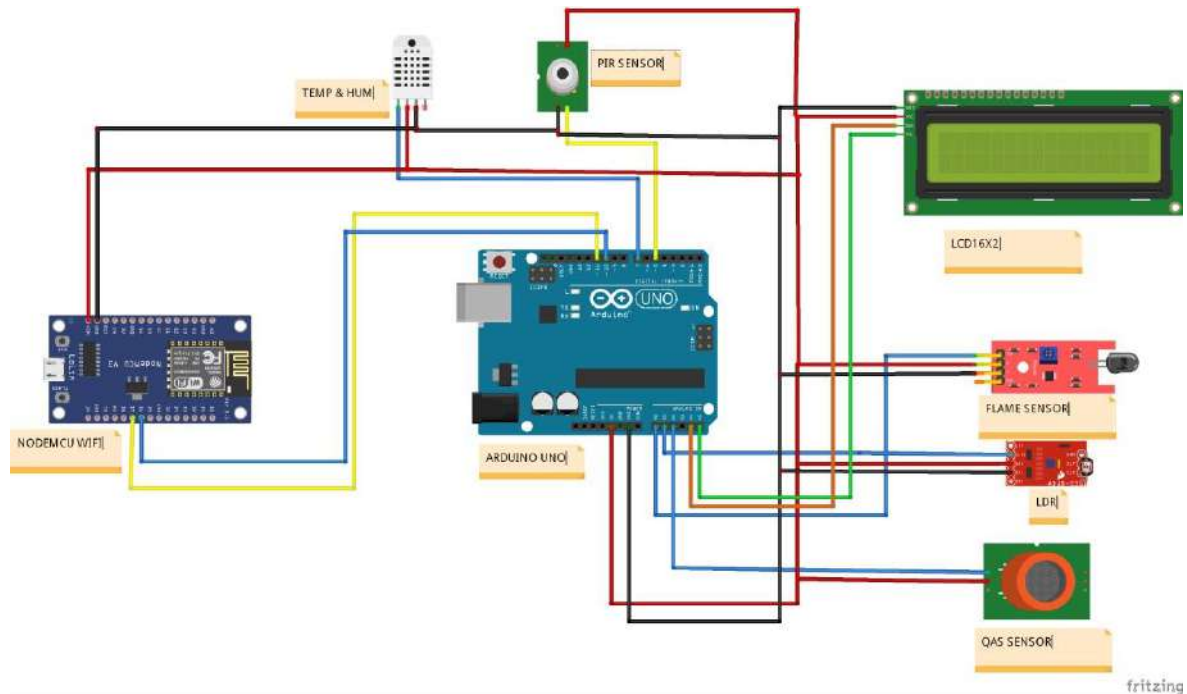


Figure : 3.1 hardware block diagram

- every part of the system is connected to the Arduino
  - The sensor used to detect temperature, humidity, flames , light and movement.
  - the Arduino uno is the brain of the product. It interfaces with all sensors, wifi board, and lcd through the pins.
- The microcontroller also carries out all program commands.
- the results appears on the screen
  - The wifi board collects the information and send it to the device
- The system consist of :



1. Arduino Uno
2. Nodemcu ESP8266WiFi. (WIFI BOARD)
3. Lcd
4. Dht-22 (Temperature and humidity sensor)
5. MQ-3 (Gas sensor )
- 6.Flames sensor
- 7.LDR (Light sensor )
8. Pir (Motion sensor)
10. Cables
11. Smartphone

Each one of this component will be discussed in detail in the next subsections.

### 3.2.1.Arduino Uno

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields)

and other circuits The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and



Leonardo as showing in Fig 3.2

**Figure : 3.2 Arduino uno**

### 3.2.2.ESP8266WiFi (wifi board )

The **ESP8266** is a low-cost Wi-Fi microchip, with a full TCP/IP stack and microcontroller capability. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands.

In addition to Wi,fi communications we can also upload codes on it. it has 8 bit digital and I bit analog. In our project we used this wifi chip a data router that transfer data from the Arduino to the platform. Through its ports it collects data, process it and then send it to the hot spot network and then to the blynk platform as showing in Fig 3.3

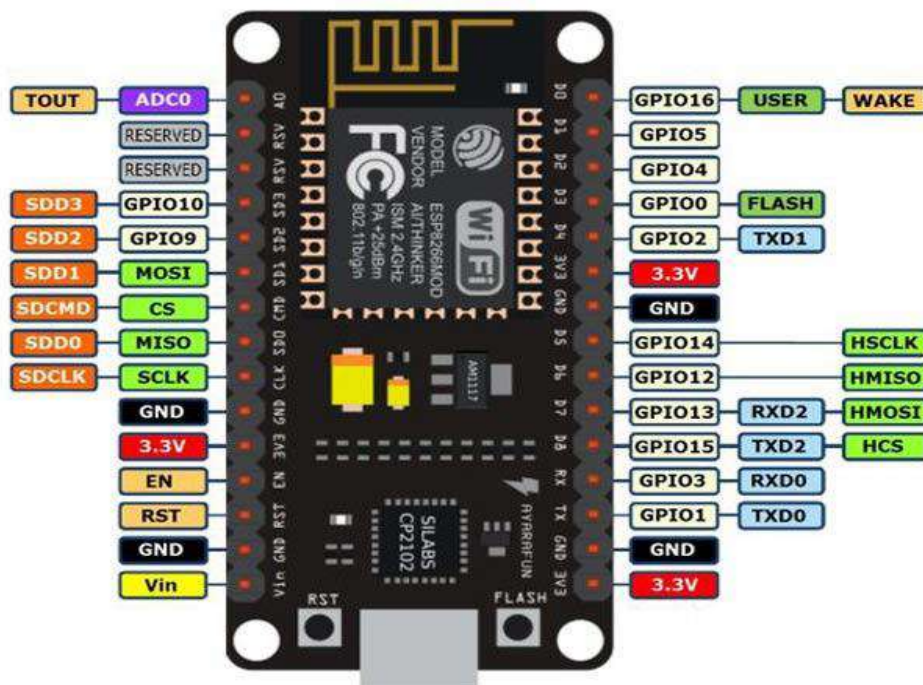


Figure :3.3 **ESP8266WiFi (wifi board )**

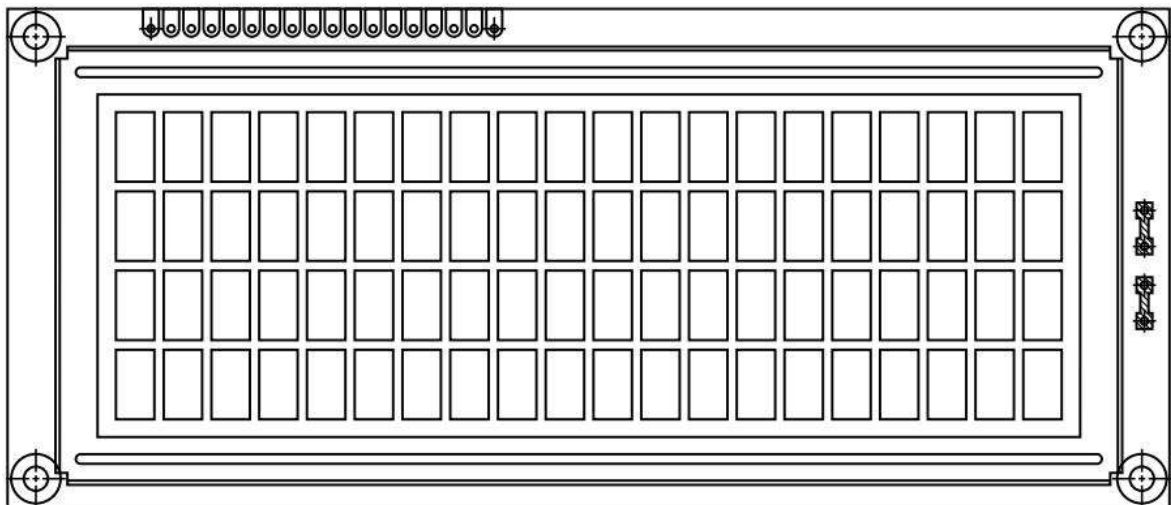
### **3.2.3. lcd**

The type of this lcd is character

The display format is  $20 \times 4$  characters

Built-in controller: St 7006

+5v power supply as showing in Fig 3.4



**Figure : 3.4 lcd**

### **3.2.4. Temperature and humidity sensor**

The DHT22 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to

grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

the Arduino decode the 22 signal it must use its private code library ‘ Through this library it processes the DHT 22 signals in and micro seconds in order to find out the heat and humidity values.

### **3.3 Applications of Temperature and humidity sensor:**

Used in weather stations, home appliances, humidity regulator, medical and other humidity measurement and control.

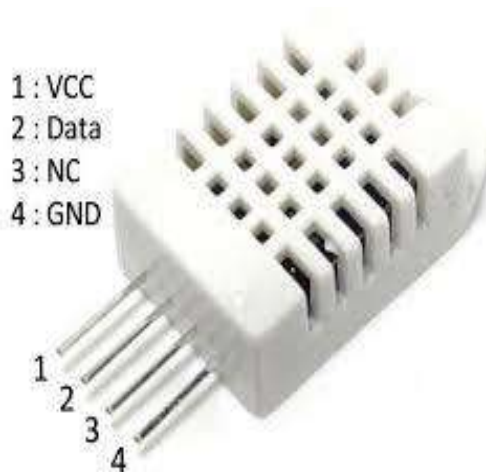


figure 3.5 dht22

### **3.4 Features of Temperature and humidity sensor:**

Low cost, long-term stability, relative humidity and temperature measurement, excellent quality, fast response. strong anti-interference ability, long distance signal transmission, digital signal output, and precise calibration as Fig 3.5

### 3. 5.Dht 22 simple circuit

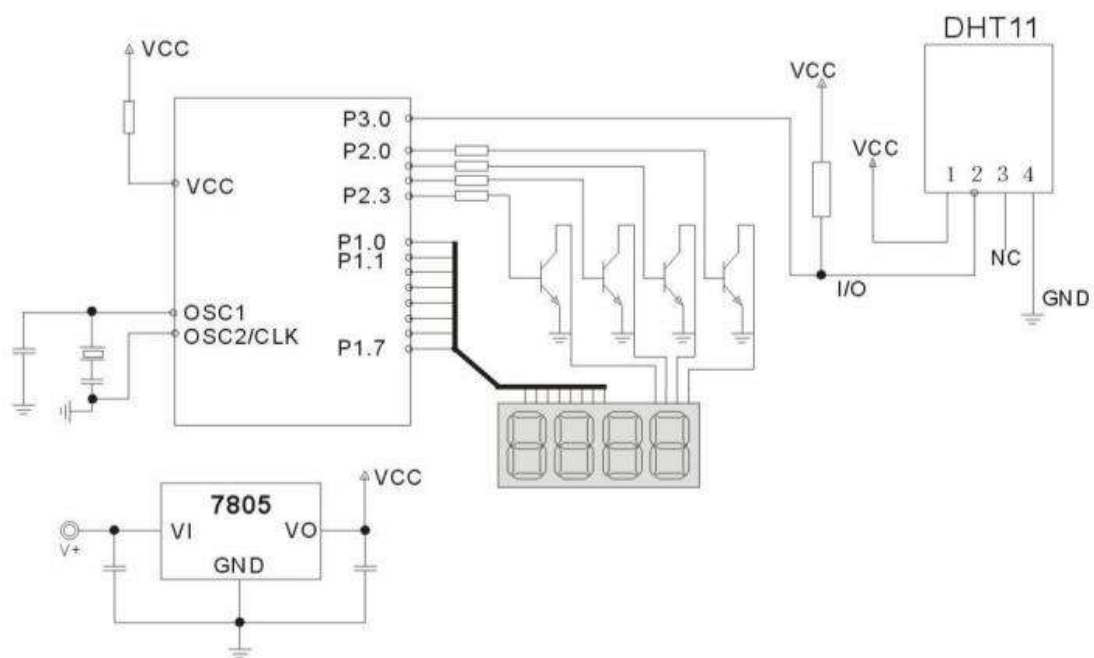


figure 3.6 **Dht 22** simple circuit

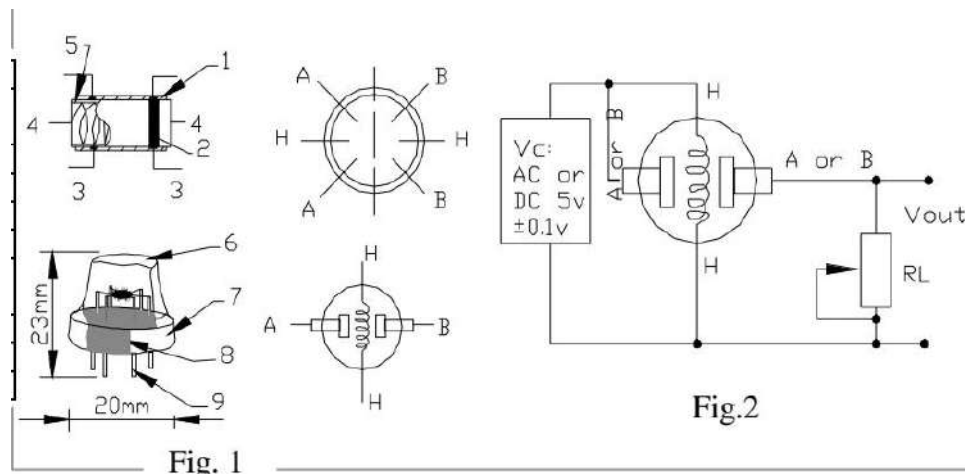
### 3. 6.MQ3 gas sensor

The second sensor that detects the gases which is the MQ-3 sensor shown in figure 3: and it is analog that it detects has a high

sensitivity to CH<sub>4</sub> and natural gases, it has a small sensitivity to alcohol and smoke which gives a signal from 0-1024 according to the gas concentration rate whose range is from 3U-4U cm. for example to which values it points at a moment according to this values we can determine the minimum and maximum values of that gas As showing in Fig 3.7.



**Fig : 3.7** Gas sensor



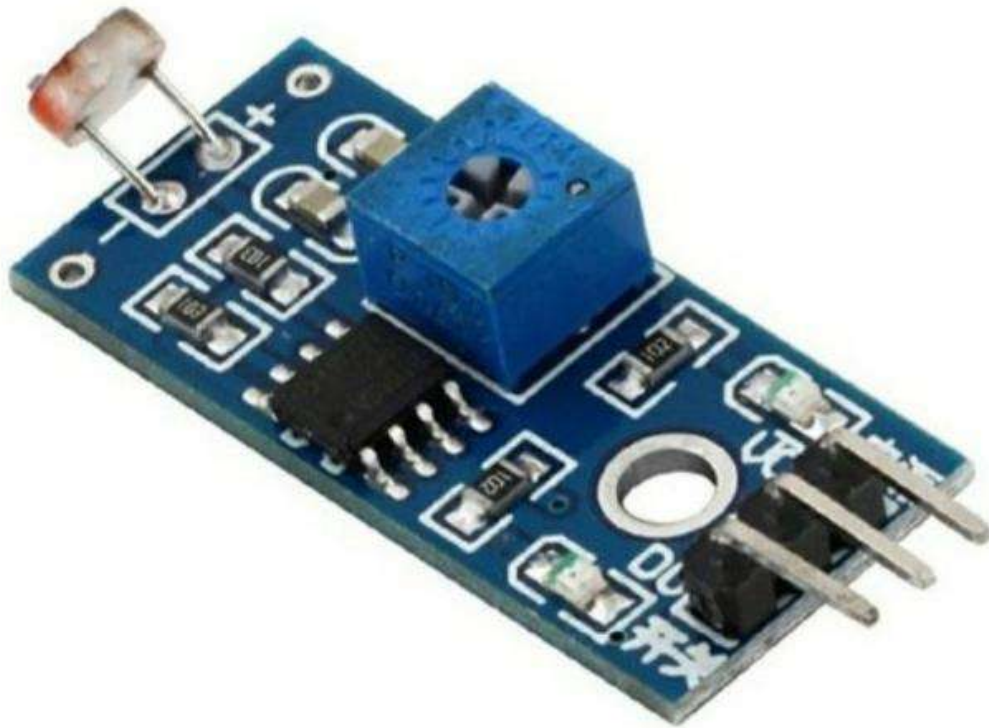
Simple circuit for Gas sensor

**Fig : 3.8** Simple circuit for Gas sensor

### 3. 7.Ldr (light sensor)

light sensitive devices most often used to indicate the presence or absence of light, or to measure the light intensity. In the dark, their resistance is very high, sometimes up to  $1M\Omega$ , but when the LDR sensor is exposed to light, the resistance drops dramatically, even down to a few ohms, depending on the light intensity. LDRs have a sensitivity that varies with the wavelength of the light applied and are nonlinear devices. They are used in many applications but are sometimes made obsolete by other devices such as photodiodes and phototransistors as showing in Fig 3.9





**Figure : 3.9 Ldr (light sensor)**

### **3. 8.Flame sensor :**

The sensor has 3 main components on its circuit board. First, the sensor unit at the front of the module which measures the area physically and sends an analog signal to the second unit,

the amplifier. The amplifier amplifies the signal, according to the resistant value of the potentiometer, and sends the signal to the analog output of the module.



The third component is a comparator which switches the digital out and the LED if the signal falls under a specific value.

W3 can control the sensitivity by adjusting the potentiometer. But we have to notice that The signal will be inverted; that means that if you measure a high value, it is shown as a low voltage value at the analog output as showing in Fig 3.10



**Fig: 3.10 flame sensor**

### **3. 9.Pair (Motion) sensor**

is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications.

All objects with a temperature above absolute zero emit heat energy in the form of electromagnetic radiation. Usually this radiation isn't visible to

the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose (pir) for example as showing in Fig 3.11



**Fig : 3.11 PIR (Motion) sensor**

### **3.10. Software description**

First we will give you a short description about the Blynk interface that we made .

We inserted gauges for 4 sensors (temp,light,gas,hum) and a notification for 2 sensors (Motion, flames) as shown in Fig 3.12



**Fig : 3.12 blynk interface**

### **3.11 program System consideration and the practical implementation: -**

We did tow kinds of programming in order for this project to work perfectly the first one is the Arduino programming with the sensors and other parts of the project and then we programmed the Nodemcu (wifi board) so it can do the job as we wanted to

### **1- Arduino Uno programming:**

```
#include <SoftwareSerial.h>
```

```
SoftwareSerial ss(10, 11);
```

```
String data = "";
```

```
#include <Wire.h>
```

```
#include "DHT.h"
```

```
#include <LiquidCrystal_I2C.h>
```

```
LiquidCrystal_I2C lcd(0x27, 16, 2);
```

```
#define DHTPIN 7
```

```
#define DHTTYPE DHT22
```

```
DHT dht(DHTPIN, DHTTYPE);
```

```
void setup() {
```

```
  Serial.begin(9600);
```

```

dht.begin();

ss.begin(9600);

pinMode(A0, INPUT); //flame

pinMode(A1, INPUT); //gas

pinMode(A3, INPUT); //ldr

pinMode(5, INPUT); //pir

lcd.begin();

}

void loop() {

    // Wait a few seconds between measurements.

    int val = analogRead(A0);

    int val2 = analogRead(A1);

    int val3 = analogRead(A2);

    int val4 = digitalRead(5);

    float h = dht.readHumidity();

    // Read temperature as Celsius (the default)

    float t = dht.readTemperature();

```

```
Serial.print(val);
```

```
Serial.print(" ");
```

```
Serial.print(val2);
```

```
Serial.print(" ");
```

```
Serial.print(val3);
```

```
Serial.print(" ");
```

```
Serial.print(val4);
```

```
Serial.print(" ");
```

```
Serial.print(t);
```

```
Serial.print(" ");
```

```
Serial.println(h);
```

```
lcd.setCursor(0, 0);
```

```
lcd.print("temp :");
```

```
lcd.print(t);
```

```
lcd.setCursor(0, 1);
```

```
lcd.print("Hum :");
```

```
lcd.print(h);
```

```
if(val4==1)////pir 0 or 1
```

```
{
```

```

lcd.clear();

lcd.print("the are someone near");

delay(1000);

lcd.clear();

}

data = String(val) + ":" + String(val2) + ":" + String(val3) + ":" +
String(val4) + ":" + String(h) + ":" + String(t) + ":" + String('x');

ss.println(data);

data = "";

delay(500);

```

## **2- Nodemcu ESP8266WiFi (wifi board) programming :**

```

#include <SoftwareSerial.h>

SoftwareSerial rece(12,13);

String s="";

int flame,pir,gas,ldr,h,t;

/* Comment this out to disable prints and save space */

#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>

```

```
#include <BlynkSimpleEsp8266.h>

// You should get Auth Token in the Blynk App.

// Go to the Project Settings (nut icon).

char auth[] = "oVVsjVRED_6aD-wYkCILPqKpjV31_MGk";

// Your WiFi credentials.

// Set password to "" for open networks.

char ssid[] = "note20";

char pass[] = "123456789";
```

```
String getValue(String data, char separator, int index)

{

    int found = 0;

    int strindex[] = {0, -1};

    int maxindex = data.length() - 1;

    for (int i = 0; i <= maxindex && found <= index; i++)

    {
```



```

    if (data.charAt(i) == separator || i == maxindex)

    { found++;

        strindex[0] = strindex[1] + 1;

        strindex[1] = (1 == maxindex) ? i + 1 : i;

    }

}

return found > index ?

    data.substring(strindex[0], strindex[1]) : "";

}

void setup()

{

    // Debug console

    Serial.begin(9600);

rece.begin(9600);

    Blynk.begin(auth, ssid, pass);

    // You can also specify server:

    //Blynk.begin(auth, ssid, pass, "blynk-cloud.com", 80);

    //Blynk.begin(auth, ssid, pass, IPAddress(192,168,1,100), 8080);

```

```
}
```

```
void loop()
```

```
{
```

```
  Blynk.run();
```

```
  re();
```

```
}
```

```
void re()
```

```
{
```

```
  if (rece.available() > 0)
```

```
  {
```

```
    s = rece.readStringUntil('x');
```

```
    flame = getValue(s, ':', 0).toInt();
```

```
    gas = getValue(s, ':', 1).toInt();
```

```
    ldr = getValue(s, ':', 2).toInt();
```

```
    pir = getValue(s, ':', 3).toInt();
```

```
    h = getValue(s, ':', 4).toInt();
```

```
    t = getValue(s, ':', 5).toInt();
```

```
  }
```

```
    Serial.print(flame);

    Serial.print(" ");

    Serial.print(gas);

    Serial.print(" ");

    Serial.print(ldr);

    Serial.print(" ");

    Serial.print(pir);

    Serial.print(" ");

    Serial.print(t);

    Serial.print(" ");

    Serial.println(h);

    int gas1=map(gas,80,300,0,100);

    int ldr1=map(ldr,690,180,0,100);


    Blynk.virtualWrite(V1,t);

    Blynk.virtualWrite(V2,h);

    Blynk.virtualWrite(V3,gas1);

    Blynk.virtualWrite(V4,ldr1);


    if(flame<=20&& flame !=0)
```

```
Blynk.notify("the are flame ");
```

```
if(pir==1)
```

```
Blynk.notify("the are someone near");
```

```
}
```

## Chapter four

# **Practical work of Arduino artificial intelligence using iot**

### **4.1 Practical result**

In this chapter the practical work and result of this project will be discussed, the fig.4.1 shows the practical circuit.

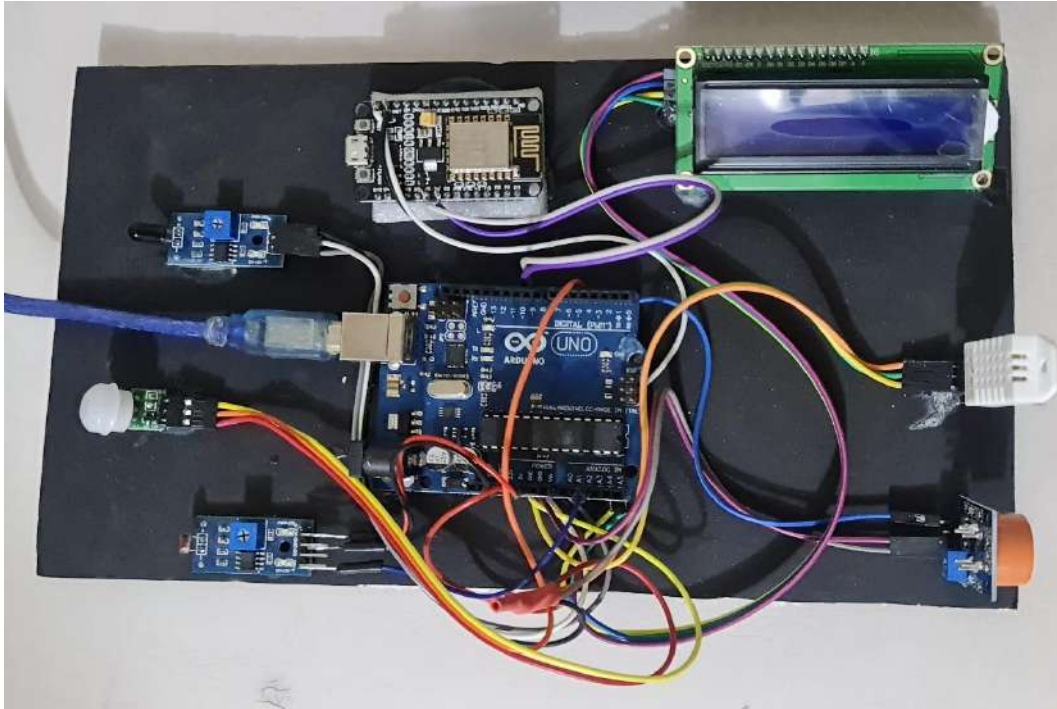


Figure (4.1): a practical circuit

## 4.2 practical work :

First we turn on the project by connecting its cable to a power supply port we will notice that the LCD is turned on which means the electricity is running through the project.

Now we need to connect the Project to our device on the same network by turning on the hotspot on our device and making sure we connect the project to our hotspots

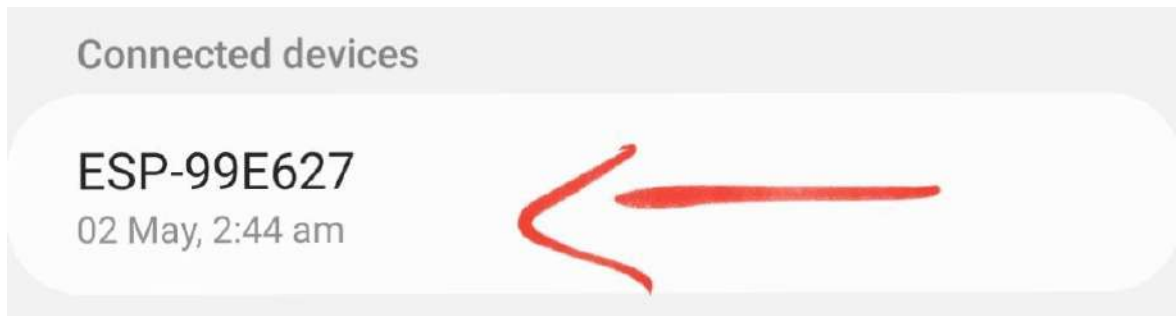


Figure 4.2 device connection

After making sure the Project is connected to the device that means we are ready to go As soon as we turn on the project we will notice that the temperature and humidity degree's are showing on the LCD as showing in



Fig :4.3 temperature and humidity degree's in lcd

The temperature showing on the LCD 32.10 is the temperature of the room that the project was working in on And the humidity Showing on the LCD 34.50 is the humidity of the room that the project was working in on And now we will be explaining the rest of the sensors and how their readings is on the phone not on the LCD expect for the motion sensor First we will be explaining how the ldr aka light sensor works When we put a light directly into the light sensor As showing In Fig :4.3

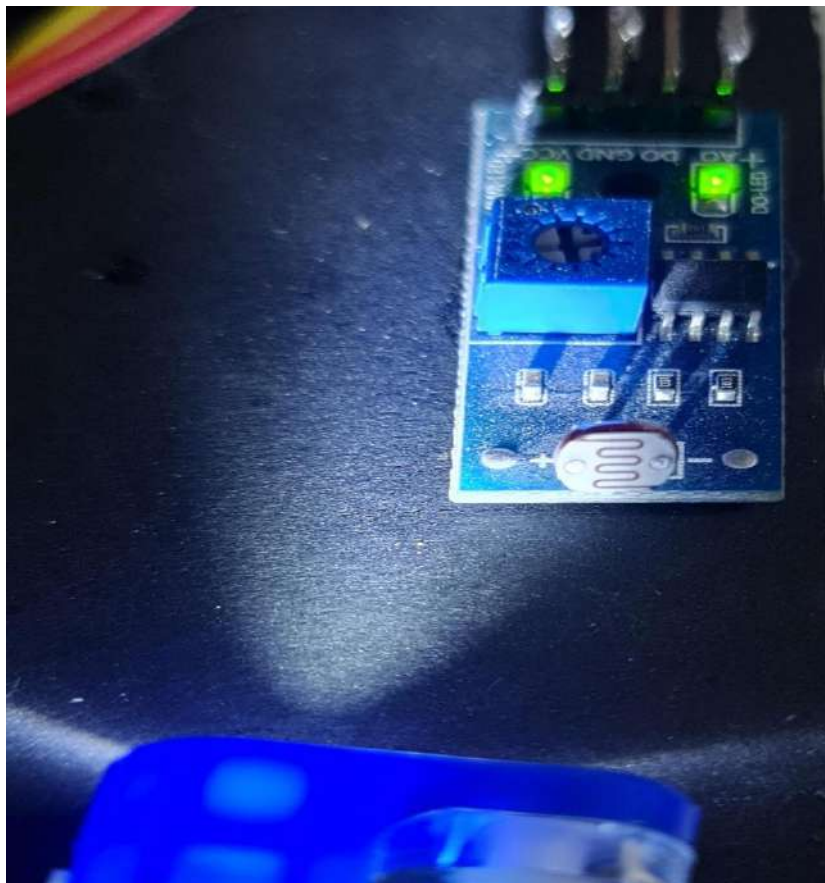


Fig: 4.4 light shedding



It will Tell us the intensity of the light From zero to 100 that's going through it by showing us the readings on gauge on the app as showing in Fig 4.4



Figure : 4.4 ldr gauge

gas sensor works in the same way as the ldr once we put directly on the gas sensor as showing in Fig 4.5

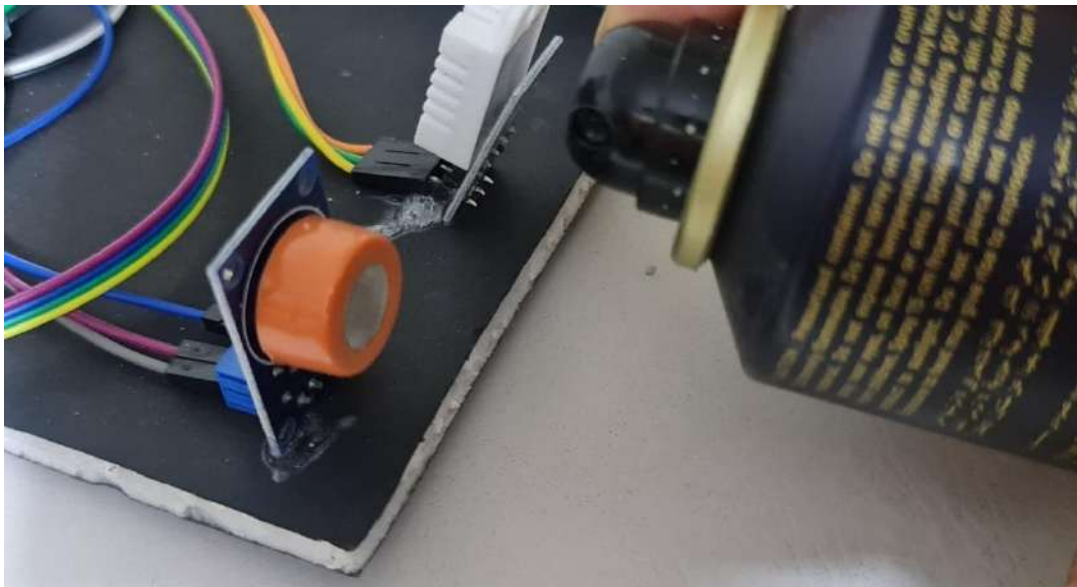


Figure : 4.5 gas spraying

it's will indicate The intensity of the gas From zero to 100 by showing us the readings on gauge on the app as showing in Fig 4.6

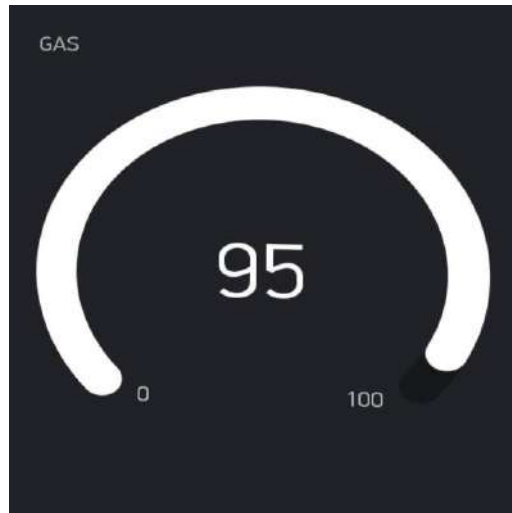


Figure 4.6 gas gauge

Just like the past two sensors the flames sensors works exactly the same way by putting a direct flames next to the flame sensor as showing in Fig 4.7

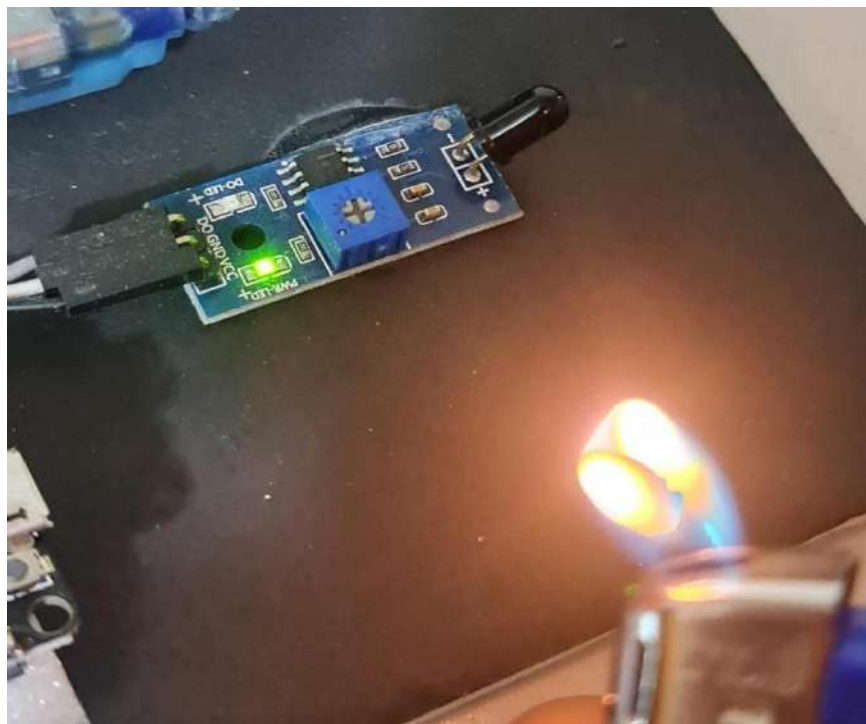


Figure : 4.7 flames

but the result it will be received as a notification telling us there are flames not on gauge like the past two sensors as showing in Fig 4.8

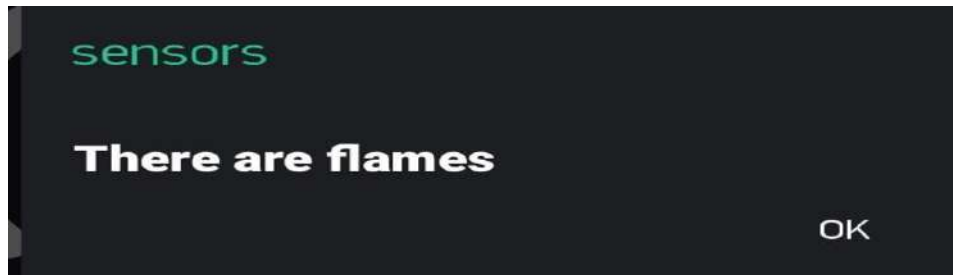


figure 4.8 flames notification

Motion sensor also works in the same way when someone or some objects move in the front of it in the range of three metre or less It will notify us in a notification in the app telling us there are some one near as showing in the fig 4.9

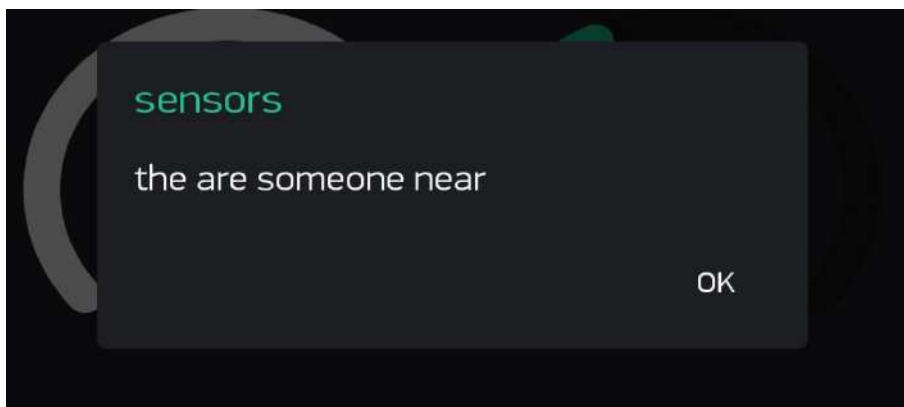


Fig: 4.9 motion notification

For the temperature and the humidity sensor we already mentioned that the results will be showing on the LCD that's right but on the same time it will be showing on the app as gauges just like the other sensors as shown in the fig 4.10

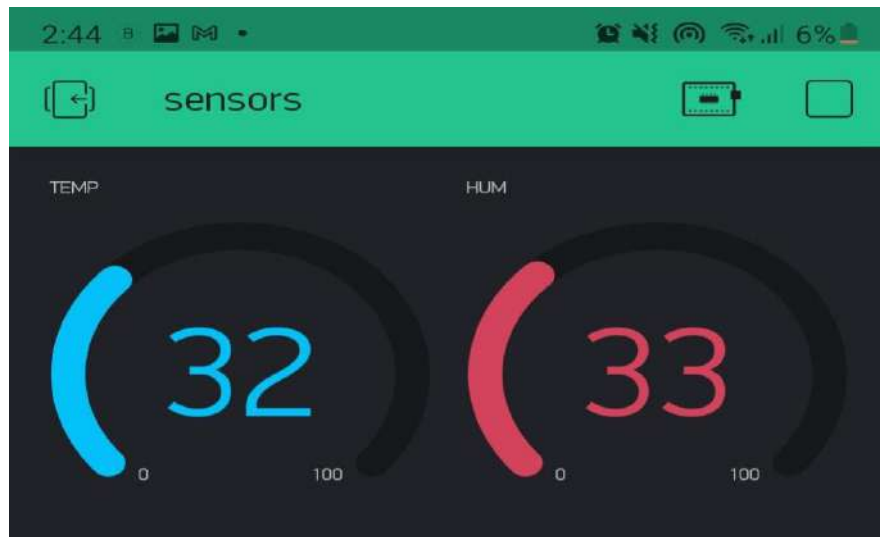


Fig : 4.10 temp , hum gauges

## Chapter five

# **Conclusion and Future Work**

## **Conclusion and Future Work**

### **5.1 Conclusion:**

In this project we conclude several points :

- This work can be applied to several applications such as home system protection , large buildings protection such as hospitals , colleges , companies, factories ..... etc.
- The wifi board (esp8266) is Very easy to apply in such projects , High reliability, small size, Cheap and Electric power consumed very few,
- The design of the circuit is simple , inexpensive and can be accomplished using commercially available components.
- The sensors used are very easy to implement.

### **5.2 Future work**

- Alarm siren can be added to the Project so it can notify us when a fire is happening for example.
- More than five sensors for the project can be added such as liquid sensor , sound sensor , etc... .

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**DESIGN AND IMPLEMENTATION OF CHATTING & SHARING SYSTEM  
FOR ANDROID, IOS, AND WINDOWS**

*A project submitted to the department of computer techniques engineering as a partial of  
the requirement to fulfillment the B.Sc. degree in the computer techniques engineering*

*By Students:*

**Abbas Ahmed Abbas**

**Ahmed Nadhim Enad**

**Laith Ahmed Hassan**

**Mohammed Ali Muhsin**

*Supervised By*

***Dr. Laith AbdulAmir M. Obaid***

***JUNE 2021***

## SUPERVISOR CERTIFICATE

I certify that this project entitled "**Design and Implementation of Chat & Sharing System for Android, iOS, and Windows**" was prepared under my supervision at the Department of Computer Techniques Engineering, Dijlah University College - Baghdad, in partial fulfillment of the requirements for the degree of B. Eng. in Computer Techniques.

Signature:

Name: **Dr. Laith AbdulAmir M. Obaid**

Date:     / 6 / 2021

## ABSTRACT

This graduation project includes the design and implementation of iOS, Android, and Windows based Chat and sharing application that can be utilized both in business and educational organizations. Real-time, flexible, and secure communication can be established by using in-house Chat and file sharing application. It does not only facilitate communication with eyewitnesses and provide a platform for people who don't feel safe speaking on the telephone. Flutter cross platform have been used along with Dart and Kotlin languages. The design is done close to similar applications. The implementation was done using Google cloud based services. On Google cloud, only one database was used that included three tables, one for users, another table for the chat, and a third table for user privileges. The application is developed based on Rational Unified Process (RUP) software development method. The architecture and Chat application are XMPP protocol based that can be implemented on Android, iOS, and Windows platforms with personal chat, group chat, broadcast messages, and file sharing features. The application can facilitate the communication in any organization especially educational organizations.

## Conclusion

The trial of application is carried out on 6 aspects of web application performance in general, like content, cookies, CSS & JavaScript, images, and server. The application assessment criteria using A (good ) scale grade based on established standardized best practices

1. Trial of Content No Performance Criteria Grade 1 Number of HTTP request F 2 Number of DOM element A 3 Number of URL redirect A 4 AJAX cache A 5 Avoiding HTTP error 404 A 6 Number of DNS

2. Trial of Cookie No Performance Criteria Grade 1 Size of cookie

3. Trial of CSS & JavaScript No Performance Criteria Grade 1 CSS expression A 2 Minify CSS & JavaScript A 3 Laying CSS A 4 Laying JavaScript A 5 CSS & JavaScript redundancy A

Table 4. Trial of Image No Performance Criteria Grade 1 Image Scaling in HTML A

Table 5. Trial of Server No Performance Criteria Grade 1 Use of entity tags (E-tags) A 2 Use of GET for AJAX request A 3 Expires headers D 4 Empty src or href A

Based on the trial that have been conducted on several performance aspects in general, the web application gets rank B with overall performance score 85 (Fig. 8).

Figure 8. Overall Trial Result of Web Application

7. Conclusion IM ,can utilize the broadcast message feature on the application to send messages in real-time. The proposed architecture model is running well by combining chat server (OpenFire) to accommodate real-time chat for Android platform through XMPP, and Web Server to accommodate web platform through HTTP. Web Service is needed for data exchange between Android platform and Web Server. 80% of respondents are wanting information delivered via IM, and SMS (50%). 93% of respondents are willing to install IM if campus information disseminated via IM. IM can also collect user contact information with registration system on the smartphone using the phone number and or e-mail address. Phone numbers and e-mail

## ACKNOWLEDGMENTS

Dedicating the joy of graduation to my mother and father who worked hard and stayed up with us and were supportive of us in every step, and to the friends who stood with us. We have reached the end of the school journey thanks to God Almighty and thanks to them and in particular our dear professors. Thanks, appreciation and respect for you for standing with us and sharing this moment. We wish from God Almighty Good luck to you and your children, and we wish your children to share this joy with you one day, with great love and respect for you

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## Chapter 1

### Introduction

Live chatting is synchronous communication; in other words, it happens in real time between remotely working individuals (Tang & Hew, 2020). It can be either scheduled or on demand (Mell, DeChurch, Leenders, & Contractor, 2020). The interaction and documentation of real time chat is not facilitated by e-mail. If the environment is fully controlled, the live chat can be monitored and high communication standard can be forced (Crandall, Steward, & Warf, 2016). Mobile applications industry developed over years and provided several communication methods such as chatting and file sharing services (Pu, Chiu, Chen, & Huang, 2015). There is a need for one-to-one and one-to-group live communication in business and learning institutes (Song & Christen, 2019).

### Background

The role of communication is when the institution wants to deliver important information to students, lecturers, and staffs. In addition, the organization also wants to deliver information to the student's parents and outside community. Information such as registration, payment, lectures, catastrophe, exam schedules, schedule change, and so on often hampered when sent through e-mail because of not immediately legible and limited quota of e-mail recipients (Tang & Hew, 2020). Moreover, the information via SMS is also having problems because they often change their phone number then difficult to contact (Mirzaei & Hayati, 2018). Chat applications are expected to maintain contact information with the single account (user only has one account) even though the users change their phone number and e-mail (Ngejane, Eloff, Sefara, & Marivate, 2021).

In the today's advancing world of technology, Mobile applications are rapidly growing segment of global mobile market. Mobile applications are developing at a meteor space to give user a rich and fast user experience. This paper involves an application for the android base operating system for an institute which will provide the detail and accurate information about an institute (Amjad & Akter, 2020). This application is simple yet powerful which integrated platform that connects all the various departments of an institute like Administration, Account, Students section, student and many more modules (Mell, DeChurch, Leenders, & Contractor, 2020). We have seen over the years that the process of notice board, important notification about academics has been carried out manually, this process is not only time consuming but also inefficient. In this application we can get the notification given by the institute via emails (Alkhuraiji, 2020).

### **Problem Statement**

There is a need for in-house application for communication and collaboration between the organization members with autonomy, security, full control, multi-language support, and customizable to meet the organization requirements (Blilat & Ibriz, 2020). Communication via Chat has been used as an interaction tool between students and lecturers outside the class in some universities across the world (Mirzaei & Hayati, 2018; Tang & Hew, 2020).

Communication like this can establish a close relationship between students and lecturers, create a sense of interconnected between the students with the class and university, reduce students' anxiety in the class, save time and students' effort, as well as add a pleasant atmosphere inside the team or the class (Mell, DeChurch, Leenders, & Contractor, 2020). Therefore, the Chat application can be used as a solution to establish

communication inside and outside the class and be able to help lectures activities (Albertengo, Debele, Hassan, & Stramandino, 2020).

### **Purpose of the Study**

The purpose of this graduation project is to design and implement a mobile application Chat and file sharing in any organization. In Dijlah University College, the users can be the students, the faculty, or the professors (Bondarenko, Khotchenko, & Ahieieva, 2020). Chat and file sharing facilitates communication to help an organization to be more efficient and effective (Aqel, Naqshbandi, Sokiyna, & Valentyn, 2020).

Previous researches had done developing Chat architecture (some for educational organization) to support only personal chat feature, without group chat feature to support communication from a lecturer to students in a class, scheduled message for reminder (assignment, exam, etc), file attachment for sharing, and collect students contact (phone number or e-mail) for urgency needs (Mirzaei & Hayati, 2018).

### **Significance of the Study**

This research contains the design and implementation of a chat and file sharing mobile application which can be used as a secure and reliable communication tool by organizations (Mirzaei & Hayati, 2018). Mobile-based Chatting applications can cover both formal and informal communication, real time interaction, the sender can know if the message was read or not, and full transparency is guaranteed (Aqel, Naqshbandi, Sokiyna, & Valentyn, 2020). Chatting applications can establish a close relationship among students, between students and lecturers, reduce students' anxiety in the class, save time and students' effort, sharing files, as well as add a pleasant atmosphere inside the class.

Chat application requires less resources than Mobile or even VoIP applications (Huang & Huang, 2019). They are cheaper and less intrusive (Tang & Hew, 2020). File sharing needs will increase in line with the number of chat users which already more than the number of e-mail users. Online collaboration through chat is also easier because the interaction takes place within one working window (chat history can be seen), and low-bandwidth because the previous message (Blilat & Ibriz, 2020; Mirzaei & Hayati, 2018). According to the research conducted in Korea, the use of chat can also improve working relationship (Ngejane, Eloff, Sefara, & Marivate, 2021). The pattern of short and efficient mass communication such as chat is also needed for an educational organization (Song & Christen, 2019).

### **Definition of Terms**

This section contains few terms or words used in this study.

**API** Application Programming Interface

**SDK** Software Development Kit

**APK** Android Application Package

**APP** Application

**GUI** Graphical User Interface

**JSON** JavaScript Object Notation

**Wi-Fi** Wireless Fidelity

**XML** eXtensible Markup Language

**DNS** Domain Name Service

### **Assumptions, Limitations, and Delimitations**

This project was limited due to time constraints and because of the COVID-19 related challenges. Lack of developing expertise was another challenge as well. In any

organization, a positive relationship between group efficacy and organizational resources are all positively related to implementation progress.

### **Outline of Project**

The outlines of this project can be summarized as follows: **Chapter two** included an explanation, description, and discussion of the software parts of the project as well as the programming languages used to create the project. **Chapter three** included the essential steps for implementing the project. **Chapter four** includes the conclusion, recommendations, and future work.

### **Chapter Summary**

The first chapter included an introduction to the graduation project, background, problem statement, purpose of the study, significance of the study, definition of terms, assumptions, limitations, delimitations, and an outline of the project besides this summary. Now it is time to go through the theoretical part of the project.

## Chapter 2

### Theoretical Analysis and Literature Review

From around 2010, the touchscreen smartphone revolution had a major impact on sales of basic feature phones, as the sales of smartphones increased from 139 million units in 2008 to 1.54 billion units in 2019 (Albertengo, Debele, Hassan, & Stramandino, 2020). Apple, Samsung, and lately also Huawei, were the big winners in this shift towards smartphones; BlackBerry and Nokia were among the losers. Nokia's focus on hardware rather than software specifications is one reason their net sales fell by around 30 billion euros in just three years (Crandall, Steward, & Warf, 2016).

### **Title Searches and Documentation**

Several databases were searched such as ProQuest, EBSCO host, Gale PowerSearch, IEEE Xplore, Science Direct, and Association for Information Systems (AIS). The search involved the use of keywords such as: Chatting Applications, Instant Messaging Software, File Sharing, Implementing Mobile Applications, Cloud Computing, Development Life Cycle, Instant Messaging Systems, and Cross Platforms. This keyword search revealed publications. The advancement of this graduation project was the consequence of researching papers from peer-reviewed articles, thesis and dissertations, and textbooks.

### **Historical Literature Review**

Modern instant messaging and SMS both began their march to prominence in the early and mid-1990s (Dempsey, 2019). The difference between the two is subtle: SMS (the acronym for "short service message") allows mobile phone users to send each other text messages without an Internet connection, whereas instant messaging (or chatting) enables similar functionality via the web. Precursors to ICQ date as far back as 1961

when MIT's Computation Center built the Compatible Time Sharing System (CTSS), allowing up to 30 users to log-in concurrently and share text messages (Aqel, Naqshbandi, Sokiyna, & Valentyn, 2020). CompuServe's CB Simulator, released in 1980, is generally recognized as the first dedicated online chat service; it required users to pay monthly fees for membership.

In 1985, Commodore launched Quantum Link (or “Q-Link”), an online service for Commodore 64 and 128 that enabled multi-person chat, file sharing, electronic email, games, and news via modem connection. Quantum Link changed its name to America Online (AOL) in 1991, and by the mid-90s was the leading U.S. Internet service provider and portal to the web. The company launched AOL Instant Messenger (AIM) in 1997 and purchased competitor ICQ in 1998 to consolidate its primacy over instant messaging. Along with a few competitors, it also pioneered chat robots like StudyBuddy and SmarterChild that provided information and played games with users (Song & Christen, 2019).

Literature review of 30 articles showed that the smartphone operating system market share in the second quarter of 2013 was dominated by Android at 69.1%<sup>25</sup> (Amjad & Akter, 2020). The distributed questionnaires to 122 respondents (students and lecturers) by researcher showed that 55% of respondents are using Android 4.x, and 33% of respondents are using BlackBerry 5-7. Not only developed on Android platform, the application will be also developed on Web platform that can be accessed while using the PC / laptop because of 72% of respondents wanted to (Bondarenko, Khotchenko, & Ahieieva, 2020). Furthermore, 78% of respondents are using LINE, then BBM (70%), and WhatsApp (66%). 87% of respondents are often using emoticon, then contact group (76%), file attachment (74%), group-chat (72%), and broadcast message (66%). These

features will become a reference for chatting application development (Albertengo, Debele, Hassan, & Stramandino, 2020).

### **Current Content**

Chatting applications in 2021 have more global users than traditional social networks because of the Covid-19 pandemic that enforce e-learning world-wide (Tang & Hew, 2020). Chatting applications will continue to play an increasingly important role in the distribution of digital materials in the future. While chat platforms initially rose to prominence by offering a low-cost, web-based alternative to SMS, over time they evolved into multimedia hubs that support photos, videos, games, payments, and more (Ngejane, Eloff, Sefara, & Marivate, 2021).

In 2006, AIM controlled 52 percent of the instant messaging market, but it struggled to monetize and went into rapid decline in the face of competition from services like Google Talk, Yahoo! Chat, MSN Messenger, and Skype. The growing popularity of BlackBerry Messenger in the late 2000s also pointed to a bright future for mobile messaging (Dempsey, 2019).

By the time mobile chat apps like WhatsApp and Kik arrived in 2009, SMS was king. Mobile texting became a key mode of global, personal communication, earning billions of dollars for telecommunications companies. But time and technology did not prove kind to telephone-service companies. As smartphones began to proliferate, chatting applications were an increasingly accessible solution to a simple problem: SMS is expensive in most countries, so why not text or call much more cheaply, or for free, via the mobile web? SMS volume peaked in 2012, and chat apps surpassed SMS in global message volume for the first time in 2013. By January 2015, WhatsApp alone hosted 30



billion messages per day compared to about 20 billion for SMS (Crandall, Steward, & Warf, 2016).

As Wi-Fi and high-speed mobile networks hit critical mass in many markets, chat apps quickly became multimedia hubs where users could easily share videos, photos, stickers, games, articles, live streams, and more (Albertengo, Debele, Hassan, & Stramandino, 2020). Between 2013 and 2014, many messengers turned their attention to monetizing their massive audiences, and in doing so introduced tools for organizations and brands.

A large swath of chat application innovation continues to originate in Asia on platforms like WeChat and LINE, and Western apps often appropriate those platforms' best products (Huang & Huang, 2019). WeChat, in particular, has a monolithic presence in China reminiscent of late 1990s Internet portals like AOL and Yahoo (with a modern mobile twist) (Bondarenko, Khotchenko, & Ahieieva, 2020). Users not only talk to friends and consume news on the app, but also make purchases, pay utility bills, book taxis and doctors' appointments, enroll in brand loyalty programs, monitor traffic and air pollution, and report incidents to the police (Huang & Huang, 2019).

The developed chatting and sharing application included push notification technology that runs on web platform and Android based smartphones (Amjad & Akter, 2020). According to a worldwide study Released in February 2021 by S. O'Dea, for a survey time period 2012 to 2021, Android operating system maintained its position as the leading mobile operating system. The smartphone operating system market share in 2020 was dominated by Android at 71.93 percent share (statista.com). Google Android and Apple iOS jointly possess over 99 percent of the global market share (Amjad & Akter, 2020; Alkhuraiji, 2020).

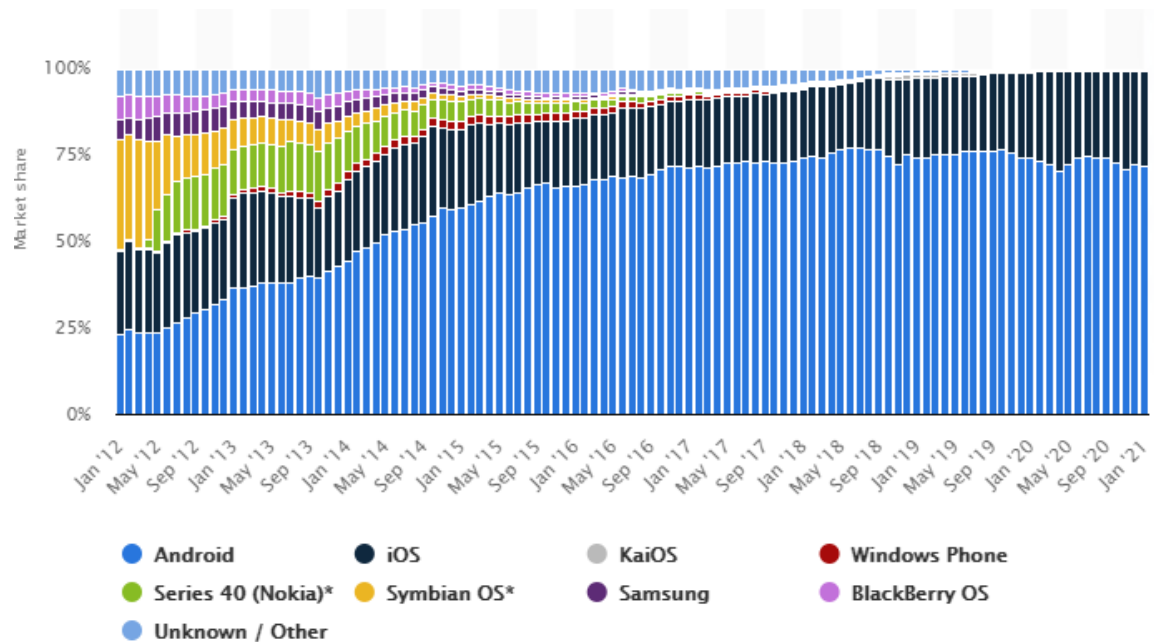


Figure 1. Market share of mobile operating systems worldwide 2012-2021

([www.statista.com](http://www.statista.com))

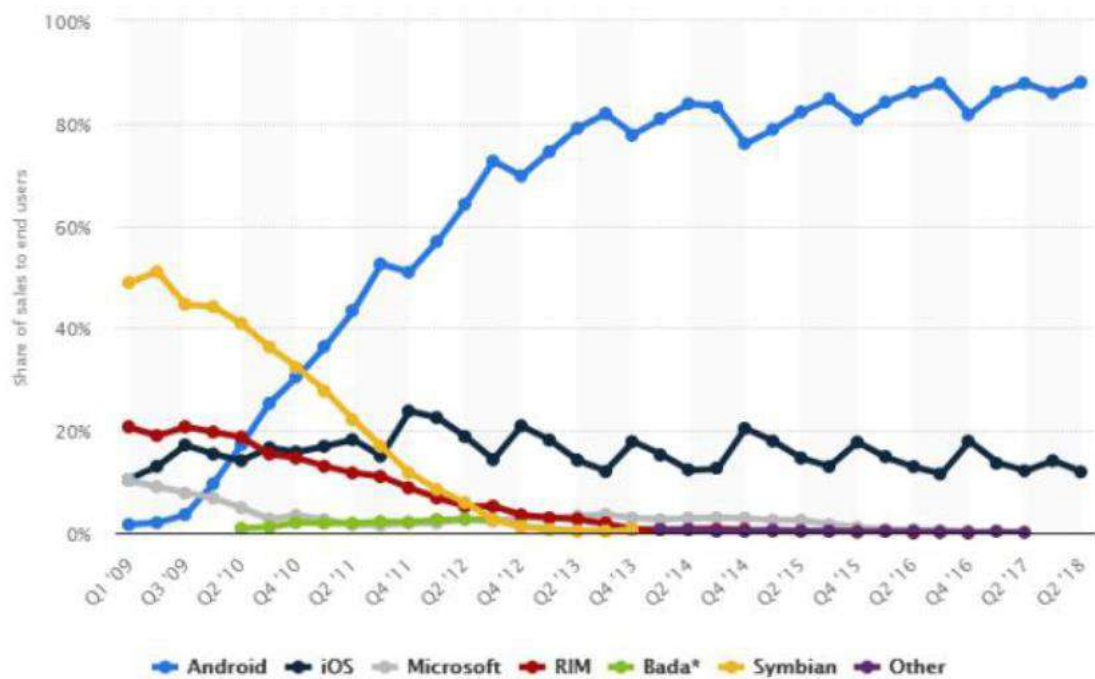


Figure 2. The Evolution of mobile OS used in the world from 2009 to 2018 (Blilat &

Ibriz, 2020)

## **Regional and Demographic Strongholds**

When devising a strategy for chatting applications, it's vital to select the right platform mix for your organization, based on three core criteria:

**Regional Strongholds:** Only a small group of apps like WhatsApp, Facebook Messenger, and Viber can be said to be truly global—and even those platforms struggle in certain countries. Meanwhile, messengers like WeChat, LINE, and KakaoTalk completely dominate specific markets but have negligible traction in others (Dempsey, 2019).

**Demographics:** It's a common misconception that chatting applications are a uniformly millennial phenomenon. Some apps like Snapchat and LINE skew both young and female, but others like Tango (which boasts 100 million monthly, active users, by our estimate) predominantly appeal to those aged 25–54 and strongly over-index with Hispanic and African-American users (Crandall, Steward, & Warf, 2016).

**Product Features:** If the primary goal is to drive traffic directly back to your website, that won't be possible with apps like Snapchat that don't support clickable URL links. And if you want to launch a sticker/emoji-pack campaign, LINE and Viber are great options, but you can rule out both WhatsApp and Snapchat. Each application has a particular set of features, so make sure to choose one that supports the activation you have in mind (Dempsey, 2019; Albertengo, Debele, Hassan, & Stramandino, 2020).

## **Chapter Summary**

The second chapter was about theoretical analysis and literature review. It included title searches and documentation, a brief historical literature review, current content, and the regional and demographic strongholds, besides this summary. Now it is time to go through the practical implementation of the project.

## Chapter 3

### Application Design and Implementation

Communication is one of the fastest-growing sectors of the economy. One form of communication is by chatting and file sharing, which focuses on delivering text and files required in professional environments such as companies and universities (Albertengo, Debele, Hassan, & Stramandino, 2020). Chatting and file sharing applications help facilitate and document a real-time communication in the organization (Dempsey, 2019). This chapter includes the design and implementation of the Chatting and file sharing application (Crandall, Steward, & Warf, 2016).

#### **Implementation Appropriateness**

To avoid doing double work, Flutter cross platform was used. Google announced Flutter 2.2, an open source toolkit for building mobile applications for any device from a single platform. Flutter 2.2 is the best version of Flutter yet. Flutter allowed us to connect to cloud services and APIs that extend apps to support new capabilities (Salvachúa, 2021). This platform increased application performance and reduced the package size. Flutter was accessed from the Android studio version 4.1.2 (Amjad & Akter, 2020).

According to Tim Sneath from Google: “With Flutter 2.2, enterprises, startups, and entrepreneurs alike can build high-quality solutions that can reach the full potential of their addressable market, allowing creative inspiration (rather than target platform) to be the only limiting factor” (Sneath, 2021; Salvachúa, 2021). Analyst firm SlashData’s Mobile Developer Population Forecast 2021 shows that Flutter is now the most popular framework for cross-platform development, with 45% of developers selecting it, representing 47% growth between Q1 2020 and Q1 2021 (Sneath, 2021).

Android Studio provides the fastest tools for building apps on every type of Android device (Amjad & Akter, 2020). The visual layout editor feature allows developers to create complex layouts with by adding constraints from each view to other views and guidelines. Then preview your layout on any screen size by selecting one of various device configurations or by simply resizing the preview window. With the APK analyzer, we as developers found opportunities to reduce the Android application size by inspecting the contents of the application APK file. The Fast emulator made the programming process fun. The emulator allowed us to install and run the application faster than with a physical device and simulate different configurations and features, including ARCore, Google's platform for building augmented reality experiences (Salvachúa, 2021). Besides the above features, Android studio includes intelligent code editor, flexible build system, and real-time profilers (Alkhuraiji, 2020; [developer.android.com/studio](https://developer.android.com/studio)).

### **Hardware Specifications**

The architecture design and back-end application for chat was implemented on a Google virtual server with the following specifications: Intel Core i7 3610 2.3 GHz Processor, 1 TB hard drives, 16 GB RAM, connected to Internet Through 1 Gbps Intel 82579LM Gigabit Network Connection, and Windows Server 2012 R2 operating system 46-bits.

The client application is implemented on Samsung Galaxy S9+ smartphone device with the following specifications: Android operating system version 10, API level 29, Qualcomm Snapdragon 845 2.80 GHz processor, 8 Cores, 720 x1480 pixels touch-screen resolution, Screen density 265 dpi, Kryo 385 architecture, 5579 MB Total RAM,

802.11 b/g/n Wi-Fi or mobile networks (EDGE, with speeds around 384 Kb/s), Screen size 6.20 inches, Java VM ART 2.1.0, OpenGL ES 3.2, Google Play Services 21.18.16.

### **Implementing the Chat Application**

The application development methodology used in this research is Rational Unified Process (RUP) with 4 phases: *inception, elaboration, construction, and transition*. (a) In the inception phase, scope definition and collection requirements were done by examining similar research (Crandall, Steward, & Warf, 2016). (b) In the second phase, remaining requirements were collected and the application was modelled by using Unified Modelling Language (UML). (c) The third phase carried out the development of non-critical features such as group chat, scheduled messages, and broadcast messages (Aqel, Naqshbandi, Sokiyna, & Valentyn, 2020). In this phase also made implementation planning, testing and bug fixing, and user manual documents updating. (d) In the fourth phase, implementation of the application was done then released the application to the user for early beta testing (Dempsey, 2019).

### **Application Development Cycle**

After the application design, the implementation stage started. It includes the application development cycle, the programming environment, and the selected programming languages. After having the idea, the research team started designing the chatting and file sharing application. Then the development stage started with several waves. It included fixing common issues and addressing multiple challenges. Then a testing procedures started in different scenarios such as one-to-one, one-to-group, testing in peak hours, testing while the phone is running an application that consume the bandwidth such as playing a YouTube video (Mirzaei & Hayati, 2018). The next stage was deploying the application, this was done manually and the application was not

published on the Google play store. The final stage is the maintenance stage (Qader, 2020). Here all the issues are addressed. This stage is still in progress and will continue during the first year. After that, as a future work, the application might be published on the Google play. At that stage, it might be restricted only for Dijlah domain i.e. emails end with @duc.edu.iq suffix.

### **Application Design and User Interface**

The designed and developed chatting application consists of two parts, front-end and back-end. Front-end side is used by the user (consists of students, lecturers, staffs, parents, and organization's associated communities) and developed on Android and iOS platforms (Alkhuraiji, 2020). Figures 3 to 13 presents the user interface of each window along with a brief description (Amjad & Akter, 2020). Figure 4. Shows the application icon that shows on the Android or the iOS phone. Innovations such as bespoke (or customized) stickers and emojis can help in quickly build significant messages via the chat application (Aqel, Naqshbandi, Sokiyna, & Valentyn, 2020).

### **Integrated Development Environment**

With regards to the development environment, there were several options to choose from, the selected Integrated Development Environment (IDE) was Flutter. And the selected language was Dart language. Flutter is Google's User Interface (UI) toolkit for building beautiful, natively compiled applications for mobile, web, desktop, and embedded devices from a single codebase (Qader, 2020). Dart is a very young computer language with many interesting features. Dart is a class-based, object-oriented language with optional types, and it can help you write very powerful programs. On Google cloud, only one database was used that included three tables, one for users, another table for the chat, and a third table for user privileges (Song & Christen, 2019).



The results of this study is a chatting application with personal chat, group chat, broadcast messages, scheduled messages, and integrated file attachment with GoogleDrive features (Aqel, Naqshbandi, Sokiyna, & Valentyn, 2020). The expected benefit of this application is facilitating fast, cheap, and effective communication in organizations in general and in Dijlah college in particular.



Figure 3. The main Icon



Figure 4. The Application Icon

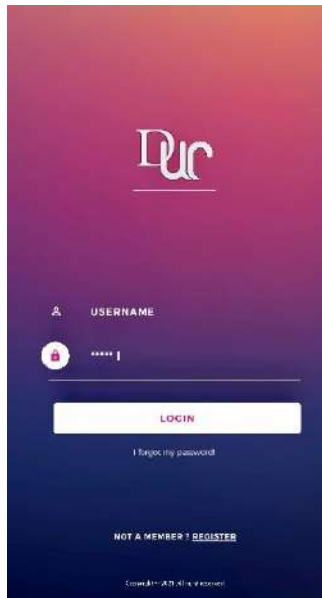


Figure 5. The Sign-on Screen

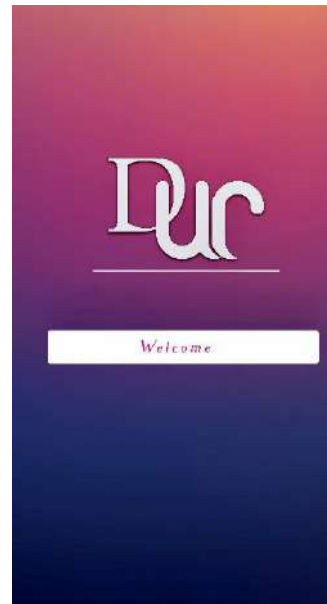


Figure 6. The Welcome Screen

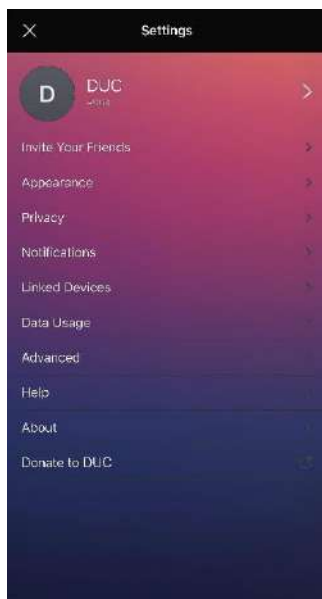


Figure 7. The Main Screen



Figure 8. The About Screen

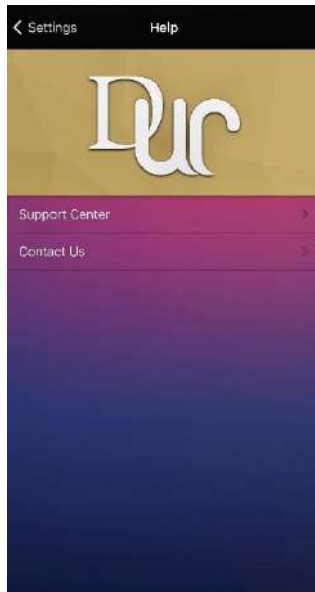


Figure 9. The Contact Us Screen

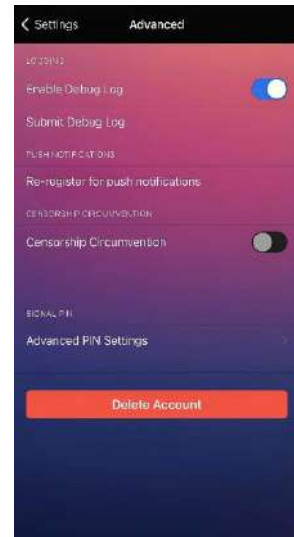


Figure 10. The Advanced Features Screen

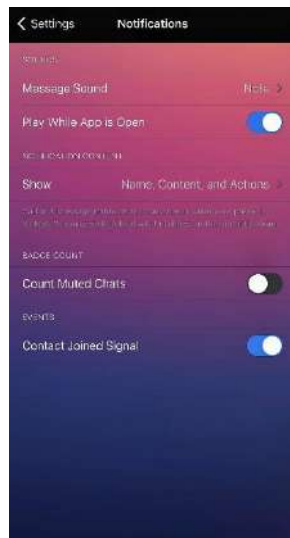


Figure 11. The Notifications Screen

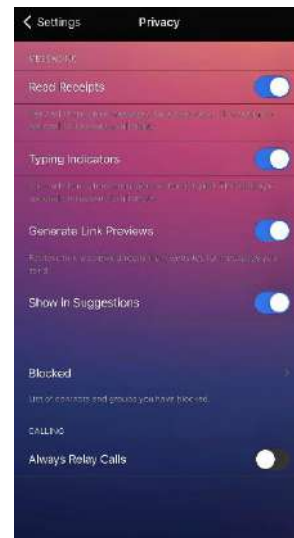


Figure 12. The Privacy Screen



Figure 13. The Appearance  
Screen

### Summary

The third chapter was about application design and implementation. It included the implementation appropriateness, hardware specifications, implementing the Chat application, application development cycle, user interface, and integrated development environment, besides this summary. Now it is time to go through the future work part of the project.

## Chapter 4

### Future Work

Chat applications offer strong opportunities to engage new or difficult-to-reach demographics. For example, Snapchat, a very popular application among millennials, has been credited with engaging and informing young audiences on complex issues like the Iran nuclear deal. This chapter includes the limitations, future work, and chapter's summary.

### Limitations

While conducting the study, the main limitation was everybody was busy. All the four students working on this project were busy and the professor Dr. Laith was also busy. Definitely having more time would have helped. But this is something out of the control of the researcher.

### Recommendations for Future Research

More opportunities exist for future work such as higher engagement, audience development, a chance to connect with users in a new way, and building community. Each one is covered in the following lines:

**Higher Engagement:** Since many chat apps provide organizations with push notifications or chatbot experiences (programmable robots that converse with users—see glossary), they can deliver significantly higher engagement rates than Facebook and Twitter. This advantage may erode from its current levels as new organizations compete for attention on each platform, but message open rates are still likely to supersede social network news feeds (Tang & Hew, 2020).

**Spam Prediction:** Predicting spam messages based on a database or other user response is a possible feature that can be done in future work (Ngejane, Eloff, Sefara, & Marivate, 2021).

**Audience Development:** With billions of active users across multiple major chat apps, organizations have been successful in building large audiences fairly quickly on several platforms (Mell, DeChurch, Leenders, & Contractor, 2020).

**A Chance to Connect with Users in a New Way:** Chat applications offer a host of features not unavailable on social networks or other platforms. Organizations can creatively leverage these tools to tell stories in new ways (Crandall, Steward, & Warf, 2016). For example, Snapchat lets users write and draw on top of content from organizations before sharing with friends. Companies like BuzzFeed are also experimenting with publisher-branded emojis that followers use to enhance personal conversations on apps like LINE.

**Building Community:** Chat apps offer an opportunity for readers and viewers to easily connect, share, collaborate, and discuss a range of topics (Blilat & Ibriz, 2020). Platforms like Kik and Tango, for example, let companies host their own chat rooms where readers and viewers can meet and discuss topics of interest (Song & Christen, 2019). And Snapchat's Live Stories allows people in a specific geolocation to contribute eyewitness media to a crowdsourced video piece the entire Snapchat community can view.

## **Summary**

The last chapter is the fourth chapter. It was about the project's Future Work. the chapter included the project's unexpected Limitations and Future Work, besides this summary.

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## **Design and installation System for Sensing Weather Conditions**

A graduation project is submitted to the Computer  
Techniques Engineering Department in partial  
fulfillment of the requirements for the degree of Bachelor  
of Science in Computer Techniques Engineering

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**June.2021**

## SUPERVISOR CERTIFICATION

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I certify that this thesis entitled **“Design Talking System for Sensing Weather Conditions”** was prepared under my supervision at the Department of Computers Techniques Engineering, Dijlah University College-Baghdad, in partial fulfillment of the B.Sc Eng. in Computer requirements for the degree of Techniques Engineering.

Signature:

Name: Jabbar Shatti

Date:     /     / 2021



# Abstract

One of the important things that interest people on a daily basis knows the weather conditions such as temperature, humidity, wind speed and direction, atmospheric pressure, rain, the intensity of light and fog. Knowing these matters is important for the purpose of building a person's daily agenda or for travel or transportation purposes, among others.

In this project, a talking system was built to help the blind, this system has the ability to speak and provide the customer with what he needs to know about the weather conditions surrounding him, depending on a group of sensors related to this topic. This system works automatically to provide the customer with weather conditions in fixed time periods and is subject to change according to the customer's request.

The basic unit in this system is an electronic development board (Arduino) consisting of an open source electronic circuit with a microcontroller programmed by a computer designed to facilitate the use of interactive electronics in multidisciplinary projects, including projects aimed at building different environmental sensors. The board relies on its programming on the open source programming language.



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# Chapter One

## Introduction

### 1.1 Overview

- One of the applications of daily life, which must be known, is the temperature that is directly affected by the human being, so it is necessary to adapt to it, and therefore there were sensors or sensors of the temperature of the temperature that tell the person, and from which machines can modify the surrounding atmosphere in line with comfort The human .
- In today's project, the DHT22 temperature sensor is used with the Arduino, which in turn measures room temperature and other things. The result is displayed on a 16-column and two-row liquid crystal display with a displacement recorder to provide the Arduino terminals for later use.

### 1.2 Application Of Project

The main objective of this project is to study the microcontrollers, especially the Arduino, which is the most advanced in the world of microcontrollers

And study the types of Arduino and his way of programming and writing his code to do different work to benefit us in our lives

And also study the most important types of electronic parts, which is sensitive to the temperature through which we can measure the temperature of rooms



### **1.3 Project Uses**

We can take advantage of this project in our daily lives:-

Central cooling located in hotels, government departments and conference rooms.

It is also used in modern cars when the temperature rise engine opens the fan to cool the engine.

And also in modern cooling devices.

In laboratories and poultry pens.

and used to measure temperature.

### **1.4 Software Used**

In this research we used the Arduino program through which the search code is written This program is downloaded from the official website of Arduino

The code is written in the IDE programming language.

This program, after writing the code code, checks the code to make sure that the code is free from giving and then download it to the Arduino board in figure 1.1





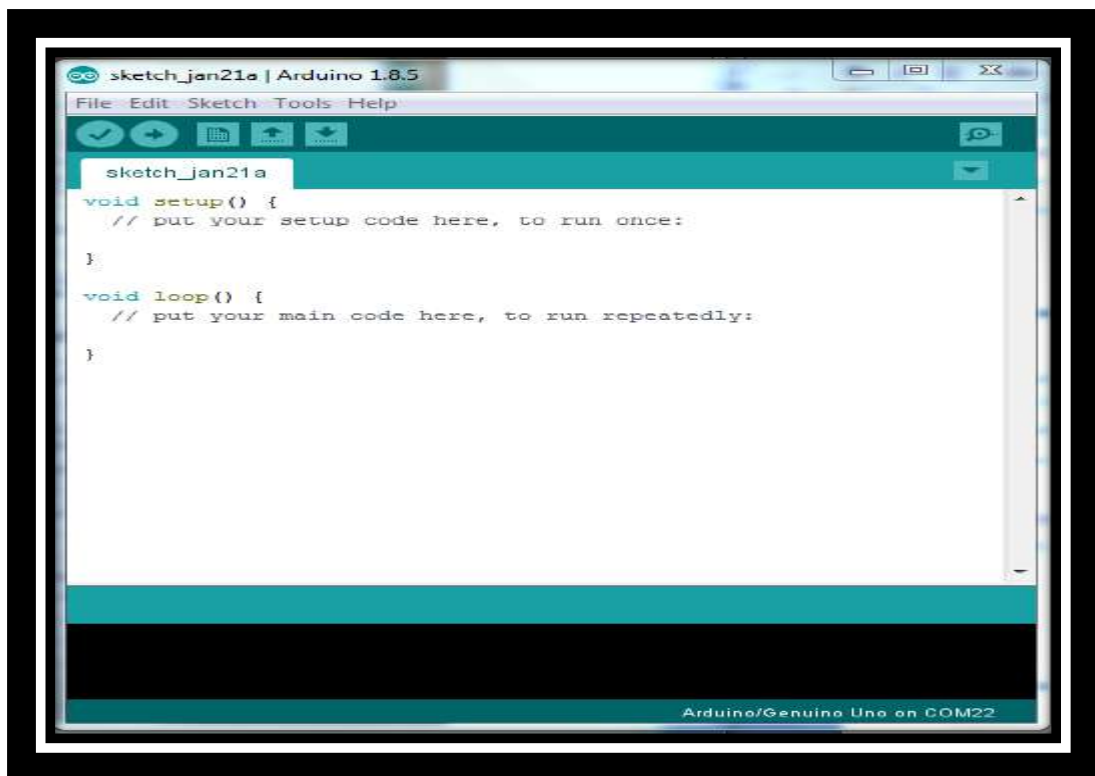


Figure 1.1 Arduino IDE

# Chapter Two

## Theory

### 2.1 Arduino

Arduino is an electronic development board consisting of an open source electronic circuit with a computer-controlled microcontroller designed to facilitate the use of interactive electronics in multidisciplinary projects. Arduino is mainly used in the design of interactive e-projects or projects aimed at building different environmental sensors such as temperature, wind, light, pressure, etc. Arduino can be connected to various programs on the PC. The software is based on the open source scripting language, The code for the Arduino language is similar to the C language and is one of the easiest programming languages used to write microcontroller programs

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (shields) and other circuits[3]. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project



In figure 2.1

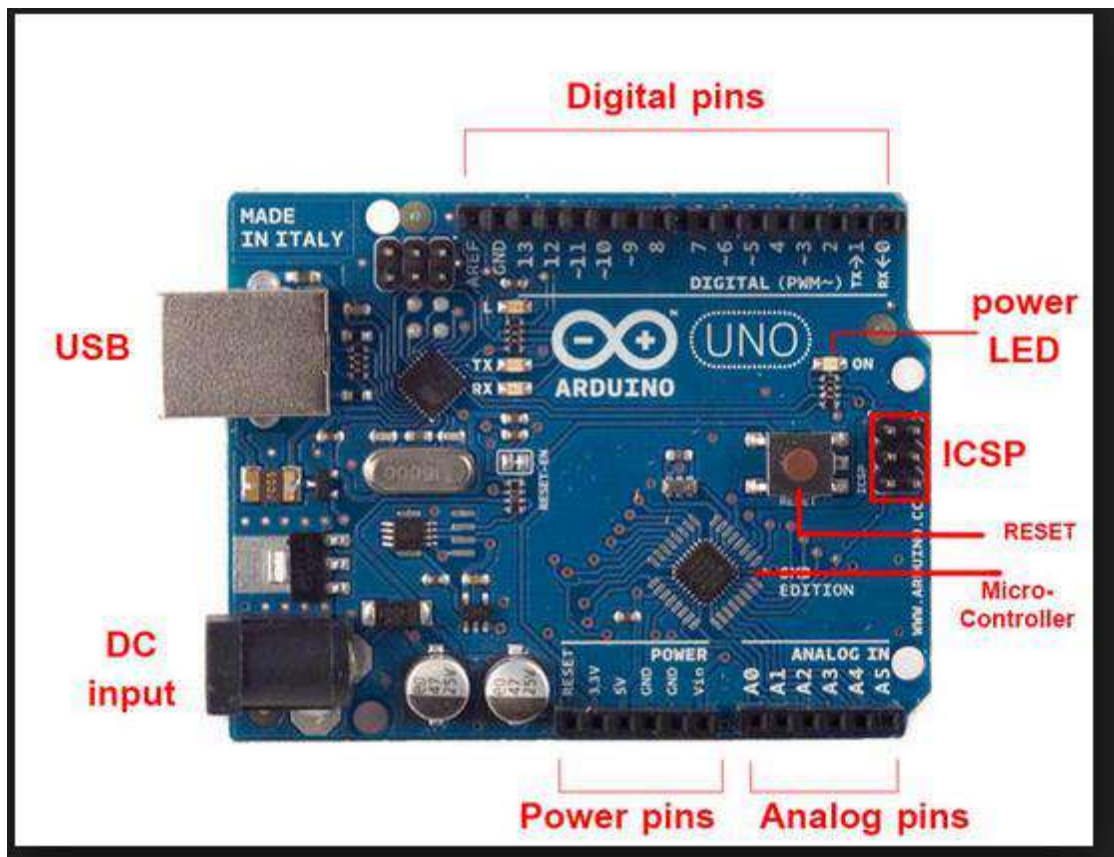


Figure 2.1 Arduino

**USB port:** The USB port used to connect the computer to the computer or to provide power to the computer

**DC power jack:** By using it, the power supply is connected to an external power supply as a battery if the USB is not used to operate it. Read the information manual for the Arduino panel for the proposed voltage and operating modes. For Uno, the panel operates on a 5 volt current, which can be connected to a current of 6-20 volts, but the current is preferably 7-12 volts

**Power pins:** Contains 5-volt and 3.3-volt power outlets, GND ground outlets, and a Vin port, which is used to power it if you



want, and can pull power from the power jack if you use it as an energy source

**Analog pins:** are the pins used for the introduction of analog signals, number 6 in the Uno

**Digital I / O pins:** The pins that are used to insert or output digital signals. The digital signal value is 1 or 0, and the other name is High or Low or True, False

In addition to the RESET button to restart the program loaded on the microcontroller, and the small LED that lights up when working the Jordanians

### **2.1-1 Arduino History**

The Arduino project started at the Interaction Design Institute Ivrea (IDII) in Ivrea, Italy. At that time, the students used a BASIC Stamp microcontroller at a cost of \$100, a considerable expense for many students. In 2003 Hernando Barragán created the development platform *Wiring* as a Master's thesis project at IDII, under the supervision of Massimo Banzi and Casey Reas, who are known for work on the Processing language. The project goal was to create simple, low cost tools for creating digital projects by non-engineers. The Wiring platform consisted of a printed circuit board (PCB) with an ATmega168 microcontroller, an IDE based on Processing and library functions to easily program the microcontroller. In 2003, Massimo Banzi, with David Mellis, another IDII student, and David Cuartielles, added support for the cheaper ATmega8 microcontroller to Wiring. But instead of continuing the work on Wiring,[4] they forked the project and renamed it *Arduino*.

The initial Arduino core team consisted of Massimo Banzi, David Cuartielles, Tom Igoe, Gianluca Martino, and David Mellis, but Barragán was not invited to participate.

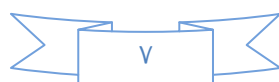
Following the completion of the Wiring platform, lighter and less expensive versions were distributed in the open-source community.

Adafruit Industries, a New York City supplier of Arduino boards, parts, and assemblies, estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced and in 2013 that 700,000 official boards were in users' hands

In October 2016, Federico Musto, Arduino's former CEO, secured a 50% ownership of the company. In April 2017, Wired reported that Musto had "fabricated his academic record.... On his company's website, personal LinkedIn accounts, and even on Italian business documents, Musto was until recently listed as holding a PhD from the Massachusetts Institute of Technology. In some cases, his biography also claimed an MBA from New York University." Wired reported that neither University had any record of Musto's attendance, and Musto later admitted in an interview with Wired that he had never earned those degrees.<sup>1</sup>

Around that same time, Massimo Banzi announced that the Arduino Foundation would be "a new beginning for Arduino But a year later, the Foundation still hasn't been established, and the state of the project remains unclear.

The controversy surrounding Musto continued when, in July 2017, he reportedly pulled many Open source licenses, schematics, and code from the Arduino website, prompting scrutiny and outcry



In October 2017, Arduino announced its partnership with ARM Holdings (ARM). The announcement said, in part, "ARM recognized independence as a core value of Arduino ... without any lock-in with the ARM architecture." Arduino intends to continue to work with all technology vendors and architectures [5]

## **2.1-2Arduino Uses**

- Arduboy, a handheld game console based on Arduino
- Arduino Motion Control Rig
- Arduinome, a MIDI controller device that mimics the Monome
- ArduinoPhone, a do-it-yourself cellphone
- Ardupilot, drone software and hardware
- ArduSat, a cubesat based on Arduino.
- Automatic titration system based on Arduino and stepper motor
- C-STEM Studio, a platform for hands-on integrated learning of computing, science, technology, engineering, and mathematics (C-STEM) with robotics.
- DC motor control using Arduino and H-Bridge
- Data loggers for scientific research
- Gameduino, an Arduino shield to create retro 2D video games
- Homemade CNC using Arduino and DC motors with close loop control by Homofaciens [7]
- Impedance sensor system to detect bovine milk adulteration
- Low cost data glove for virtual reality applications
- OBduino, a trip computer that uses the on-board diagnostics interface found in most modern cars
- Water quality testing platform
- Xoscillo, an open-source oscilloscope



### **This Specifications**

Controller	ATmega328P
Voltage work	5V
Voltage Recommended	7-12V
Voltage Critical	6-20V
Digital exits	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
Current on 5V pin	20 mA
Current on 3.3V pin	50 mA
Flash memory	32 KB (ATmega328P) of which 0.5 KB
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Processor speed	16 MHz
Height	68.6 mm
Width	53.4 mm
Weight	25 g

## **2.1-3 Arduino Types**

There are several kinds of Arduino boards that reach more than 40 species

Vary in shape, size, efficiency, speed, and number of electrodes

Of these species

### **1- Arduino Mega ADK**

### **2- Arduino Due**

### **3- Arduino Leonardo**

### **4- Arduino micro**

### **5- LilyPad Arduino USB**

### **6- Arduino Pro Mini**

### **7- Arduino Fio**

### **8- Arduino Esplora**

## **2-2 DTH11**

The DHT11 sensor is one of a series of DHTXX moisture sensors.

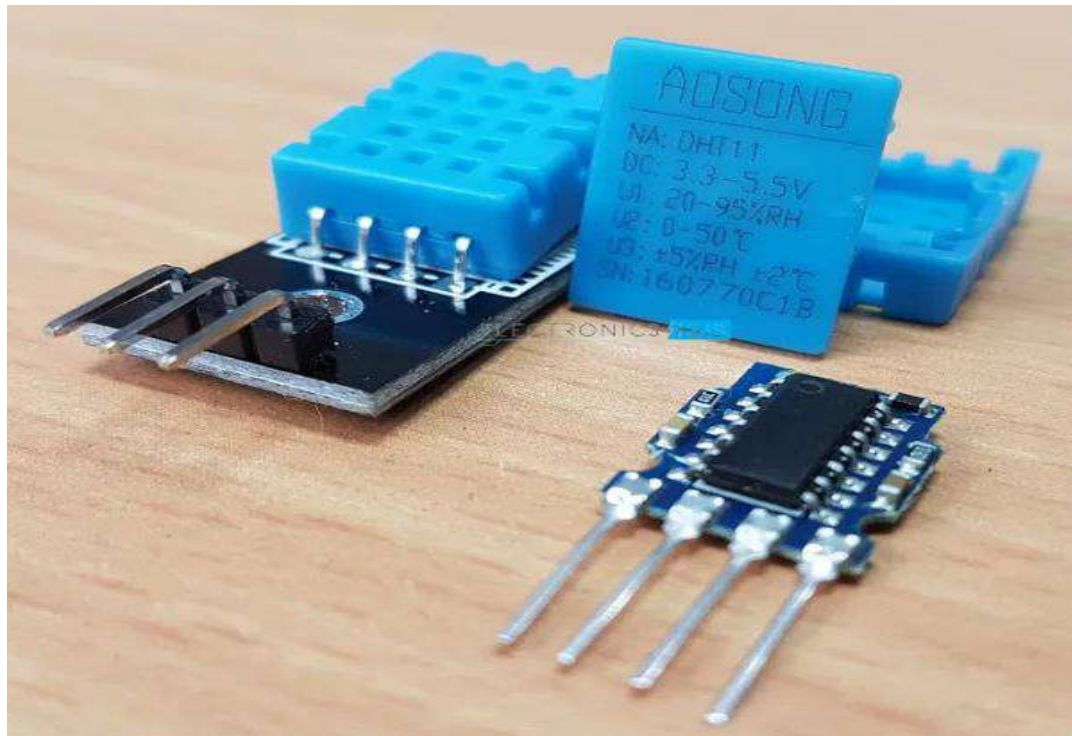
The other sensor in this series is the DHT22

Both sensors are Relative Humidity (RH) sensors, meaning that the two sensors measure temperature and humidity. DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition.

technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a highperformance 8-bit microcontroller, offering excellent quality, fast response, anti-interference and ability and cost-



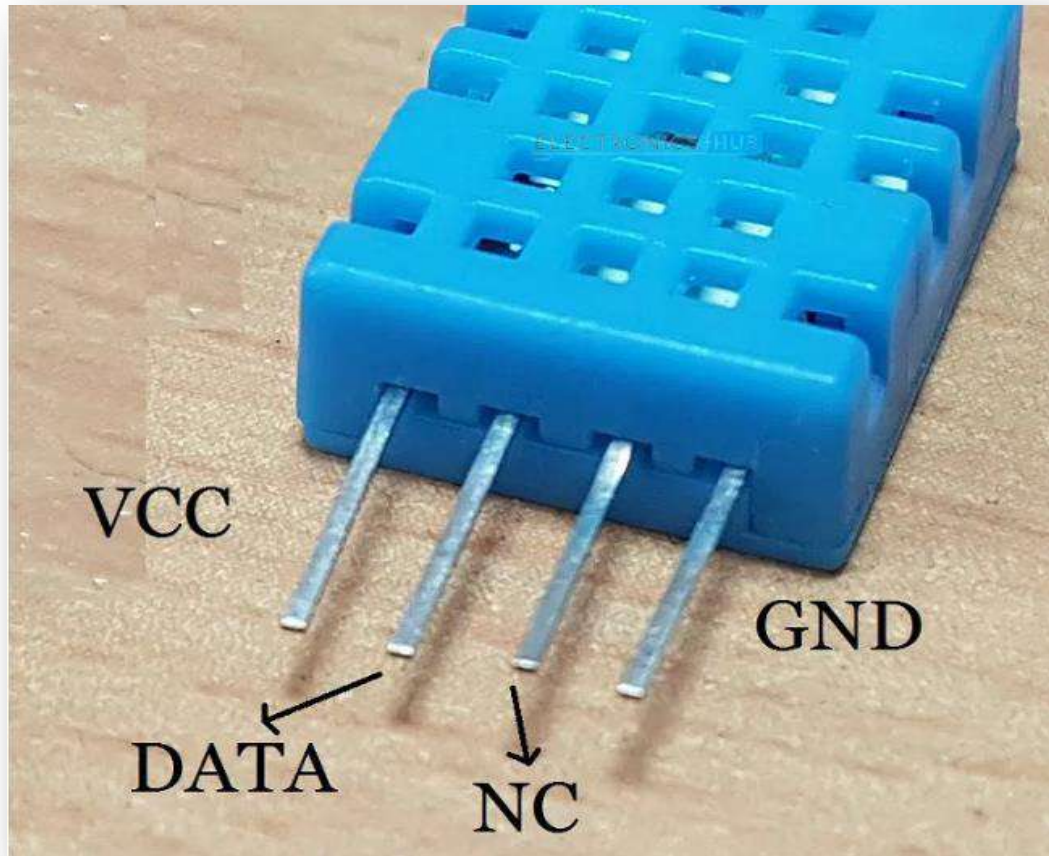
effectiveness. The DHT11 sensor is popular with beginners despite its slowness, because it is cheap



Fig(2.2)dth11

The DHT11 sensor consists of three basic components: a resistance-type moisture sensor, an NTC temperature sensor (with a negative thermal coefficient) to measure the temperature, and an 8-bit microcontroller that converts the analog signals from the two sensors into a single digital signal on the output.

The digital signal can be read by any microprocessor or microcontroller for analysis.



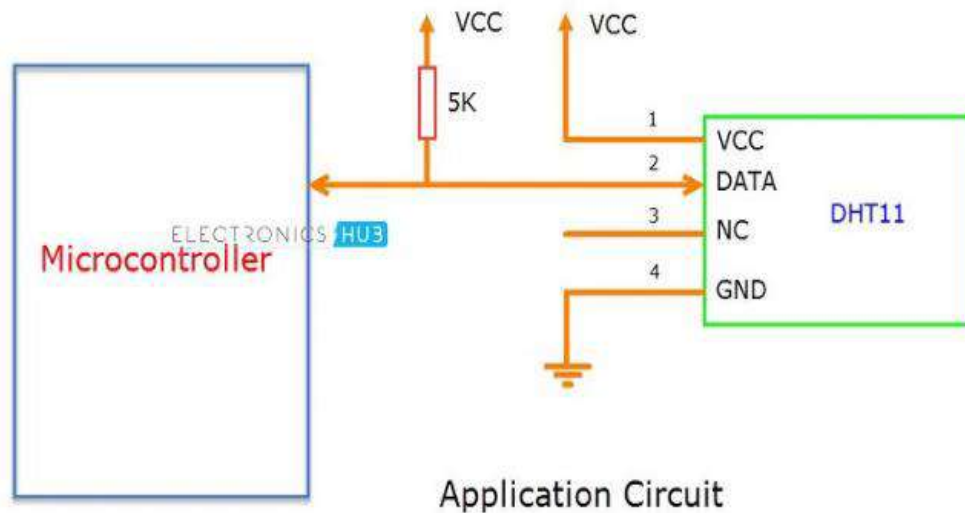
Fig(2.3)pin of dth11

The (DHT11) sensor has four poles: VCC Feed, Data Out, Disconnected (NC), and GND Ground.

The feed voltage range of the sensor is between 3.5V and 5.5V, from which a 5V supply source can be used.

Data on the terminal The output data is serial digital data.

The following figure shows the sensor measures Relative Humidity (RH) values between 0-90% and temperature values between 0-50 ° C, and the sampling period is 1 second.



Fig(2.4)application circuit

DHT11 sensors are accurately calibrated in laboratories, and the results are stored in memory.

The connection between the sensor and the Arduino can be built by a single wire that can be up to 20 meters in length.

The data coming from the sensor consists of: integer and decimal parts of both relative humidity (RH) and temperature.

The data coming from the sensor consists of 40 bits: 8 bits for the integer value for humidity, 8 bits for the decimal value for humidity, 8 for the integer value for temperature, 8 for the decimal value for heat, and 8 bits for the validity of the transmission checksum.

### Example

Suppose that the data received from the DHT11 sensor is as follows

00100101 00000000 00011001 00000000 00111110

The data can be divided into the following sections as mentioned previously

<b>00100101</b>	<b>00000000</b>	<b>00011001</b>	<b>00000000</b>	<b>00111110</b>
High Humidity	Low Humidity	High Temperature	Low Temperature	Checksum (Parity)

Fig(2.5) data of dth11

To ensure the correctness of the data, we perform a simple math. We collect the integer and decimal parts of both humidity and temperature, and check if they are equal to the value of the transmission verification bit (the last eight bits(

$$00100101 + 00000000 + 00011001 + 00000000 = 00111110$$

The value is equal to the validation byte, hence the received data is correct

To obtain the values of humidity and temperature, we convert the binary data to decimal

Relative humidity (RH) = decimal conversion of 00100101 = 37%

Heat = decimal conversion of 00011001 = 25 deg C

Project work principle:

We will be using the Arduino UNO and DHT11 humidity and temperature sensor to display the humidity and environment temperature on the LCD.

After the wires are connected, there is no need to do anything because the program will do all the work.

We did not use a private library even though there is a library for the DHT11 sensor which is "DHT". If you want to use this library,

you have to download it separately and add it to the Arduino Libraries.

The program relies on the timing charts of the data contained in the datasheet. The Arduino will automatically read the data from the sensor and display it on the screen, and when the temperature or humidity increases, it will give us an alert.

# Chapter Three

## Practical work

### **3-1 Overview**

We will be using the Arduino UNO and the DHT11 humidity and temperature sensor to display the humidity and temperature of the environment on the LCD screen.

After the wires are connected, we don't need to do anything because the program will do all the work.

We did not use a private library even though there is such a library for the DHT11 sensor which is "DHT". If you want to use this library, you must download it separately and add it to the Arduino libraries.

The program relies on data timing diagrams found in the datasheet. The Arduino will read the data automatically from the sensor and display it on the screen

### **3-2 Description the proposed system**

To do this project we will need

#### **1-arduino**

Arduino is an electronic development board, based on material hardware - hardware - and hardware - software - easy to use and learn. It can be used by both professionals and beginners, and it uses everything you can think of. The official site of Arduino

Arduino can communicate with the surrounding environment through a number of sensors, and can influence its surroundings by controlling small motors or lights and other electronic parts.



The micro-controller on the board is programmed by easy-to-learn Arduino Programming language and by Arduino's integrated development environment (Arduino IDE). Arduino can be integrated - Arduino is connected to its sensors and electronic parts only - or Arduino is connected and communicates with programs on the computer, such as Processing, MaxMSP and MATLAB in figure 3.1



Figure 3.1 Arduino Uno

## **2 DTH11**

HT11 sensor: It is a humidity and temperature sensor with standard digital output. The sensor can be connected with any microcontroller such as Arduino or Raspberry Pi, etc. and get instant results

This sensor is characterized by its low cost, high reliability, and long-term stability Weather monitoring is one of the primary applications of this sensor

DHT11 output calibrated digital signal. It applies exclusive digital-signal-collecting-technique and humidity sensing technology,

assuring its reliability and stability. Its sensing elements is connected with 8-bit single-chip computer. Every sensor of this model is temperature compensated and calibrated in accurate calibration chamber and the calibration-coefficient is saved in type of programme in OTP memory, when the sensor is detecting, it will cite coefficient from memory. Small size & low consumption & long transmission distance(100m) enable DHT11 to be suited in all kinds of harsh application occasions. Single-row packaged with four pins, making the connection very convenient.

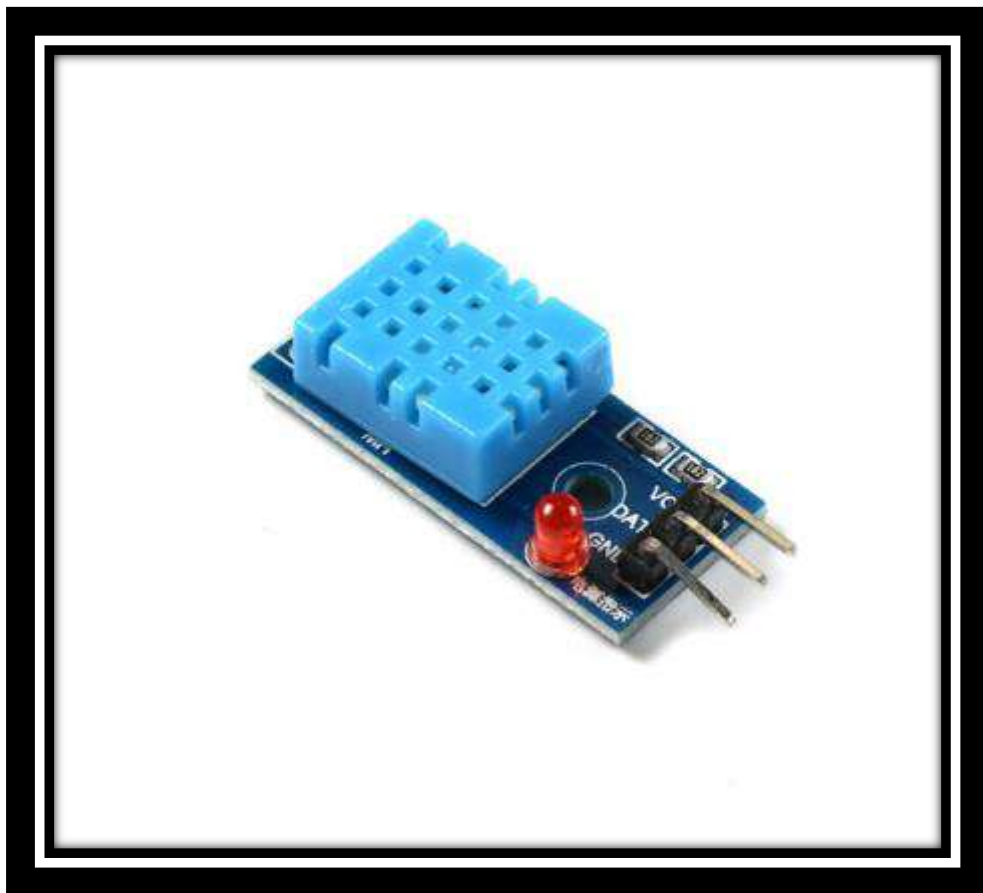


Figure 3.2 dth11

### **3- Liquid Crystal Display ( LCD)**

This component is specifically manufactured to be used with microcontrollers, which means that it cannot be activated by standard IC circuits. It is used for displaying different messages



on a miniature liquid crystal display. it can display messages in two lines with 16 characters each. Also it can display all the letters of alphabet, Greek letters, punctuation marks, mathematical symbols etc. Fig. 3 illustrates LCD (2 x 16 characters) and its connection

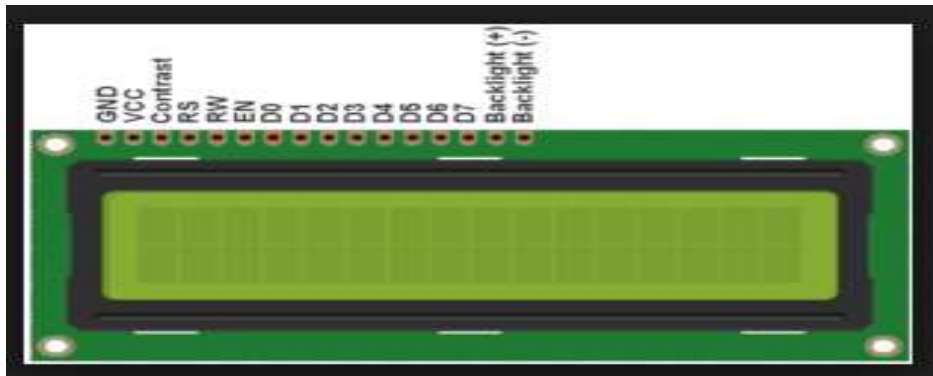


Figure 3.3 lcd

#### **4- Board**

#### **5- Power Supply 12V**

The power supply circuit consists of a step-down transformer which is 230v step down to 12v. In this Circuit 4 diodes are used to for M-bridge rectifier which delivers pulsating dc voltage & then fed to capacitor filter the output Voltage from the rectifier is fed to filter to eliminate any AC. components present even after rectification. The filtered DC voltage is given to regulator to produce 12v constant DC voltage It is used to feed Relay and Arduino in figure 3.5

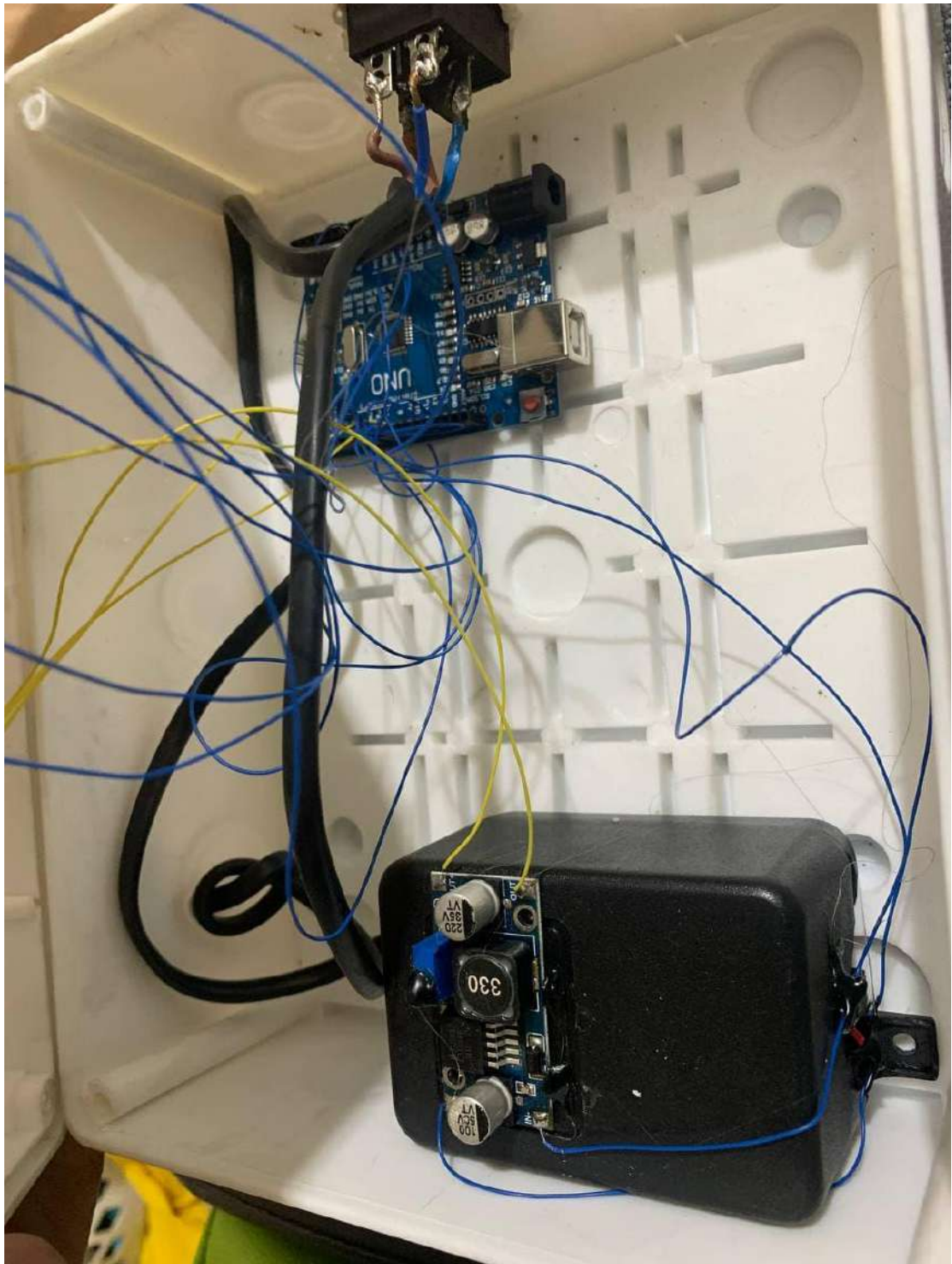


Figure 3.5

Hardware:-

Now we connect the electronic circuit as in Figure 3.7

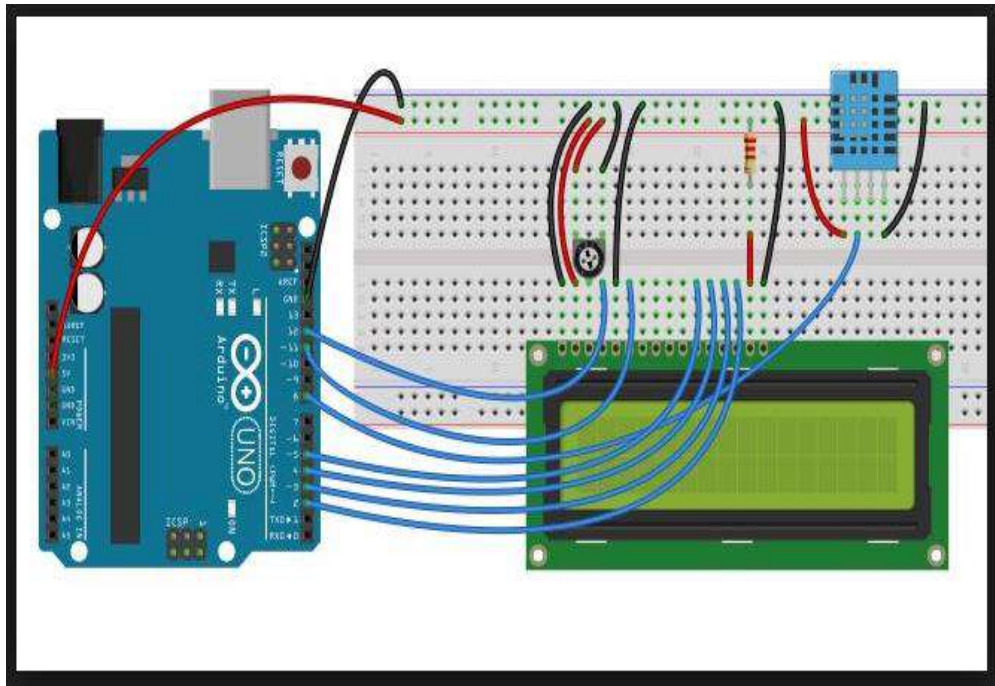


Figure 3.6 circuit diagram

We connect lcd pins to the arduino pins (2-3-4-5-11-12)

And we connect dht11 to arduino pin 6

We connect variable resistor to pin 3 in lcd

We will connect relay 12 volt instead of the fan in this figure

### Code

```
#include <LiquidCrystal.h> //library
#include <SimpleDHT.h> //library
int DHT11pin = 8; //DHT PIN
int buzzer = 7; // 5V Buzzer
SimpleDHT11 dht11;
LiquidCrystal lcd(12, 11, 5, 4, 3, 2); //LCD pins
```

```

void setup} ()
  Serial.begin(9600){
  pinMode(buzzer, OUTPUT); //set buzzer pinmode
  lcd.begin(16, 2); //set lcd to 16 positions and 2 rows
  {

void loop} ()
  // read with raw sample data.
  byte temperature = 0{
  byte humidity = 0{
  byte data[40] = {0{
  // Show error when DHT11 reading fails
  if (dht11.read(DHT11pin, &temperature, &humidity, data) ((
    lcd.setCursor(0,0){
    lcd.print("DHT11{("
    lcd.setCursor(0,1){
    lcd.print("ERROR{("
  // Error sound from Buzzer
  tone(buzzer, 1000){
  delay(1500){
  noTone(buzzer){
  delay(500){
  tone(buzzer, 1500){
  delay(1000){
  noTone(buzzer){
  delay(1000){
  return{
  //
  // LCD print

```



```

{
  if (humidity < 20(
  } tone(buzzer, 1000{(
  delay(1500{(
  noTone(buzzer{(
  delay(500){{(
  else
  } noTone(buzzer{(
  delay(1000){{(

    if (temperature > 20(
    } tone(buzzer, 1000{(
    delay(1500{(
    noTone(buzzer{(
    delay(500){{(
    else
    } noTone(buzzer{(
    delay(1000){{(

// clear screen
  lcd.setCursor(0, 0){
// print text
  lcd.print("Temp:  C{("
// set cursor to position 6 first row
  lcd.setCursor(6,0){
// print temperature data
  lcd.print(temperature{(
// set cursor to second row
  lcd.setCursor(0,1){

```

```
// print text
lcd.print("Humidity: ")
// set cursor to position 6 second row
lcd.setCursor(6,1);
// print humidity data
lcd.print(humidity);
// Wait 2 seconds to read new data
delay(2000);

{
```

### **Result:**

We have put the device we designed in different weather conditions as follows:

- 1- It was placed in a closed room in its normal atmosphere, the temperature was 32 degrees Celsius and the humidity was 23%
- 2- It was placed in the refrigerator and the temperature was measured at 5 degrees Celsius and the humidity was 7%
- 3- It was placed outside the house at noon. The temperature was measured at 42 degrees Celsius and the humidity was 19%.

# Chapter Four

## Conclusion and future work

### 4.1 Conclusion

This project demonstrates the design and construction of a talking system for weather conditions. Using the temperature and humidity sensor

Carefully selected to measure room temperature. Besides, the microcontroller is used to control the fan speed by using the fan speed in number of revolutions per minute

The Arduino has been programmed successfully using C / C ++ language to compare the temperature with the standard temperature and the relative humidity. We will display the values displayed on the LCD screen.

Moreover, when the temperature is too high or the humidity level is too high. In sum, the system designed in this work performed very well, for any change in temperature and could be classified as automatic control.

### 4.2 future work

We can develop this project by adding several cooling devices

Or by placing sensitive heat and moisture instead of just heat



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## المخلص

من الامور المهمة التي تثير اهتمام الانسان بشكل يومي هو معرفة الظروف الجوية مثل الحرارة، الرطوبة، سرعة واتجاه الرياح، الضغط الجوي، الامطار، شدة الضوء والضباب. معرفة هذه الامور مهمة لغرض بناء جدول اعمال الانسان اليومي او لاغراض السفر او التنقل وغيرها.

تم في هذا المشروع بناء منظومة ناطقة لمساعدة مكفوفي البصر، هذه المنظومة لها القابلية على التكلم وتزويد الزبون بما يحتاج معرفته عن الظروف الجوية المحيطة به بالاعتماد على مجموعة من المتحسسات الخاصة بهذا الموضوع. تعمل هذه المنظومة بصورة اوتوماتيكية لتزويد الزبون بالظروف الجوية بفترات زمنية ثابتة وقابلة للتغير حسب طلب الزبون.

الوحدة الاساسية في هذه المنظومة هي بورد تطوير إلكتروني (اردينو) يتكون من دائرة إلكترونية مفتوحة المصدر مع متحكم دقيق يُبرمج عن طريق الحاسوب مصمم لتسهيل استخدام الإلكترونيات التفاعلية في المشاريع متعددة التخصصات ومنها المشاريع التي تستهدف بناء حساسات بيئية مختلفة ويعتمد البورد في برمجته على لغة البرمجة مفتوحة المصدر.



## **تصميم وبناء منظومة للاستشعار بمتغيرات الجو**

يتم تقديم مشروع تخرج لقسم هندسة تقنيات الحاسبات في استيفاء جزئي لمتطلبات درجة بكالوريوس العلوم في هندسة تقنيات الحاسوب.

بواسطة

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*Dijlah University College*  
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# Design of smart phone controlled high power LED power supply

A Project Submitted to the Department of  
Computer Techniques Engineering / Dijlah University College  
In Partial Fulfillment of the Requirement for  
The Degree of B. Eng. In Computer Techniques.

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# SUPERVISOR CERTIFICATION

## **SUPERVISOR CERTIFICATION**

I certify that this Project entitled

**“Design of smart phone controlled high power led power supply”** was prepared under my supervision at the Department of Computer Techniques Engineering, Dijlah University College - Baghdad, in partial fulfillment of the requirements for the degree of B. Eng. in Computer Techniques.

**Signature:**

**Name:**

**Date:**     /     /

## شهادة المشرف

### إهداء

□ إلى أعز الناس وأقربهم إلى قلبي إلى والدتي العزيزة ووالدي العزيز اللذان كانا عوناً وسنداً لي ، و كان لدعائهما المبارك أعظم الأثر في تسيير سفينة البحث حتى ترسو على هذه الصورة .

□ إلى من ساندتني وخطت معي خطواتي، ويسرت لي الصعاب؛ إلى زوجتي العزيزة التي تحملت الكثير وعانت، ووقوفني في هذا المكان ما كان ليحدث لولا تشجيعها المستمر لي .

□ إلى زهراتي وفلذات كبدي؛ ولدي العزيز وابنتي العزيزة . اللذان حرما مني طيلة الفترة التي قضيتها في إعداد هذا البحث .

□ إلى أساتذتي وأهل الفضل عليّ الذين غمروني بالحب والتقدير والنصيحة والتوجيه والإرشاد .

إلى كل هؤلاء أهديهم هذا العمل المتواضع؛ سائلاً الله

العلي التقدير أن نفعنا به ويمدنا بتوفيقه .

## **Abstract**

**The using of Light emitting diode (LED) technology get more attractive nowadays due to long life time and low cost. However the design of the LED power supply (driving circuit is slightly complicated than ordinary bulb. The LED driver is an electronic circuit unit which feed a controllable constant current in to the LED so, that it can generate a significant amount of optical power as an output.**

**Controlling the LED On/Off as well as the lightening power using the smartphone based on IoT is on demand to facilitate the human life**

**We have designed and developed a LED power supply that controlled through the smart phone based on IoT Technology. The designed is uses NodeMCU 1.0 (ESP-12E Module) microcontroller both with Blynk IoT platform to accomplish the mission.**

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# Chapter One

## Introduction

### **1.1 Introduction to embedded system**

We can easily find embedded systems everywhere in our daily lives. The numbers of embedded systems are rapidly growing especially in wireless and web applications. The embedded systems market is one of the fastest growing areas in the world. By name, an embedded system is a special purpose computing device designed to perform dedicated functions. Some of the embedded systems with real-time constraints are called real-time embedded systems. An embedded system consists of its hardware and software. The hardware includes a microprocessor or microcontroller with additional attached external memory, I/O, and other components such as sensors, keypad, LEDs, LCDs, and any kind of actuators. The embedded software is the driving force of an embedded system. Most real-time embedded systems software has specific application programs supported by a Real Time Operating System (RTOS). The embedded software is usually called firmware because this type software is loaded to ROM, EPROM, or Flash memory, and once it is loaded it will never be changed unless it needs to be reloaded or replaced.

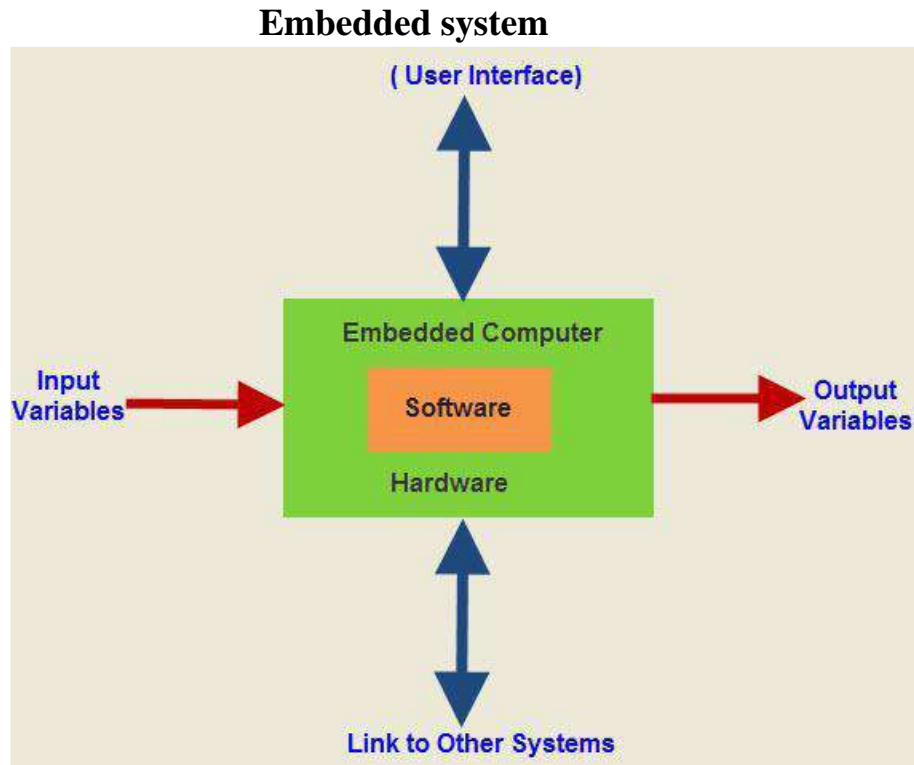


Figure 1.1 Introduction to embedded system

## 1.2 Comparing between microprocessor and Microcontroller

A microcontroller is a chip optimized to control electronic devices. It is stored in a single integrated circuit which is dedicated to performing a particular task and execute one specific application.



Figure 1.2 Comparing between microprocessor and Microcontroller

It is specially designed circuits for embedded applications and is widely used in automatically controlled electronic devices. It contains memory, processor, and programmable I/O.

A microprocessor is a controlling unit of a micro-computer wrapped inside a small chip. It performs Arithmetic Logical Unit (ALU) operations and communicates with the other devices connected with it. It is a single Integrated Circuit in which several functions are combined.

### **1.3The Internet of Things (IoT)**

the network of physical objects—devices, instruments, vehicles, buildings and other items embedded with electronics, circuits, software, sensors and network connectivity that enables these objects to collect and exchange data.



**Internet of Things**

Figure 1.3 The Internet of Things (IoT)

The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency and accuracy. The concept of a network of smart devices was discussed as early as 1982, with a modified Coke machine at Carnegie Mellon University becoming the first internet-connected appliance [3], able to report its inventory and whether newly loaded drinks were cold. Kevin Ashton (born 1968) is a British technology pioneer who is known for inventing the term "the Internet of Things" to describe a system where the Internet is connected to the physical world via ubiquitous sensors. IoT is able to interact without human intervention. Some preliminary IoT applications have been already developed in healthcare, transportation, and automotive industries. IoT technologies are at their infant stages; however, many new developments have occurred in the integration of objects with sensors in the Internet. The development of IoT involves many issues such as infrastructure, communications, interfaces, protocols, and standards.

#### **1.4 Aim of the work**

This work aims to design and implement a Light Emitting Diode (LED) power supply controlled via smart as an application of IOT. The proposed power supply controller circuit was built based on NodeMCU microcontroller.

## **Chapter Two**

### **Hardware and software description**

#### **2.1 Light Emitting Diode**

Light Emitting Diodes (LEDs) are the most widely used semiconductor diodes among all the different types of semiconductor diodes available today. Light emitting diodes emit either visible light or invisible infrared light when forward biased. The LEDs which emit invisible infrared light are used for remote controls.

LED is an optical semiconductor device that emits light when voltage is applied. In other words, LED is an optical semiconductor device that converts electrical energy into light energy.



Figure 2.1 **Light Emitting Diode**

When LED is forward biased, free electrons in the conduction band recombine with the holes in the valence band and release energy in the form of light.

The process of emitting light in response to the strong electric field or flow of electric current is called electroluminescence.

A normal p-n junction diode allows electric current only in one direction. It allows electric current when forward biased and does not allow electric current

when reverse biased. Thus, normal p-n junction diode operates only in forward bias condition.

Like the normal p-n junction diodes, LEDs also operates only in forward bias condition. To create an LED, the n-type material should be connected to the negative terminal of the battery and p-type material should be connected to the positive terminal of the battery. In other words, the n-type material should be negatively charged and the p-type material should be positively charged.

The construction of LED is similar to the normal p-n junction diode except that gallium, phosphorus and arsenic materials are used for construction instead of silicon or germanium materials.

In normal p-n junction diodes, silicon is most widely used because it is less sensitive to the temperature. Also, it allows electric current efficiently without any damage. In some cases, germanium is used for constructing diodes.

However, silicon or germanium diodes do not emit energy in the form of light. Instead, they emit energy in the form of heat. Thus, silicon or germanium is not used for constructing LEDs.

### **2.1.1 How Light Emitting Diode works?**

Light Emitting Diode works only in forward bias condition. When LED is forward biased, the free electrons from n-side and the holes from p-side are pushed towards the junction.

When free electrons reach the junction or depletion region, some of the free electrons recombine with the holes in the positive ions. We know that positive ions have less number of electrons than protons. Therefore, they are ready to accept electrons. Thus, free electrons recombine with holes in the depletion region. In the similar way, holes from p-side recombine with electrons in the depletion region.

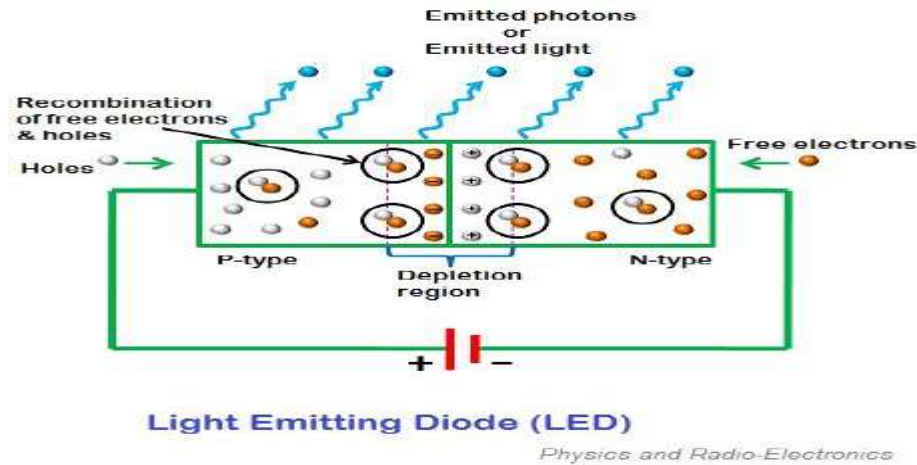


Figure 2.2

Because of the recombination of free electrons and holes in the depletion region, the width of depletion region decreases. As a result, more charge carriers will cross the p-n junction.

Some of the charge carriers from p-side and n-side will cross the p-n junction before they recombine in the depletion region. For example, some free electrons from n-type semiconductor cross the p-n junction and recombine with holes in p-type semiconductor. In the similar way, holes from p-type semiconductor cross the p-n junction and recombine with free electrons in the n-type semiconductor.

Thus, recombination takes place in depletion region as well as in p-type and n-type semiconductor. The free electrons in the conduction band releases energy in the form of light before they recombine with holes in the valence band. In silicon and germanium diodes, most of the energy is released in the form of heat and emitted light is too small.

However, in materials like gallium arsenide and gallium phosphide the emitted photons have sufficient energy to produce intense visible light.

### 2.1.2 Biasing of LED



The safe forward voltage ratings of most LEDs is from 1V to 3 V and forward current ratings is from 200 mA to 100 mA.

If the voltage applied to LED is in between 1V to 3V, LED works perfectly because the current flow for the applied voltage is in the operating range.. This sudden rise in current may destroy the device.

To avoid this we need to place a resistor ( $R_s$ ) in series with the LED. The resistor ( $R_s$ ) must be placed in between voltage source ( $V_s$ ) and LED.

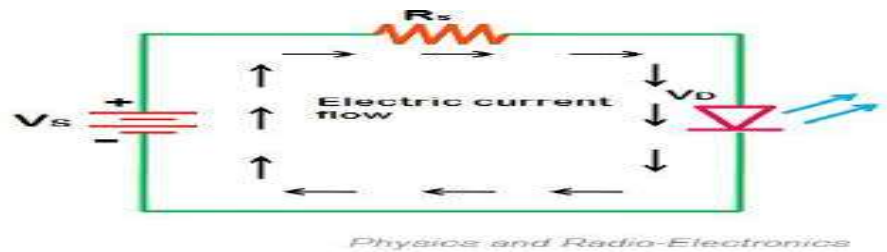


Figure 2.3

The resistor placed between LED and voltage source is called current limiting resistor. This resistor restricts extra current which may destroy the LED. Thus, current limiting resistor protects LED from damage.

The current flowing through the LED is mathematically written as

Forward current in LED formula

$$I_F = \frac{V_S - V_D}{R_S}$$

Where,

$I_F$  = Forward current

$V_S$  = Source voltage or supply voltage

$V_D$  = Voltage drop across LED

RS = Resistor or current limiting resistor

Voltage drop is the amount of voltage wasted to overcome the depletion region barrier (which leads to electric current flow). The voltage drop of LED is 2 to 3V whereas silicon or germanium diode is 0.3 or 0.7 V.

Therefore, to operate LED we need to apply greater voltage than silicon or germanium diodes. Light emitting diodes consume more energy than silicon or germanium diodes to operate.

### 2.1.3 Output characteristics of LED

The amount of output light emitted by the LED is directly proportional to the amount of forward current flowing through the LED. More the forward current, the greater is the emitted output light. The graph of forward current vs output light is shown in the figure.

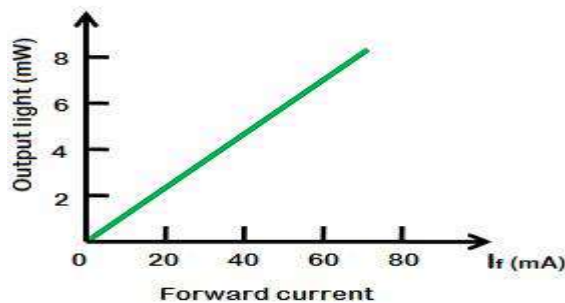
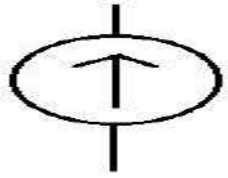


Figure 2.4

## 2.2 Constant current source

A constant current source is a power source which provides a constant current to a load, even despite changes and variance in load resistance.

In other words, the current which a constant current source provides is steady,



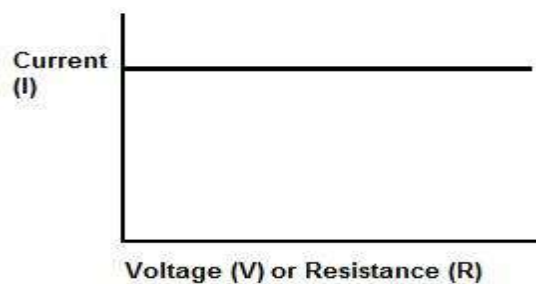
even if the resistance of the load varies.

Figure 2.5

A constant current source is, thus, a very valuable component because it can supply steady current even if there are changes in resistance, even a wide variance in the resistance. This comes in use when a circuit needs a steady current supply, without fluctuations.

The represents the current which comes from a constant current source

Figure 2.6



One can see that the current is constant all throughout despite changes in voltage or resistance.

### 2.2.1 How Does A Constant Current Source Work?

A constant current source is a power generator whose internal resistance is very high compared with the load resistance it is giving power to. Because its internal resistance is so high, it can supply a constant current to a load whose resistance value varies, even over a wide range.

Thus, a constant current source follows the rules of current division. Being that it has very high internal resistance and the load resistance is much lower, current takes the path of least resistance, flowing out of the (high internal resistance) current source and into the load resistance, since it is of much lower resistance. If one know current division, current takes the path of least resistance. Look at the following current divider circuit below:

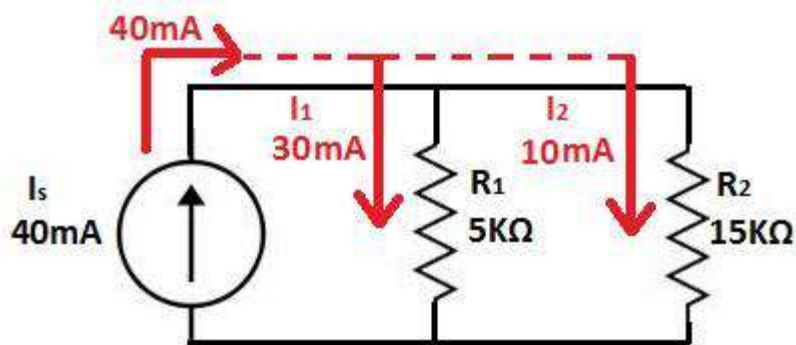


Figure 2.7

Notice how this current source, shown above, supplies 40mA of total current from out of it. The majority of this 40mA of current takes the path of least resistance, the 5KΩ resistor, and the other 10mA of current goes through the larger resistance, 15KΩ.

Now let's increase the difference in resistances between the two resistors, so that the current division is even more pronounced.

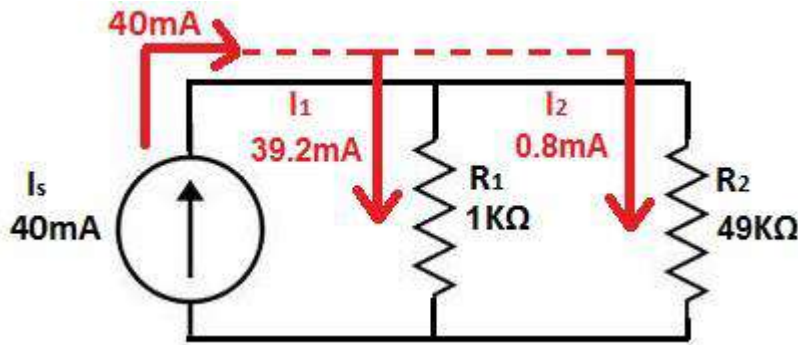


Figure 2.8

Now that one resistor is  $1\text{K}\Omega$  and the other resistor is  $49\text{K}\Omega$ , the vast majority of the current goes through the  $1\text{K}\Omega$  resistor. Very little current goes through the  $49\text{K}\Omega$ , because it is such a great resistance.

Now let's increase the resistance again. The below current source represents a current source which has infinite internal resistance.

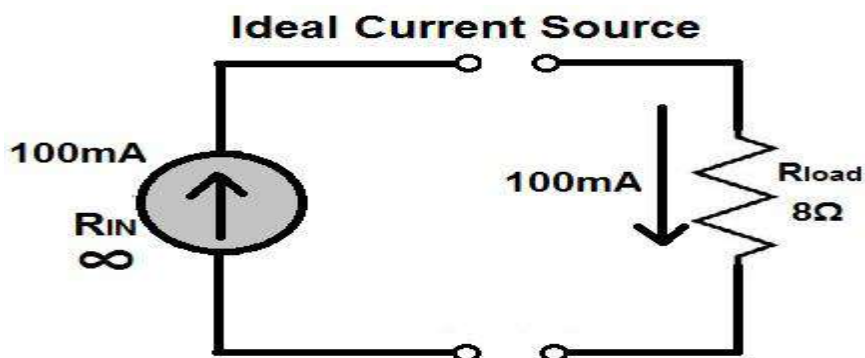


Figure 2.9

Because the resistance is infinite and the load is only  $8\Omega$ , most of the current goes through the  $8\Omega$  resistor, which is the path of least resistance. Again, current always take the path of least resistance. Since the load has infinite internal resistance, current will always seek to escape from it to a lower resistance path.

This is how constant current sources work.

### 2.2.2 Constant Current Source Circuit

A constant current source circuit is just a constant current source connected to the load which it powers.

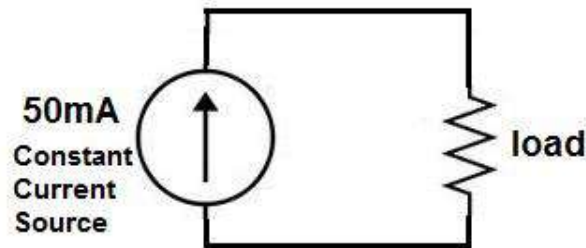
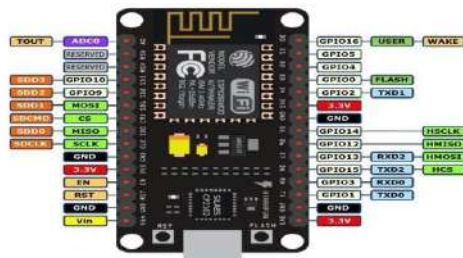


Figure 2.10

This load above will have a constant current of 50mA supplied to it regardless of whether the load resistance varies.

## 2.3 NodeMCU ESP8266

NodeMCU is an open-source based firmware and **development board** specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.



NodeMCU ESP8266 Pinout

Figure 2.11



NodeMCU ESP8266

Figure 2.12

### 2.3.1 NodeMCU ESP8266 Specifications & Features

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects

➤ **Other Espressif Boards**

ESP8266, ESP12E, ESP32

➤ **Other Development Boards**

Arduino, Raspberry Pi, PIC Development Board, AVR Development Board, MSP430 Launchpad, Intel Edison, Beagle Bone

### **2.3.2 NodeMCU ESP8266**

The **NodeMCU ESP8266 development board** comes with the ESP12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. NodeMCU can be powered using Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.



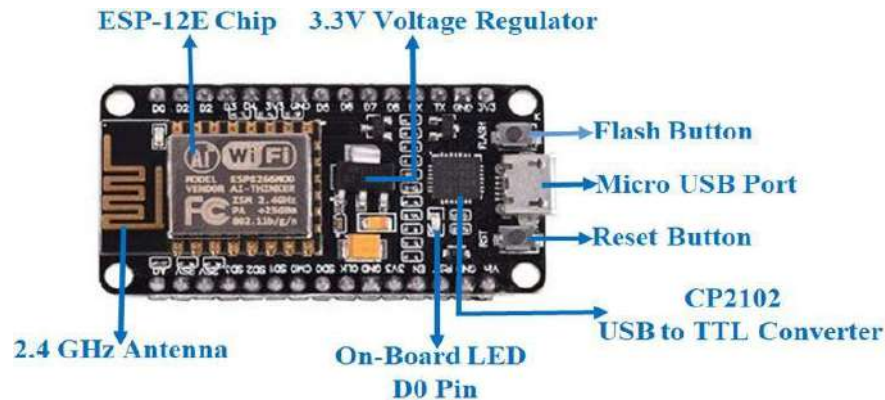


Figure 2.13

### 2.3.3 Programming NodeMCU ESP8266 with Arduino IDE

The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use. Programming NodeMCU with the Arduino IDE will hardly take All you need is the Arduino IDE, a USB cable and the NodeMCU board itself. You can check this [Getting Started Tutorial for NodeMCU](#) to prepare your Arduino IDE for NodeMCU.

#### 2.3.4 Uploading the program

Once Arduino IDE is installed on the computer, connect the board with the computer using the USB cable. Now open the Arduino IDE and choose the correct board by selecting

Tools>Boards>NodeMCU1.0 (ESP-12E Module), and choose the correct Port by selecting Tools>Port. To get it started with the NodeMCU board and blink the built-in LED, load the example code by selecting Files>Examples>Basics>Blink. Once the example code is loaded into your IDE, click on the „upload“ button given on the top bar. Once the upload is finished, you should see the built-in LED of the board blinking.

### 2.3.5 Applications of NodeMCU ESP8266

- Prototyping of IoT devices
- Low power battery operated applications
- Network projects
- Projects requiring multiple I/O interfaces with Wi-Fi and Bluetooth functionalities

## **2.4 The Blynk platform**

With Blynk, one can create smartphone applications that allow you to easily interact with microcontrollers or even full computers such as the Raspberry Pi.

The main focus of the Blynk platform is to make it super-easy to develop the mobile phone application.

developing a mobile app that can talk to your Arduino is as easy as dragging a widget and configuring a pin.

# The Blynk Platform

- Blynk is a platform for the development of smartphone applications that work with a wide range of microcontrollers.
- No mobile programming needed.
- Concentrate on the functionality.
- Free.



Mobile Development with Blynk

Tech  
Explorations



The Blynk platform

Figure 2.14

With Blynk, one can control an LED or a motor from your mobile phone with literally zero programming.

. But don't let this simplicity make you think that Blynk is only useful for trivial applications. Blynk is a robust and scalable tool that is used by hobbyists and the industry alike.

One can use it to monitor the soil humidity of your vegetable garden and turn on the water, or open up your garage door, with your phone. You can also use it to control smart furniture that can learn from your routines, or embed IoT and AI to traditional industrial products such as a boiler, or for improving the integrity and safety of oilfields.

Blynk is free to use for personal use and prototyping. Their business model generates profits by selling subscriptions to businesses that want to publish Blynk-powered apps for their hardware products or services.

### 2.4.1 The Blynk smartphone app



The Blynk smartphone app

Figure 2.15

The Blynk innovation is the smartphone app. The Blynk app is really an app editor. It allows you to create one or more projects. Each project can contain graphical widgets, like virtual LEDs, buttons, value displays and even a text terminal, and can interact with one or more devices. With the help of the Blynk library, it is possible to control Arduino or ESP32 pins directly from your phone, without having to write any code at all.

It is also possible to share a project with friends and even customers so that they can access the connected devices but not be able to modify the project. Imagine a scenario where you build a smartphone application where you can control lights, window blinds and room temperature from your phone. You can share

the project with other family members so that they can also access the functionality.

## 2.4.2 The Blynk microcontroller libraries


# The Blynk Platform: MCU libraries

- Blynk library available for many devices:
  - Arduino MKR1010, Uno, Nano, Zero etc.
  - ESP32/8266, BBC: micro, Teensy, Microduino, Digistump etc.
  - Particle Core, Photon etc.
- Blynk library available for Javascript, Python or Lua clients.
- Connectivity via USB(!), Ethernet, Wifi, BLE, 3G, LTE etc.

Supported hardware: <https://txplo.re/x5i>  
Blynk library (Arduino): <https://txplo.re/voy>

Mobile Development with Blynk

Tech Explorations



The Blynk microcontroller libraries

Figure 2.16

If one want to use your Arduino Uno with the Wifi101 shield, you would use the library “BlynkSimpleWiFiShield101”.

Both sketches would use the same Blynk infrastructure, such as the physical pins that are part of the Arduino's hardware, as well as the virtual pins which are implemented in software by the Blynk Platform. This means that with a bit of planning, you can write sketches that can be easily shared among different target devices. You can potentially write a sketch for an Arduino Uno and with minimal modification run it on an Arduino MKR1010.

Blynk also supports clients that are not a microcontroller. You can write client code in Javascript, Python or Lua thanks to the available Blynk libraries for these languages. This means that you can have a Blynk project that interacts with an Arduino and with Python code running on a Linux virtual machine somewhere on the Cloud. The possibilities are really very exciting.

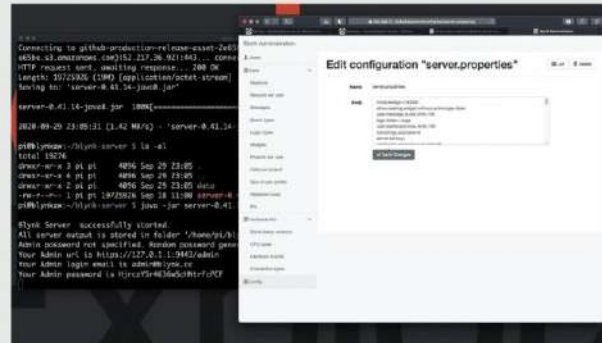
### **2.4.3 The Blynk server**

Unlike IoT platforms such as [IFTTT](#), [Twilio](#), and even [Adafruit IO](#), you can host a private instance of the full Blynk server and connect your smartphone Blynk app to it.

The Blynk Cloud server is an excellent choice for most projects, as it is always there, ready to use.

# The Blynk Platform: server

- Can run on any host with a Java runtime environment.
- Cloud server: ease of use, quick start.
- Private server: full control of your data, access. Low latency and maximum security.



Blynk server: <https://txplo.re/dqc>

Mobile Development with Blynk



The Blynk server

Figure 2.17

## 2.5 Relay

The relay is the device that open or closes the contacts to cause the operation of the other electric control. It detects the intolerable or undesirable condition with an assigned area and gives the commands to the circuit breaker to disconnect the affected area. Thus protects the system from damage.

### 2.5.1 Working Principle of Relay

It works on the principle of an electromagnetic attraction. When the circuit of the relay senses the fault current, it energizes the electromagnetic field which produces the temporary magnetic field.

This magnetic field moves the relay armature for opening or closing the connections. The small power relay has only one contacts, and the high power relay has two contacts for opening the switch.

The inner section of the relay is shown in the figure below. It has an iron core which is wound by a control coil. The power supply is given to the coil through the contacts of the load and the control switch. The current flows through the coil produces the magnetic field around it.

Due to this magnetic field, the upper arm of the magnet attracts the lower arm. Hence close the circuit, which makes the current flow through the load. If the contact is already closed, then it moves oppositely and hence open the contacts.

***Pole and Throw*** The pole and throws are the configurations of the relay, where the pole is the switch, and the throw is the number of connections. The single pole, the single throw is the simplest type of relay which has only one switch and only one possible connection. Similarly, the single pole double throw relay has a one switch and two possible connections.

### ***2.5.2 Construction of Relay***

The relay operates both electrically and mechanically. It consists electromagnetic and sets of contacts which perform the operation of the switching. The construction of relay is mainly classified into four groups. They are the contacts, bearings, electromechanical design, terminations and housing. Bearing – The bearing may be a single ball, multi-ball, pivot-ball and jewel bearing. The single ball bearing is used



for high sensitivity and low friction. The multi-ball bearing provides low friction and greater resistance to shock. Electromechanical design – The electromechanical design includes the design of the magnetic circuit and the mechanical attachment of core, yoke and armature. The reluctance of the magnetic path is kept minimum for making the circuit more efficient. The electromagnet is made up of soft iron, and the coil current is usually restricted to 5A and the coil voltage to 220V. Terminations and Housing – The assembly of an armature with the magnet and the base is made with the help of spring. The spring is insulated from the armature by moulded blocks which provide dimensional stability. The fixed contacts are usually spot welded on the terminal link.

## **Chapter Three**

### **Practical work**

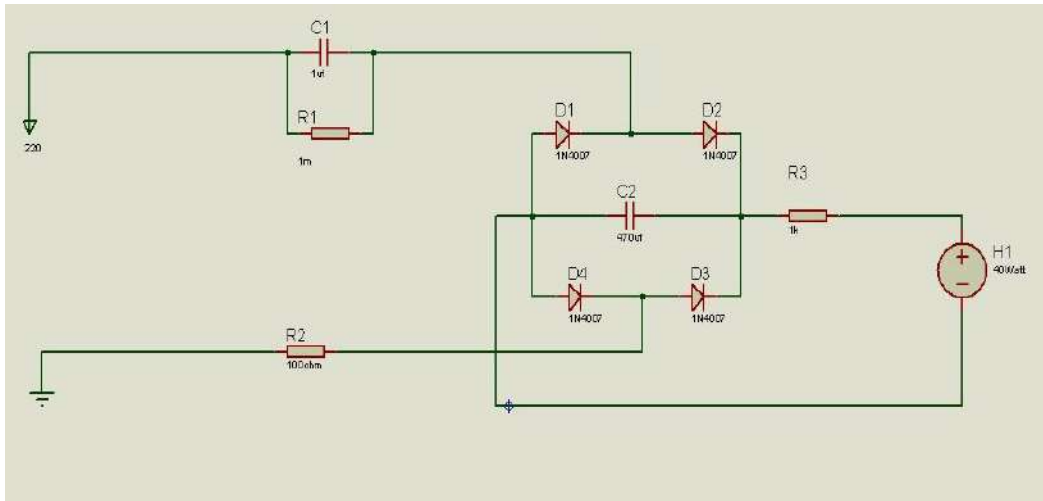
#### **3.1. Introduction**

This chapter describe the practical work of the project including the hardware and software development. Results will illustrated in chapter four.

#### **3.2 Hardware implementation**

Firstly, the LED power supply schematic diagram shown in figure 3.1 and its components shown in figure 3.2 was connected as shown in figure 3.3 In this stage

the NodeMCU microcontroller was not connected. The test result for the circuit in this stage will be shown in chapter four



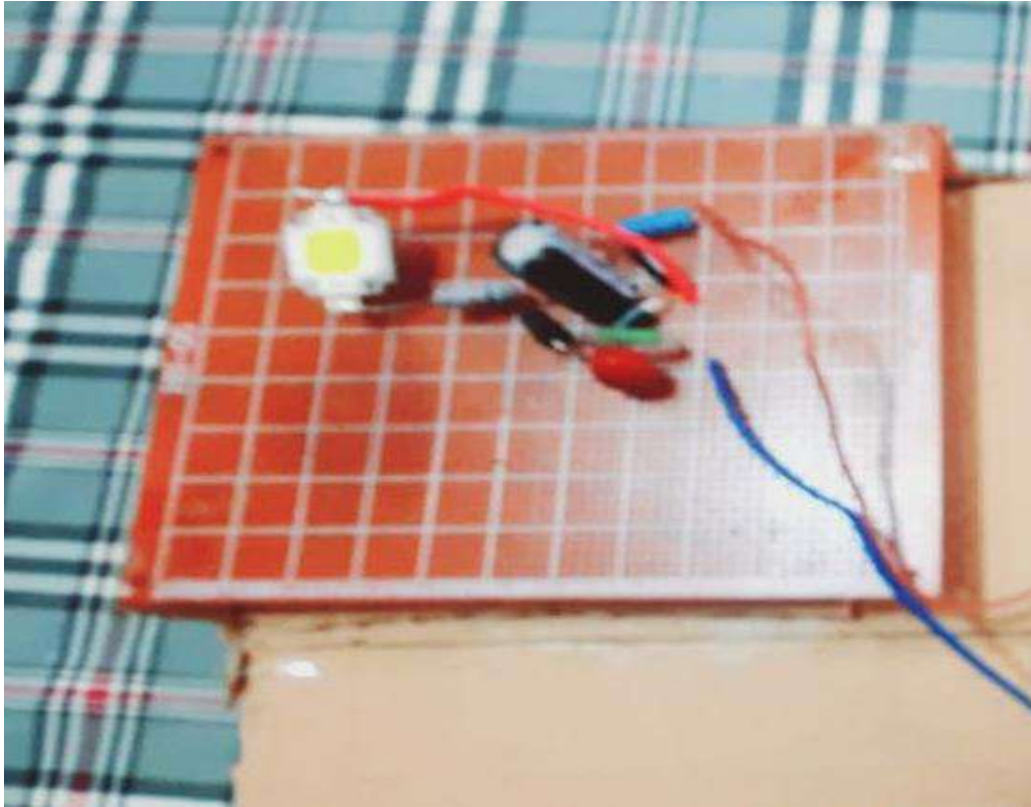
**Design Circuit LED power supply**

**Figure 3.1**



**Component Circuit LED power supply**

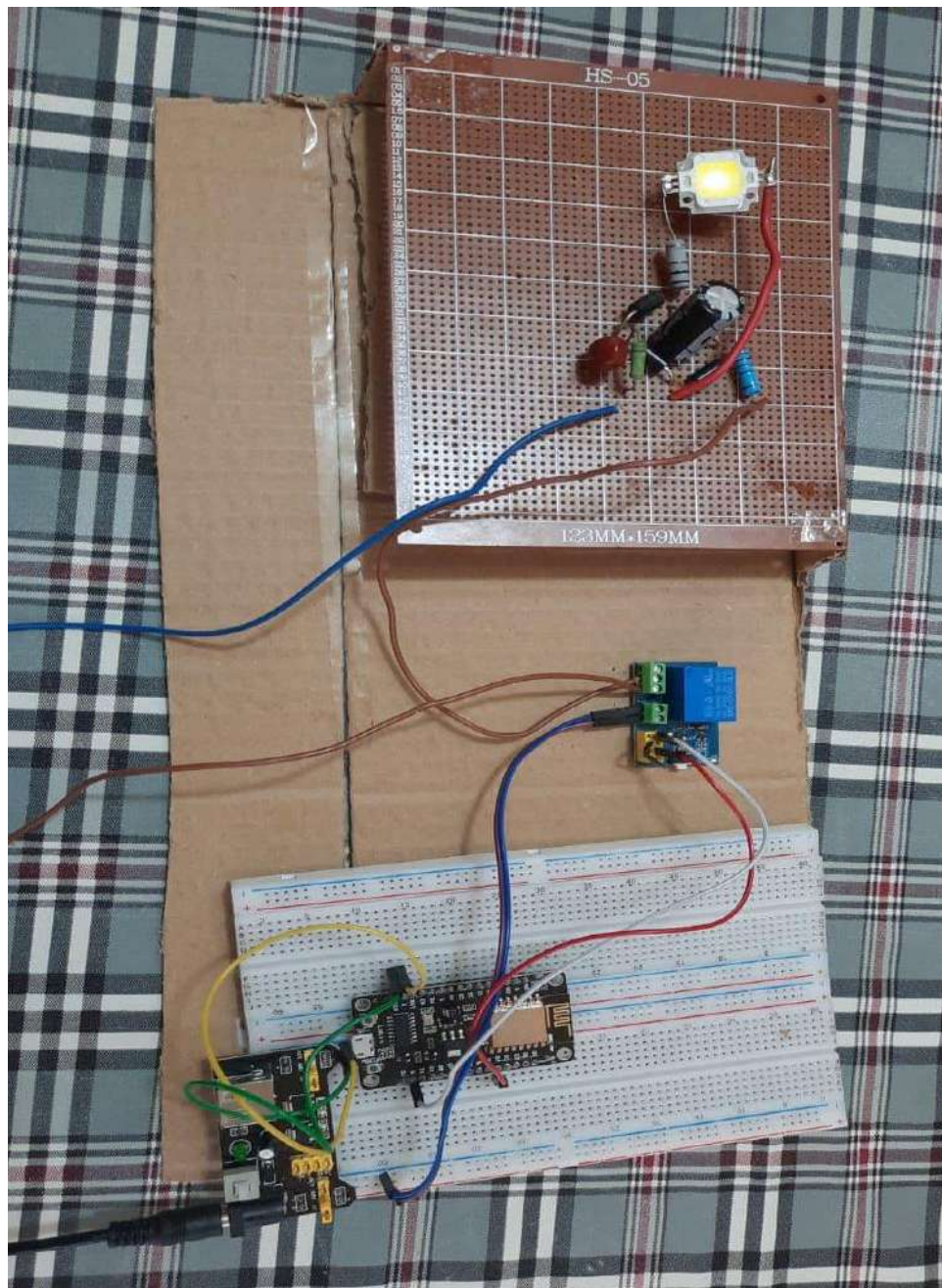
**Figure 3.1**



**Circuit LED power supply**

**Figure 3.2**

Then the NodeMCU and the relay module was connected to control the ON operation of the power supply as shown in A breadboard power supply with 9V power supply charger was used to power the NodeMCU as well as the RELAY operation



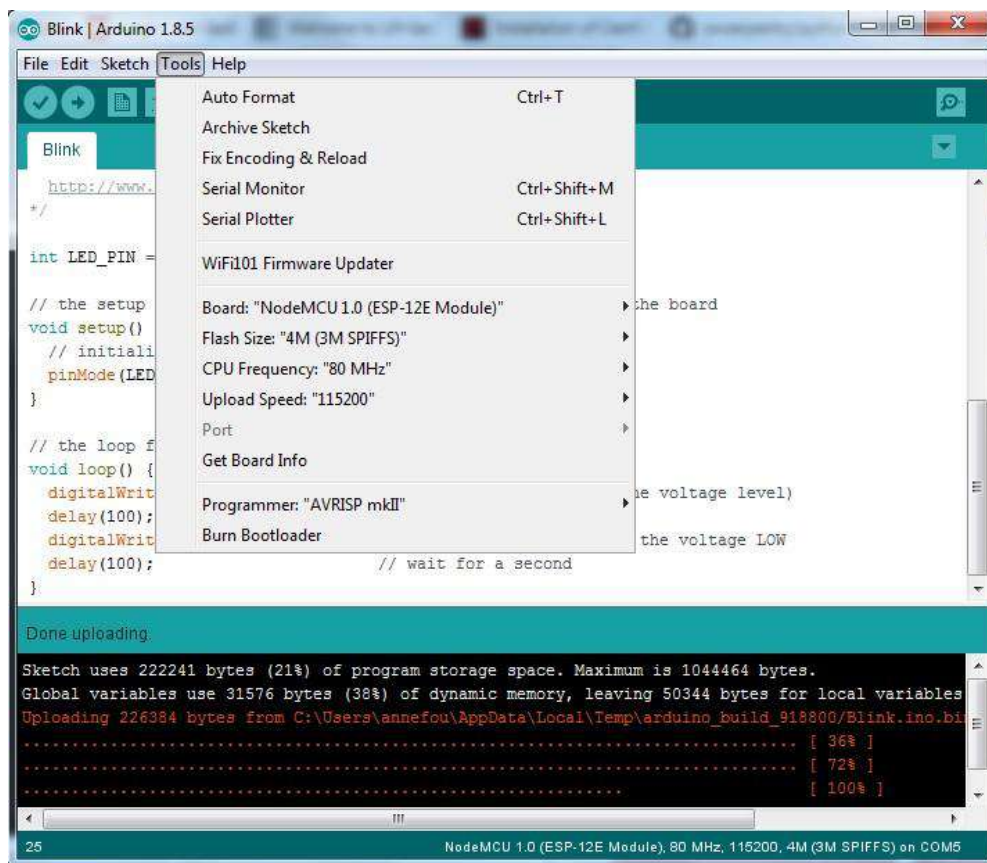
The Final Project

Figure 3.3

## 3.3 Software development

### 3.3.1 Arduino IDE

There are different ways to program the ESP8266 such as micropython (a subset of python) or using the Arduino IDE. In this project, Arduino IDE was used as it has a simple interface with built-in examples.



Software Arduino

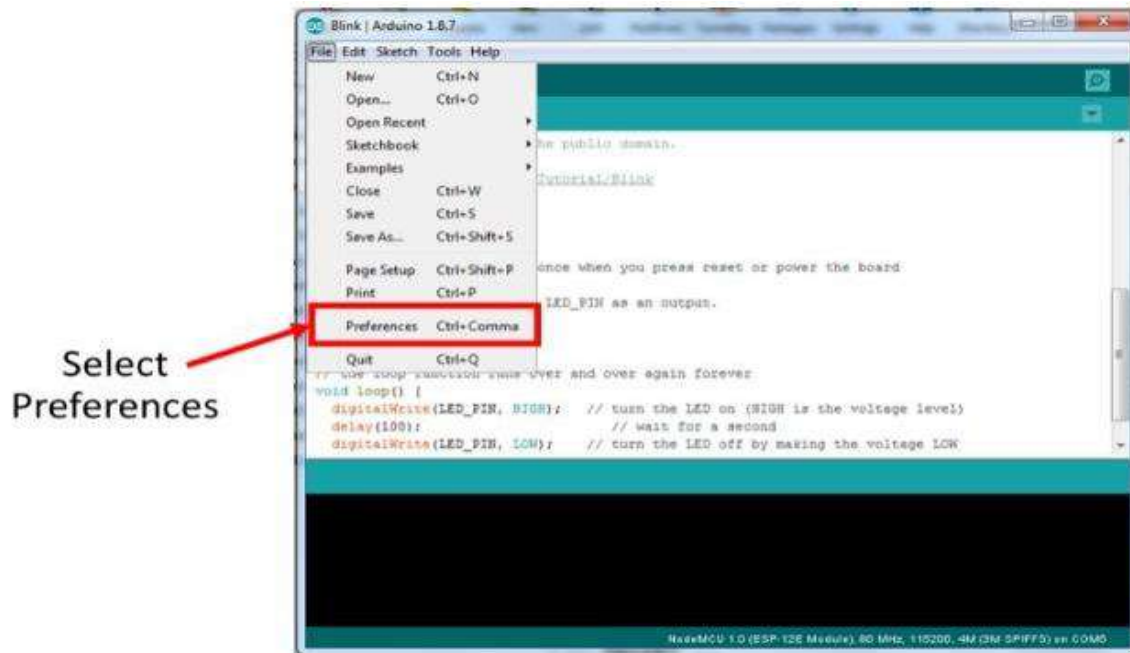
Figure 3.4



Next section the main steps on how the Arduino IDE was configured to do the job with the NodeMCU

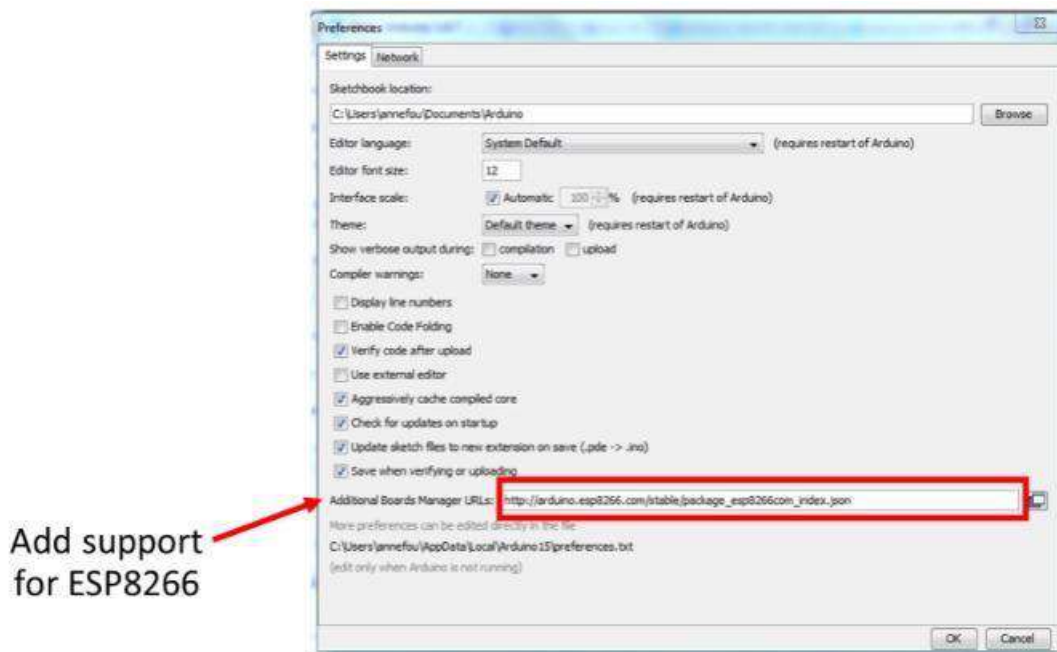
## Program an ESP8266 with Arduino GUI

- Select “File → Preferences”



Software Arduino

Figure 3.5



Software Arduino

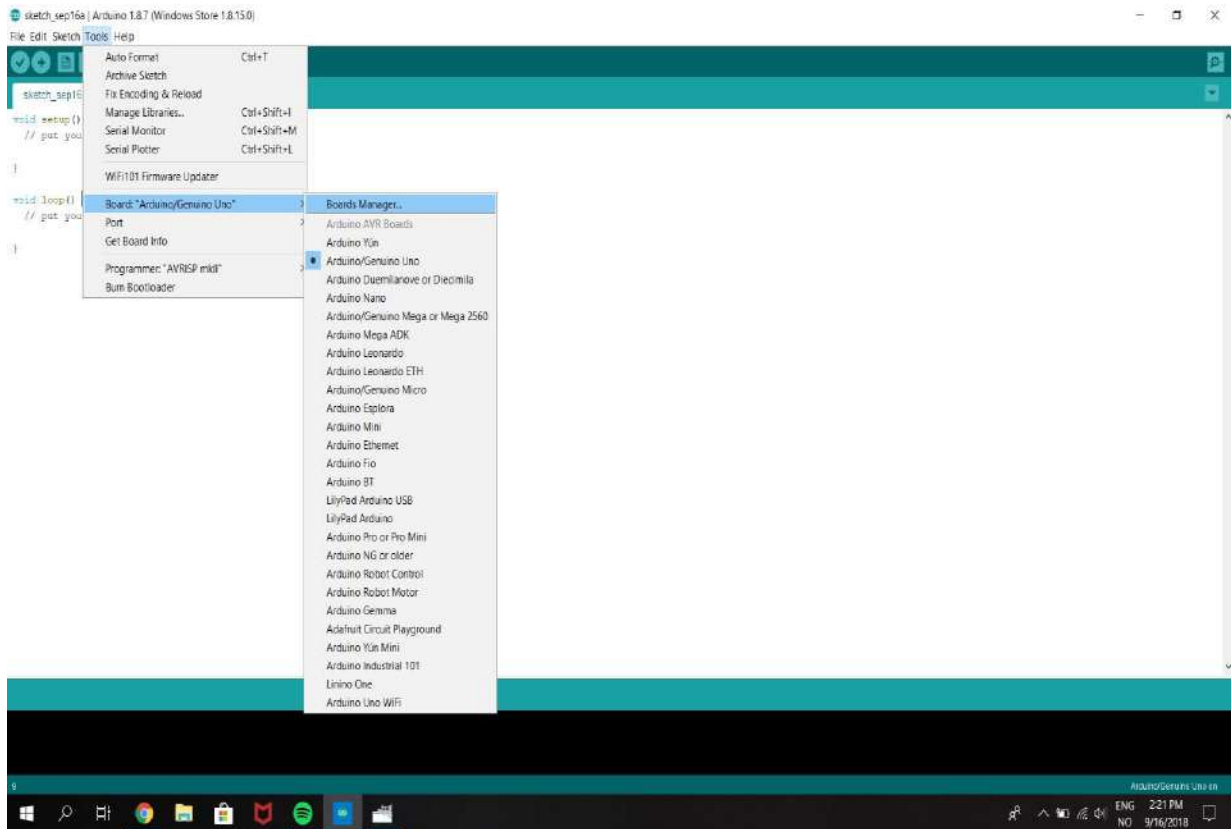
Figure 3.6

- Click on “OK”

### Verify that the ESP8266 board is recognized

- Connect the micro USB type B side of the cable to the ESP8266 board as shown on the figure below (mind the direction of the connector!)
- Connect the USB type A side of the cable to your computer.
- Open tab “Tools → Boards → Boards Manager” and check “NodeMCU 1.0 (ESP-12E Module)” is available. If it is not available, then you also need to install a driver for USB chip; follow instructions given in the next section and go to 4 to continue your installation.
- Select **NodeMCU 1.0 (ESP-12E Module)** board

- Install driver for USB chip (Windows only)
- If NodeMCU 1.0 (ESP-12E Module) is not available:
  - Click **“Tools → Board → Boards Manager”**

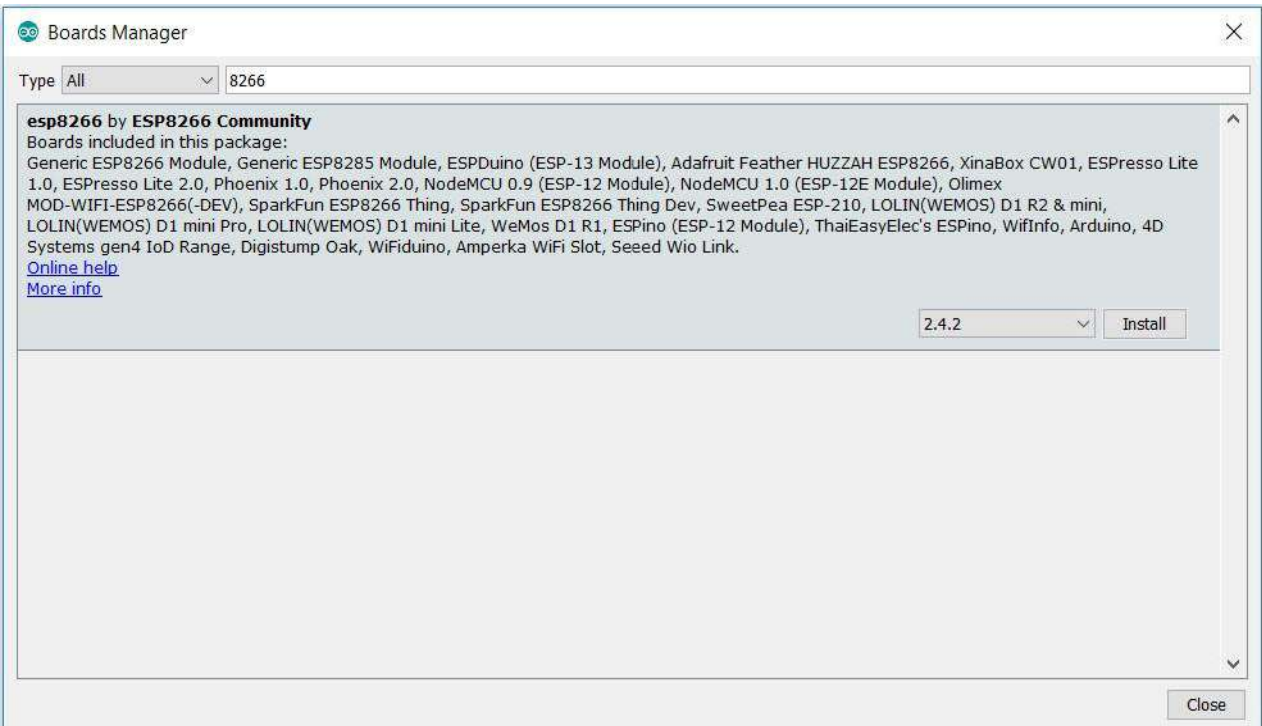


Software Arduino

Figure 3.7

- Enter **“esp8266”** as shown on the figure below





## Software Arduino

Figure 3.8

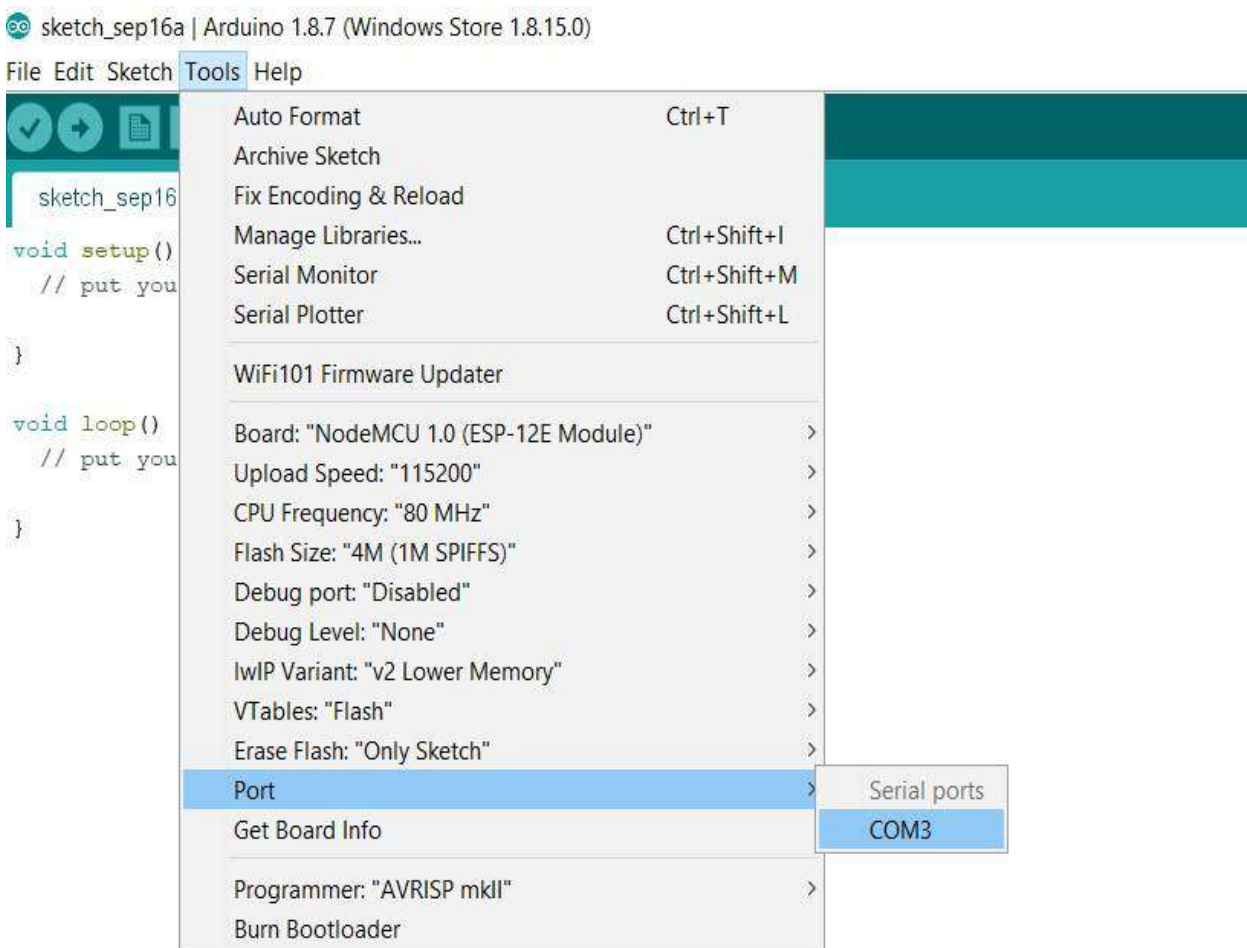
- Click on “**Install**” (this step may take a few minutes)
- You should then be able to select “NoneMCU 1.0 (ESP-12E Module)”:
- Open tab “Tools → Boards → Boards Manager” and check “NodeMCU 1.0 (ESP-12E Module)” is available. If it is not available, then you also need to install a driver for USB chip; follow instructions given in the next section and go to 4 to continue your installation.
- Select **NodeMCU 1.0 (ESP-12E Module)** board

## Select Port

Finally you need to select the **port** (physical USB connector on your computer) to tell the path where the board is physically plugged in your computer.

- Click on “**Tools** → **Port**” and select the corresponding USB port.

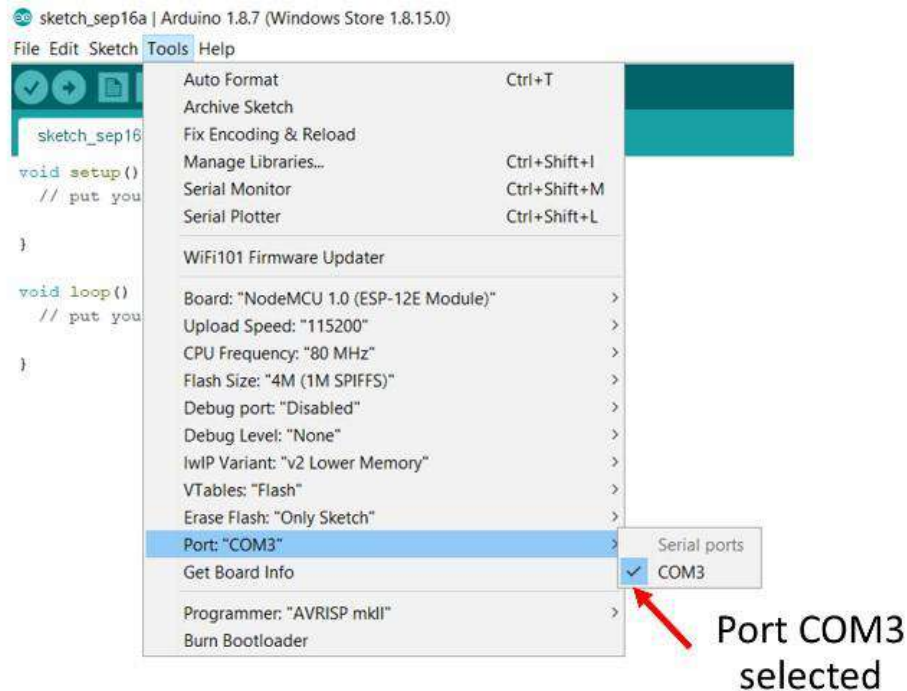
17



Software Arduino

Figure 3.9

- Check you have selected it: when you click again on “**Tools** → **Port**”, you should see a “tick” in front of your selected port (see image below):



Software Arduino

Figure 3.10

Now the Arduino IDE is ready to program the NodeMCU. Below is the Arduino code for the project.

```
#define BLYNK_PRINT Serial

#include <SPI.h>

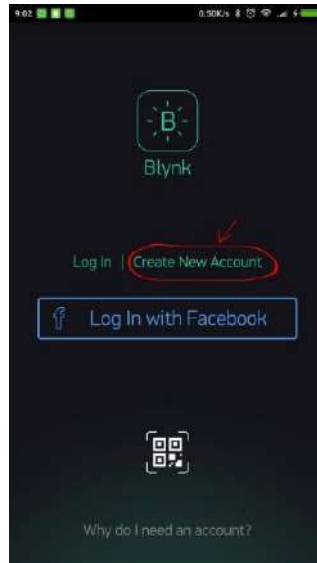
#include <Ethernet.h>
#include <BlynkSimpleEthernet.h>
```

```
char auth[] = "YourAuthToken";  
void setup()  
{  
  Serial.begin(9600); // See the connection status in Serial Monitor  
  
  Blynk.begin(auth); // Here your Arduino connects to the Blynk Cloud.  
  
}  
  
void loop()  
{  
  Blynk.run(); // All the Blynk Magic happens here..  
}
```

### 3.3.2 Blynk platform

#### 1. Create a Blynk Account

After download the Blynk App, New Blynk account was created.

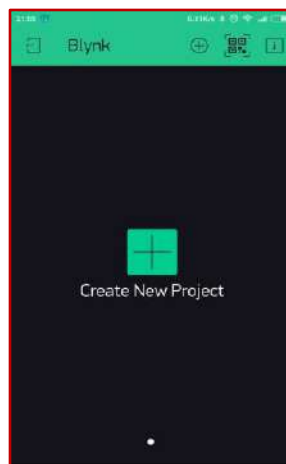


Create a Blynk Account

Figure 3.11

An account is needed to save the projects and have access to them from multiple devices from anywhere. It's also a security measure.

## 2. Create a New Project



Create a New Project

Figure 3.12

### 3. Choose Hardware

Select the hardware model you will use. Check out the

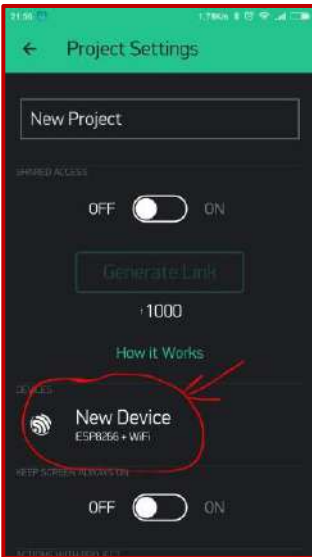


### Choose Hardware

**Figure 3.13**

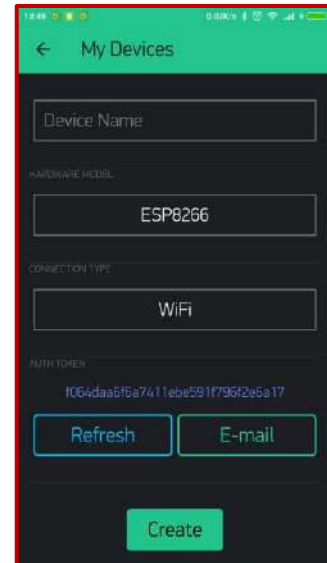
### 4. Auth Token

**Auth Token** is a unique identifier which is needed to connect the hardware to the smartphone. Every new project you create will have its own Auth Token. Auth Token got automatically on your email after project creation.



Auth Token

Figure 3.14

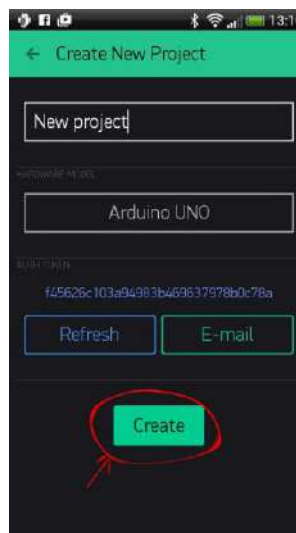


Auth Token

Figure 3.15

It's very convenient to send it over e-mail. Press the e-mail button and the token will be sent to the e-mail address you used for registration. You can also tap on the Token line and it will be copied to the clipboard.

Now press the **“Create”** button.



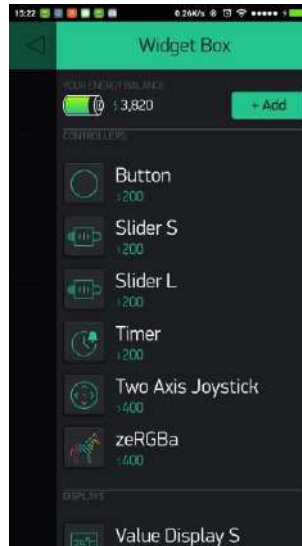
Auth Token

Figure 3.16

## 5. Add a Widget

The project canvas is empty, let's add a button to control our LED.

Tap anywhere on the canvas to open the widget box. All the available widgets are located here. Now pick a button.



### Add a Widget

Figure 3.14

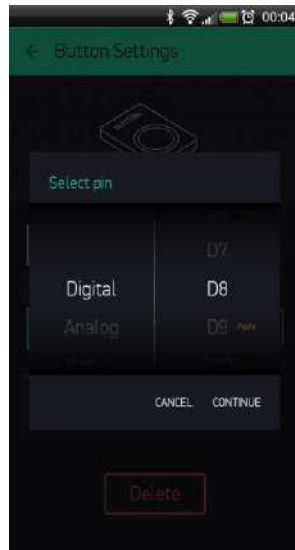
## Widget Box

**Drag-n-Drop** - Tap and hold the Widget to drag it to the new position.

**Widget Settings** - Each Widget has it's own settings. Tap on the widget to get to them.

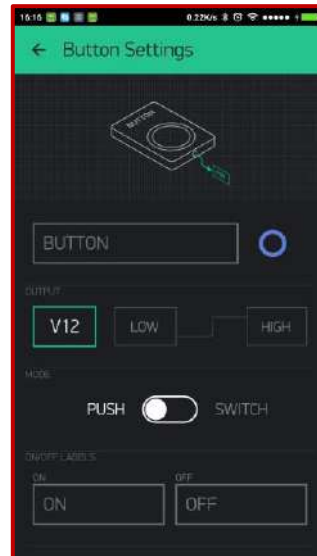
The most important parameter to set is PIN . The list of pins reflects physical pins defined by your hardware. If your LED is connected to Digital Pin 8 - then select D8 (D - stands for Digital).





Widget Box

Figure 3.15

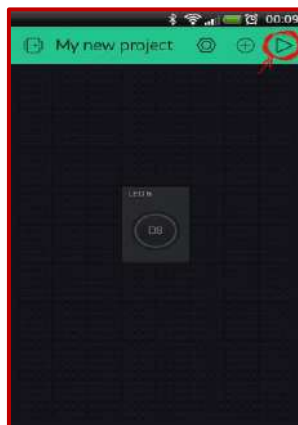


Widget Box

Figure 3.16

## 6. Running the Project

When the settings are done - pressing the **PLAY** button. This will switch from EDIT mode to PLAY mode where we can interact with the hardware. While in PLAY mode, you won't be able to drag or set up new widgets, press **STOP** and get back to EDIT mode.



Running the Project

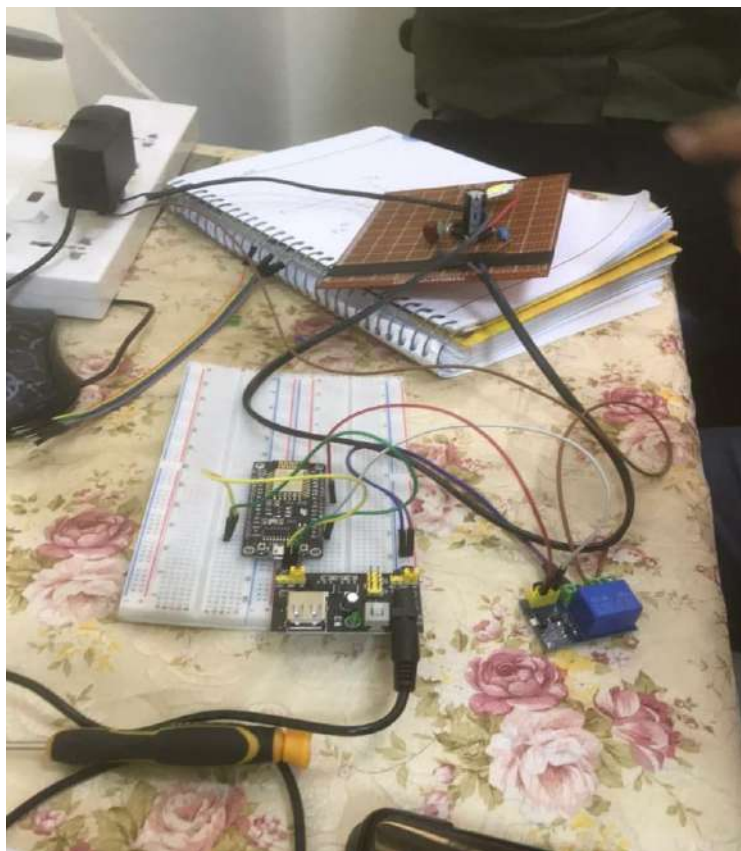
Figure 3.17

## Chapter Four

### Results

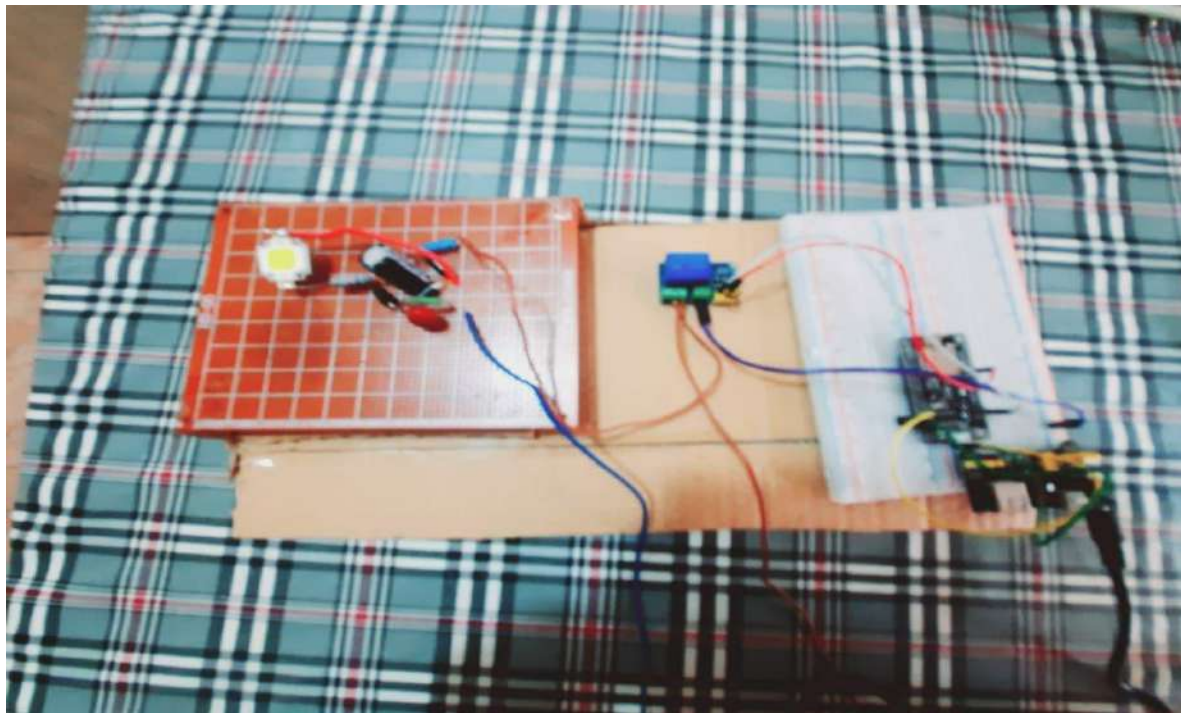
#### 4.1 Results

Figures below show the smart phone controlled LED power supply operation before and after NodeMCU instillation



The Final project

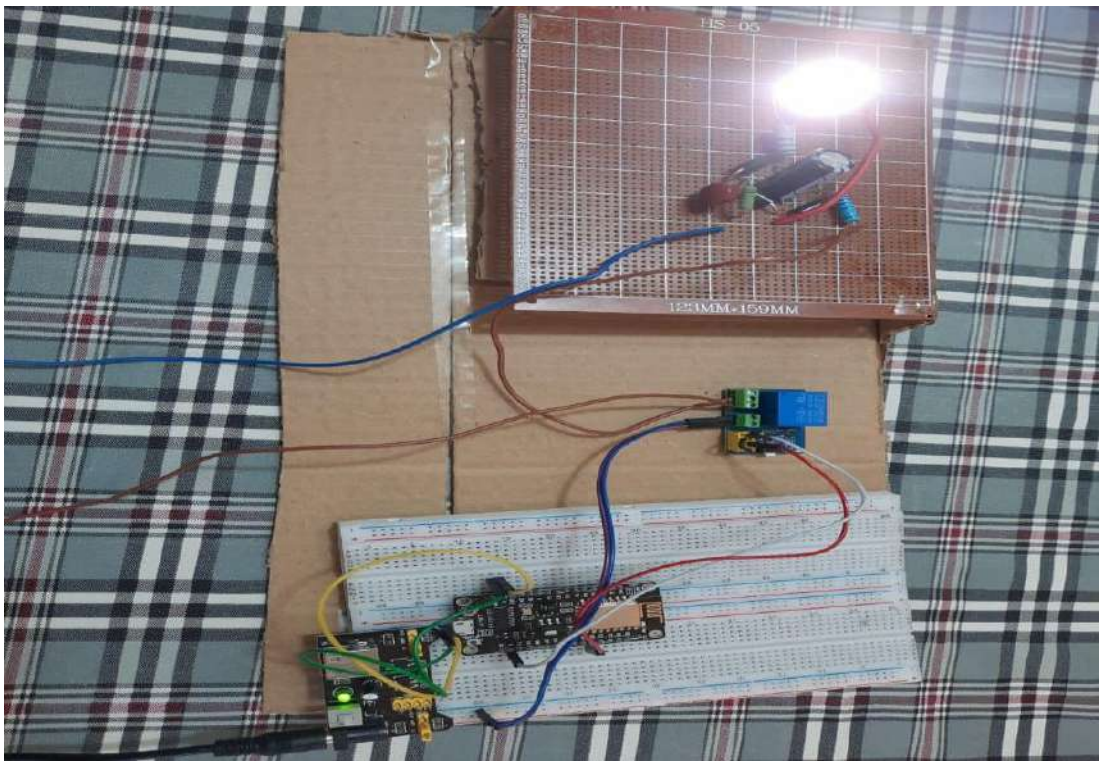
Figure 4.1



The Final project

Figure 4.2





The Final project

Figure 4.3



The Final project

Figure 4.4

## **Chapter Five: Conclusions & Suggestions for Future Works**

### **5.1 Conclusions**

This designed and developed mobile controlled LED power supply give the ability to control the on off operation of the LED.

LED lightening nowadays become the most lightening technology due to the LED low consuming power, as well as, its long live time comparing with ordinary lightening bulbs.

Moreover, controlling the lighting through Wi-Fi network or internet becomes more attainable.

First of all the LED power supply was designed and constructed using over shelve components.

Then with the use of NodeMCU microcontroller and Blynk platform we were able to control the power supply operation using the smartphone through the internet.

The designed circuit was cost effective, reliable as well as reproducible.

### **5.2 Suggestions for Future Works**

Due to coronaviruses separation situation. This work doesn't include the lightening intensity controlled through the PWM. So we suggest it as a first development for the circuit.

Also a power supply can be more enhanced to increase its power for controlling a series of LED for high lightening intensity.

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## الخلاصة

أصبح استخدام تقنية الصمام الثنائي الباعث للضوء (LED) أكثر جاذبية في الوقت الحاضر بسبب العمر الطويل والتكلفة المنخفضة. ومع ذلك ، فإن تصميم مصدر طاقة لل LED معقدة بعض الشيء قياساً باللمبة العادية. مصدر طاقة ال LED عبارة عن وحدة دائرة إلكترونية تغذي تياراً ثابتاً يمكن التحكم فيه في LED بحيث يمكن أن تولد قدرًا محددًا من الطاقة الضوئية.

ان التحكم في تشغيل / إيقاف LED بالإضافة إلى قوة الإضاءة باستخدام الهاتف الذكي القائم على إنترنت الأشياء أمر مطلوب لتسهيل حياة الإنسان

لقد قمنا بتصميم وتطوير مصدر طاقة LED يتم التحكم فيه من خلال الهواتف الذكية بناءً على تقنية إنترنت الأشياء (IOT)

يستخدم التصميم متحكم (NodeMCU 1.0 (ESP-12E Module) سويتاً كل من منصة Blynk لإنجاز المهمة.

بسبب حالة الإغلاق نتيجة لانتشار فايروس كورونا. لم يشمل هذا العمل التحكم بشدة الإضاءة عن طريق تعديل عرض النبضة. (PWM)





كلية دجلة الجامعية

.الهندسة التقنيات الحاسوب. م. قسم

تصميم مزود طاقة عالي للثنائي الباعث للضوء متحكم به عن طريق الهاتف الذكي

مشروع مقدم إلى إدارة

هندسة تقنيات الحاسوب / الكلية الجامعية دجلة

كجزء من متطلبات منح درجة بكالوريوس هندسة في التقنيات الحاسوب

بواسطة:

عمر عبد المنعم صبحي

احمد سلمان داود

عمر خالد محمد عيسى

امير حيدر حامد خليل

بإشراف: د. أحمد عبد الكريم علي



# **DESIGN AND IMPLEMENTATION OF HOME AUTOMATION SYSTEM BASED ON VOICE RECOGNITION**

*A project submitted to the department of computer techniques engineering as a  
partial of the requirement to fulfillment the B.Sc. degree in the computer  
techniques engineering*

*By Students:*

*Mohammed Jamal Naji*

*Mohammed Adel Fadil*

*Hanan Haider Adnan*

*Mustafa Ahmed Ali*

*Supervised By*

*Dr. Mohammed Abdullah Abdulsada*

**JUNE 2021**

## ***SUPERVISOR CERTIFICATE***

I certify that this project entitled "Design and Implementation of Home Automation System Based on Voice Recognition" was prepared under my supervision at the Department of Computer Techniques Engineering, Dijlah University College - Baghdad, in partial fulfillment of the requirements for the degree of B. Eng. in Computer Techniques.

Signature:

Name: **Dr. Mohammed Abdulla Abdulsada**

Date:     / 6 / 2021

## ***ABSTRACT***

Automation is a trending topic in the 21st century making it play an important role in our daily lives. The main attraction of any automated system is reducing human effort, time and errors due to human negligence. With the development of modern technology, smart phones have become a necessity for every person on this planet. Applications are being developed on Android systems that are useful to us in various ways.

The aim of this project is to design and implement a microcontroller based voice controlled home automation system using smart phone. Such a system will enable users to have control over every appliance in the home with the voice. All that the user needs is an Android smart phone, an Arduino Uno microcontroller, Bluetooth device and relays. The system intended to control electrical appliances and devices in house with relatively low cost design, user-friendly interface and ease of installation.

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# CHAPTER ONE

## *INTRODUCTION*



## ***Chapter One: Introduction***

### **1.1. Introduction**

The use of mobile phone is highly prevalent nowadays. Although the main aim of the mobile phone is to enable communication between two mobile phone users, recent advancement in embedded technology have made it possible to use mobile phones to control home and office appliances, monitor and control vehicles, and for several other applications [1]. Advancement in technology has made life more efficient and comfortable. The comfort of being able to take control of devices from one particular location has become imperative as it saves a lot of time and effort. With the advancement and breakthroughs in technology over the years, the lives of people have become more complicated and thus they have become busier than before [2].

Home automation systems have gained popularity in recent years, paralleling the advances in the concept of the Internet of Things. Although automation for commercial buildings is a mature technology automation applications for residences are a relatively new development which is gradually being adopted by consumers. Home automation involves the monitoring and control of activities such as lighting, heating, ventilation, air conditioning, electrical appliances, sound systems, security cameras, door locks, and alarms. Home automation has various advantages, such as comfort, increased security, and energy efficiency [3].

There are a few concerns to be addressed when designing a home automation system. The system should be designed in a manner that integrates new devices so that these devices should not be a problem at a later stage. On the host side, the system should be user-friendly, so that the devices can be monitored and controlled easily. Also, the system should be cost effective so that it can be widely used by anyone in the market [4].

Generally, conventional home wiring system use simple latching switch that being connected to the power supply for controlling electrical appliances such as fan or light. The switch usually located at the wall near to the electrical appliance. In this project, the idea is to develop a system that can control the entire electrical appliance in the house by using a voice command. The concept is to use wireless system to control home appliances wirelessly, which it is easy for installation rather than reconstruct all the wiring in the house. Fig.(1.1) shows the home automation organization.



**Figure (1.1)** Home automation organization

## **1.2. Objectives of Project**

The main attraction of any automated system is reducing human labour, effort, time and errors due to human negligence. With the development of modern technology, smartphones have become a necessity for every person on this planet. Applications are being developed on Android systems that are useful to us in various ways. Another upcoming technology is natural language processing which enables us to command and control things with our voice.

Combining all of these, the objectives of this project presents a microcontroller-based voice-controlled home automation system using smartphones. Such a system will enable users to have control over every appliance in his/her home with their voice. All that the user needs is an Android smartphone, which is present in almost everybody's hand nowadays, and a control circuit. The control circuit consists of an Arduino Uno microcontroller, which processes the user commands and controls the switching of devices. The connection between the microcontroller and the smartphone is established via Bluetooth, a widespread wireless technology used for sharing data.

### **1.3. Outline of Project**

The outlines of this project can be summarized as follows:

- Chapter Two: In this chapter of the project, we will explain, describe, and discuss the electronic parts as well as the parts that used to create this project, such as the Arduino microcontroller, the Bluetooth module, the relay module and the voice recognition module.
- Chapter Three: In this chapter of the project, we will explain the essential steps for the implementation of this project.
- Chapter Four: Finally, in this chapter, we will present the conclusion of this project and also the necessary additions that could develop this work in the future.

# CHAPTER TWO

## *THEORATICAL*

## *ANALYSIS*

## ***Chapter Two: Theoretical Analysis***

### **2.1. Introduction**

This chapter of the project comprises many subsections that describe and discuss the electronic parts as well as the parts that used to make up this project, such as the Arduino microcontroller, the Bluetooth module, the relay module, and the android application.

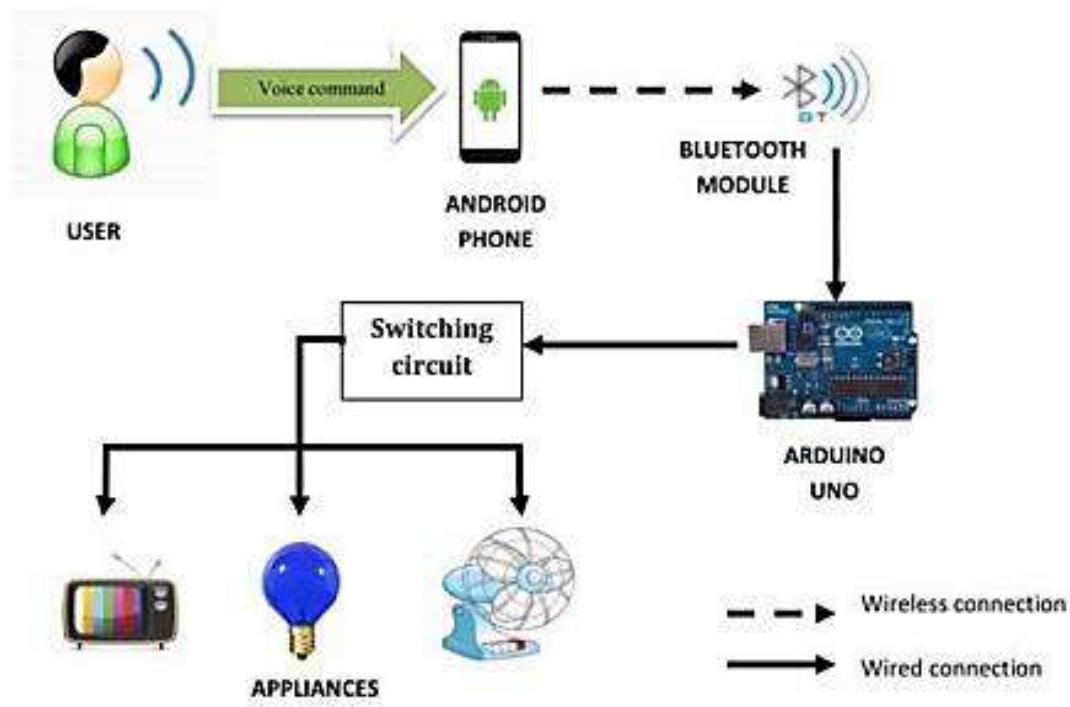
### **2.2 Theoretical Design of Voice Home Automation System**

Home automation was first introduced into the world market in the 1970s, but it failed to meet the expectations of people and was unsuccessful. There were various reasons associated with the failure of the home automation system. The system was neither user friendly nor cost efficient. Currently, the foremost point to be kept in mind when designing a home automation system is that it should be cost-efficient and easy to install [5].

The block diagram of overall voice control based home automation system is shown in Fig.(2.1).

The key components of this system are Android based phone (AMR Voice Software), Bluetooth module, microcontroller represented by an Arduino Uno and Relay boards. The controlling device for the whole system is a microcontroller. The data received by the Bluetooth module from the phone is fed as input to the controller. The controller acts accordingly on the relays to switch connected electrical appliances. In achieving the task the microcontroller is loaded with embedded C language. For controlling devices of home or office, firstly Bluetooth connection of mobile and Arduino board will be done. The devices will be

connected to Arduino board through relays. The user who wants to switch ON/OFF particular device will send the signal from mobile to controller through Bluetooth. Then as per requirement the controller will operate devices.



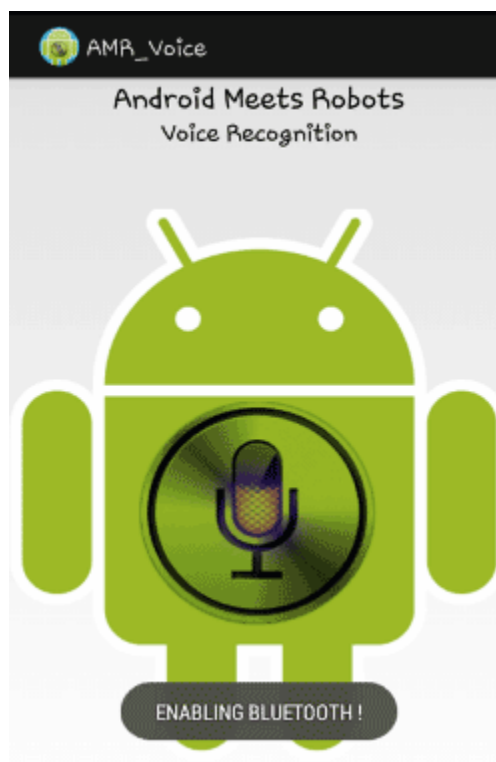
**Figure (2.1)** Diagram of voice control based home automation system

### 2.3 Android Based Phone and AMR Voice Recognition

Android is a mobile operating system developed by Google, based on a modified version of the Linux kernel and other open source software and designed primarily for touchscreen mobile devices such as smart phones.

The Adaptive Multi-Rate (AMR) codec is an audio compression format optimized for speech coding or voice recognition. The AMR is an android application that allows to control the Arduino by voice orders. AMR Voice Application can be downloaded and installed from the Google Play Store along with Google Voice Application. AMR Voice Application takes the voice as input and converts it into

text string using Android mobiles internal voice recognition (Google Voice App) and sends this converted text serially over Bluetooth. The voice recognizer listens and converts what is said to the nearest matching words or text. The Bluetooth adapter present in the smart phone is configured to send this text to the Bluetooth module on the Arduino Uno board that would in turn control the electrical appliances through the relay boards. Fig.(2.2) shows the AMR Voice Recognition Application[6].



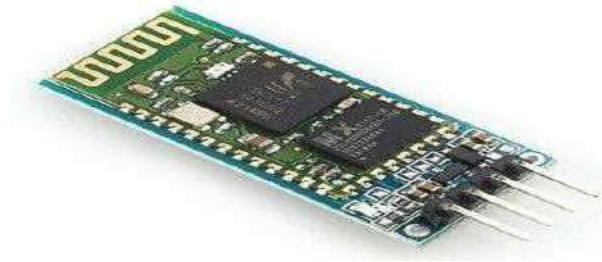
**Figure (2.2)** AMR voice recognition application

## **2.4 Bluetooth Module**

Bluetooth is a wireless technology standard for exchanging data over short distances from mobile devices, and building personal area networks. The Bluetooth module being used allows us to transmit and receive signals [7]. It receives the text



from the Android phone and transmits it to the serial port of the Arduino Uno. The Bluetooth module being used in this project is the HC-05 module as shown in Fig.(2.3).



**Figure (2.3)** HC-05 Bluetooth module

The pin description can be summarized as bellow:

ENABLE: When enable is pulled LOW, the module is disabled which means the module will not turn ON.

VCC: Supply Voltage 3.3V to 5V.

GND: Ground pin.

TXD & RXD: These two pins acts as a transmitter and receiver interface for communication.

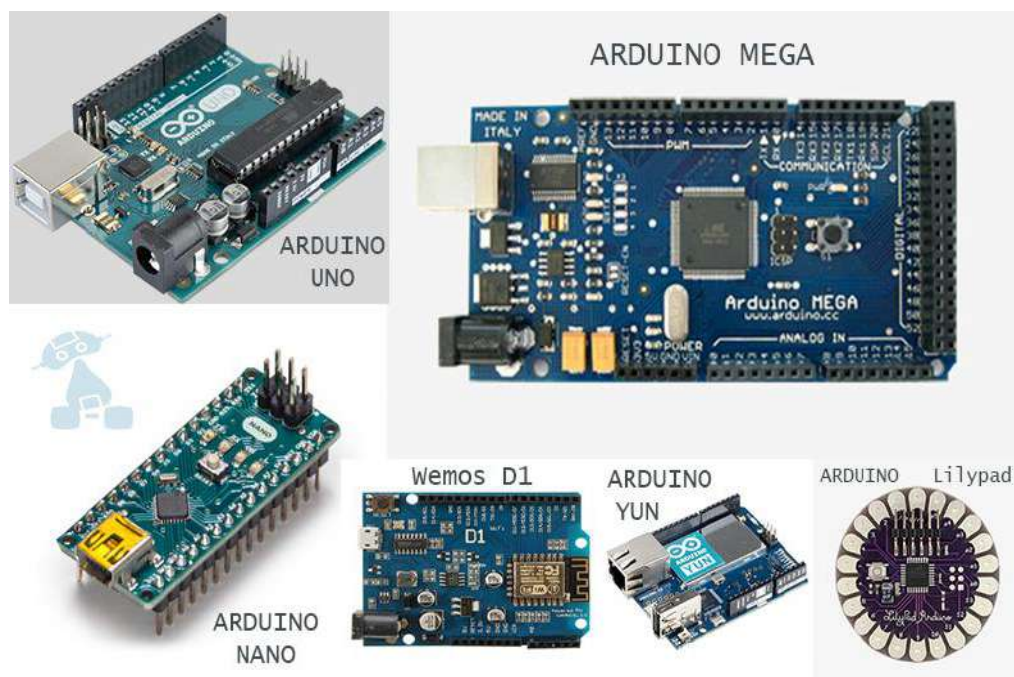
BUTTON SWITCH: This is used to switch the module into command mode.

## **2.5 Arduino Microcontroller**

An Arduino is a single-board microcontroller and a software suite for programming it. The hardware consists of a simple open hardware design for the controller with an Atmel AVR processor and on-board I/O support. The software consists of a standard programming language and the boot loader that runs on the board. In other

words, an Arduino is a tiny computer that you can program to process inputs and outputs between the device and external components you connect to it. The Arduino board is where the code you write is executed. The board can only control and respond to electricity, so specific components are attached to it to enable it to interact with the real world. These components can be sensors which include switches, accelerometers, and ultrasound distance sensors. Actuators are things like lights and LEDs, speakers, motors, and displays [8-10].

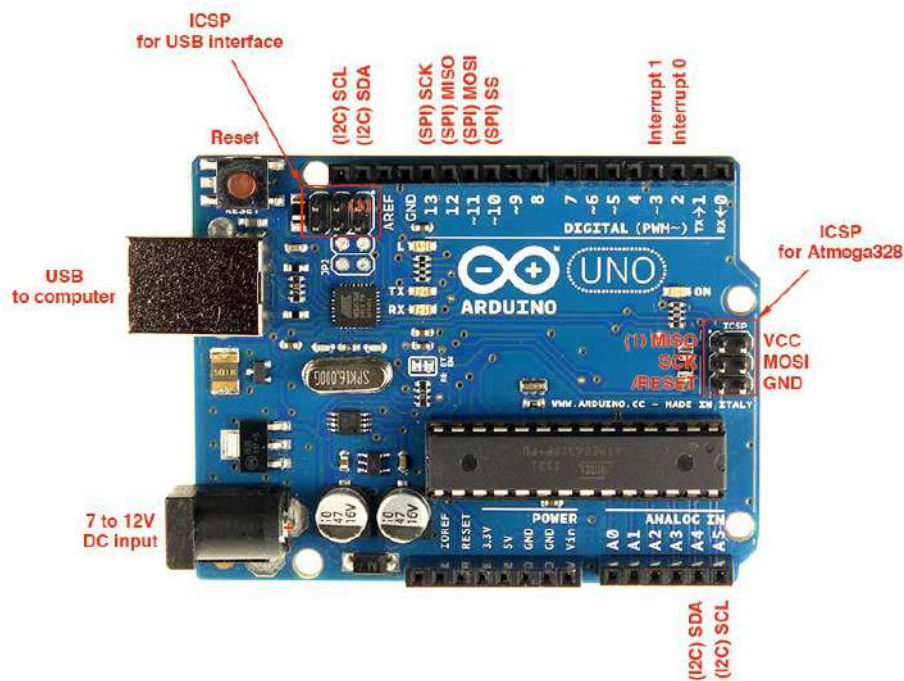
There are many types of the Arduino microcontroller board each one has its own properties, Fig.(2.4) shows some of the most known of the Arduino microcontroller board types [11].



**Figure (2.4)** Some Arduino families

## 2.6 ArduinoUNO Interfacing Board

The Arduino UNO is a board based on the ATmega328 microcontroller. The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically, It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts [12].



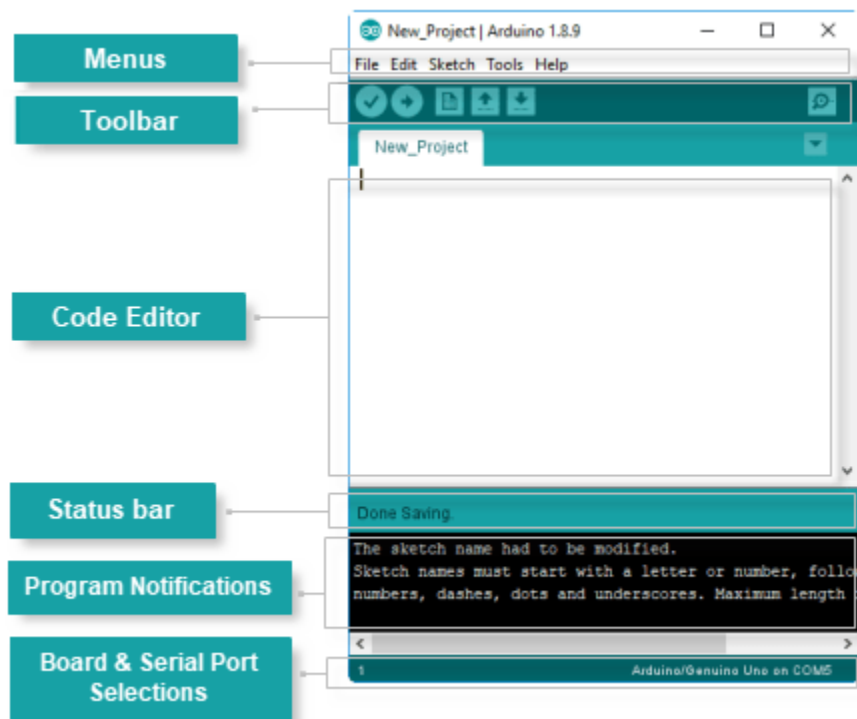
**Figure (2.5)** Arduino UNO microcontroller

The specifications of the Arduino UNO are as follows:

- ✚ 14 digital pin used for digital I/O.
- ✚ 6 analog pin used for analog input.
- ✚ 16MHZ processor speed.

- ✚ Microcontroller aTmega328.
- ✚ 32KB memory size.
- ✚ From digital pins there are 6-pins used for PWM.

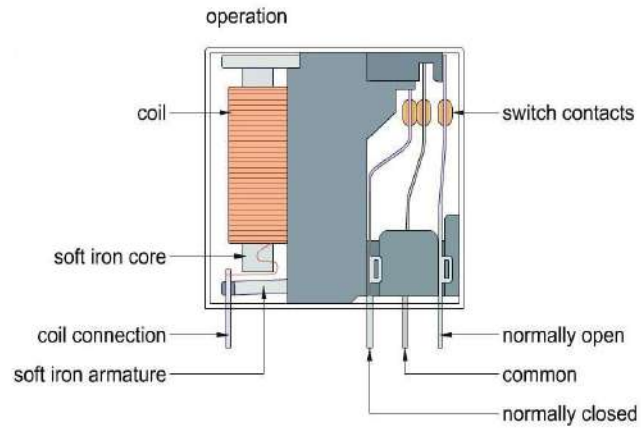
The Arduino has his own application software that enables the programmer to download and upload programs and other functionalities such as debugging. Download the Arduino IDE (The software name) from the Arduino download page. This software uses micro C language as the programming language for the Arduino as shown in Fig.(2.6) [13]. The communication between Arduino and PC is accomplished using USB cable to transfer data serially.



**Figure (2.6)** Arduino IDE software

## 2.7 Relay Module

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a microcontroller. When activated, the electromagnet pulls to either open or close an electrical circuit. A simple relay consists of a wire coil wrapped around a soft iron core, or solenoid, an iron yoke that delivers a low reluctance path for magnetic flux, a movable iron armature and one or more sets of contact, as illustrated in Fig.(2.7). The movable armature is hinged to the yoke and linked to one or more set of moving contacts. Held in place by a spring, the armature leaves a gap in the magnetic circuit when the relay is de-energized. While in this position, one of the two sets of contacts is closed while the other set remains open. When electrical current is passed through a coil, it generates a magnetic field that in turn activates the armature. This movement of the movable contacts makes or breaks a connection with the fixed contact. When the relay is de-energized, the sets of contacts that were closed, open and breaks the connection and vice versa if the contacts were open. When switching off the current to the coil, the armature is returned, by force, to its relaxed position. This force is usually provided by a spring, but gravity can also be used in certain applications. Most power relays are manufactured to operate in a quick manner [14]. The relay is used with the Arduino to pass an alternating current through the connection points of the relay.



**Figure (2.7)** Internal structure of relay module

CHAPTER  
THREE  
*PRACTICAL  
ANALYSIS*

## ***Chapter Three: Practical Analysis***

### **3.1 Introduction**

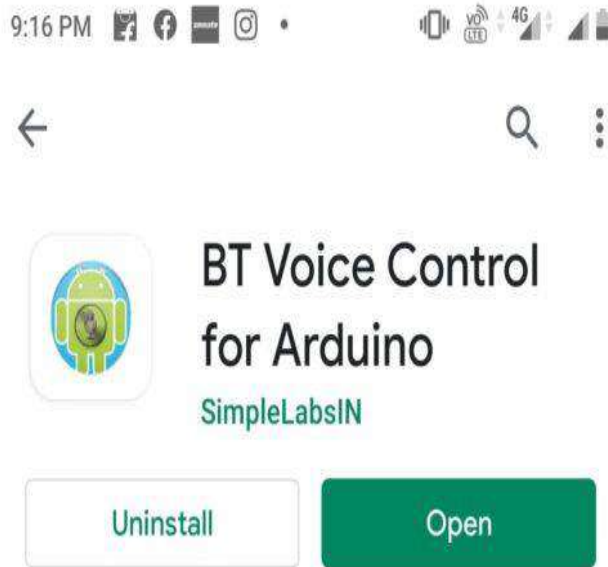
In this chapter, the implementation of a low-cost smart voice controlling system will be presented and discussed.

### **3.2 System Implementation**

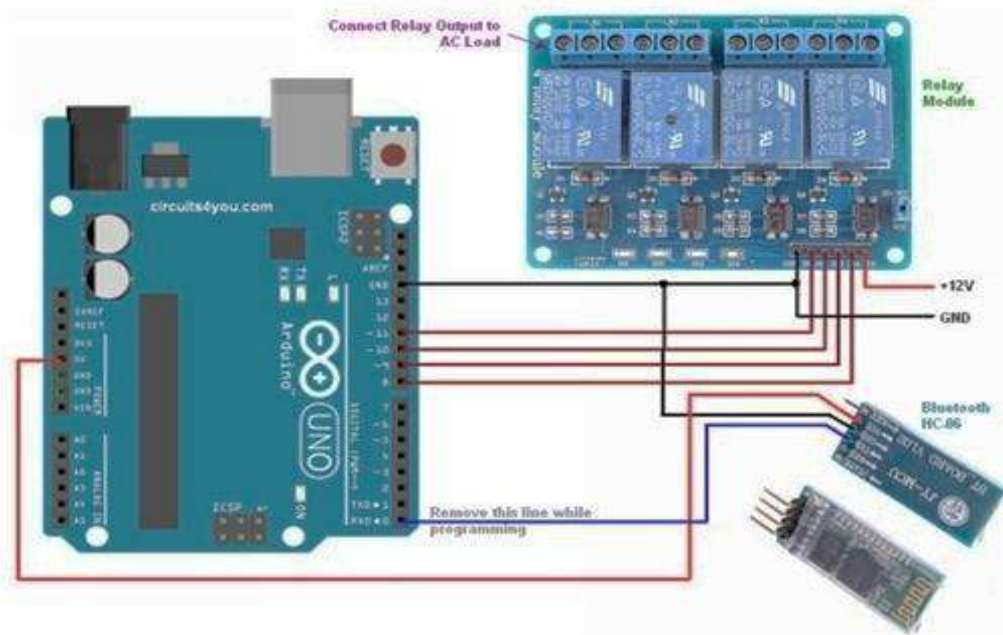
In this project, an AC home appliances controlling system is implemented based on the Arduino Uno microcontroller, 4-channels relay module, and Bluetooth module. The home appliances are controlled by sending voice command from the smartphone. The Bluetooth module is used in this project to connect and communicate with the smartphone wirelessly. Also, a Bluetooth app is installed on the smartphone, which is helping to send the user voice command from the smart phone to the project circuit.

At first, we need to install the app. on our smartphone, which is easily available in the play store, as illustrated in Fig.(3.1). This app. receives our voice command and sends it to the Bluetooth module wirelessly. The Arduino decodes this command from the Bluetooth module. Then Arduino sends a command to the relays to control the home appliances. These four home appliances are switched on/off by a different voice commands. Fig.(3.2) shows the circuit diagram of the Arduino, Bluetooth module and relay module.





**Figure (3.1)** Bluetooth voice control for Android in Play Store



**Figure (3.2)** Circuit diagram of the Arduino, Bluetooth module and relay module

After completing the installation process, open the app. and make sure the circuit is connected to the power supply and the Bluetooth module is ON. Now click on the mic button to come on the app. dashboard

Now, the 3 dots can be seen on the top right corner of the app dashboard. Then click on it and select the Connect Robot option. Before doing this make sure, your smartphone has paired with Bluetooth Module. If it not paired then find the HC-05 Bluetooth module in your phone Bluetooth settings and pair your phone with it. In this case, the HC-05 Bluetooth module asks for a pin code for pairing, usually, the pin code is 1234 or 0000.

After connecting the previously mentioned hardware component according to the connection diagram the programming process was started by the Arduino IDE.

The Arduino Uno in this work is programmed and given as below:

```
// 4 channel relay pins
const int Light = 6; // Relay pin 1 (IN1)
const int Fan = 5; // Relay pin 2 (IN2)
const int TV = 4; // Relay pin 3 (IN3)
const int Pump = 3; // Relay pin 4 (IN4)
String data; //Variable for storing received data
void setup()
{
  Serial.begin(9600); //Sets the baud for serial data transmission
  // Set Relay pins as OUTPUT
```

```

pinMode(Light, OUTPUT);
pinMode(Fan, OUTPUT);
pinMode(TV, OUTPUT);
pinMode(Pump, OUTPUT);
// All devices are Off when system is on
digitalWrite(Light, HIGH);
digitalWrite(Fan, HIGH);
digitalWrite(TV, HIGH);
digitalWrite(Pump, HIGH);
// Print Device status (all Off) on LCD Display
}
void loop()
{
// Read data from Bluetooth Module
char ch=0;
data="";
while(1)
{
while(Serial.available()<=0);
ch = Serial.read();
if(ch=='#')
break;
data+=ch;
}
// Print Bluetooth Module data on serial monitor
Serial.print(data);
Serial.print("\n");

```

```
// Control the devices using voice command
if (data == "*turn on light") // turn on Device1
{
    digitalWrite(Light, LOW);
    delay(200);
}
else if (data== "*turn off light") // turn off Device1
{
    digitalWrite(Light, HIGH);
    delay(200);
}
else if (data== "*turn on fan" ) // turn on Device2
{
    digitalWrite(Fan, LOW);
    delay(200);
}
else if (data== "*turn off fan" ) // turn off Device2
{
    digitalWrite(Fan, HIGH);
    delay(200);
}
else if (data== "*turn on TV" ) // turn on Device3
{
    digitalWrite(TV, LOW);
    delay(200);
}
else if (data== "*turn off TV" ) // turn off Device3
```

```

{
    digitalWrite(TV, HIGH);
    delay(200);
}
else if (data== "*turn on pump" ) // turn on Device4
{
    digitalWrite(Pump, LOW);
    delay(200);
}
else if (data== "*turn off pump" ) // turn off Device4
{
    digitalWrite(Pump, HIGH);
    delay(200);
}
else if (data== "*turn on all" ) // turn on all Device
{
    digitalWrite(Light, LOW);
    digitalWrite(Fan, LOW);
    digitalWrite(TV, LOW);
    digitalWrite(Pump, LOW);
    delay(200);
}
else if (data== "*turn off all" ) // turn off all Device
{
    digitalWrite(Light, HIGH);
    digitalWrite(Fan, HIGH);
    digitalWrite(TV, HIGH);

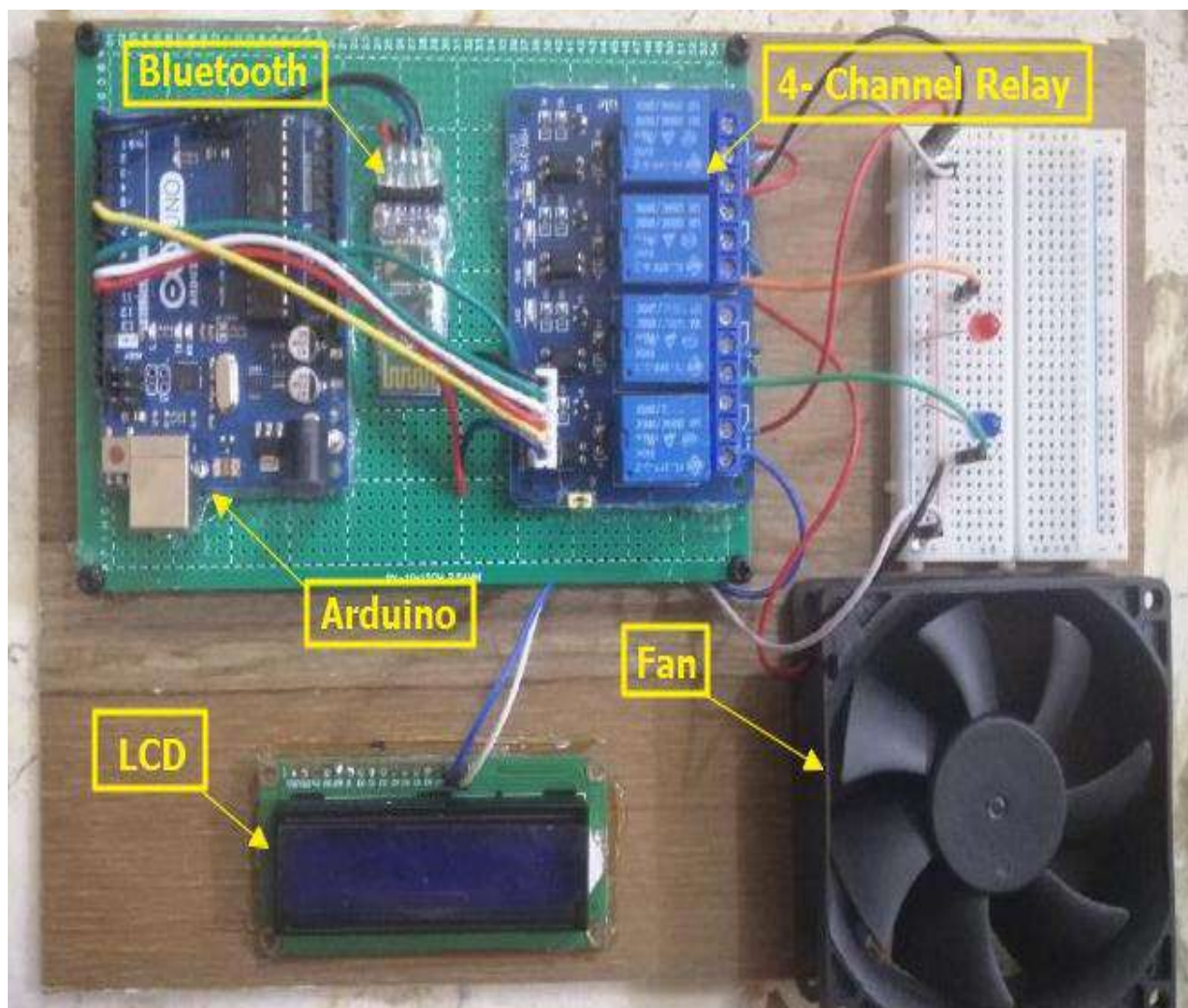
```

```

digitalWrite(Pump, HIGH);
delay(200);
}
}

```

The practical work is implemented and tested as shown in Fig.(3.3).



**Figure (3.3)** Implemented prototype for the proposed system

The project implementation is works successfully and gives the desired results. The voice commands to switch the home appliances are as follows:

All on                    (all device start working lamps ,fan and TV)

All off                    (all device stop working)

First lamp on            (the lamp no.1 will work)

First lamp off        (the lamp no.1 will stop working)

Second lamp on        (the lamp no.2 will work)

Second lamp off    (the lamp no.2 will stop working)

Fan on                    (the fan start working)

Fan off                    (the fan stop working)

TV on                    (the TV start working)

TV off                    (the TV stop working)

CHAPTER  
FOUR  
*CONCLUSION  
AND FUTURE  
WORK*



## ***Chapter Four: Conclusion and Future Work***

### **4.1. Conclusion**

In this project, the voice control based home automation system is presented theoretically and practically. The conclusions of the project are summarized as follows:

1. The home appliances can be easily controlled by using the user's voice.
2. The Arduino control the status (ON/OFF) of home appliances depending on the user selection.
3. The design implementation of the project's circuits is successfully gives the desired results.
4. The number of appliances can be easily modified and connected according to the user's requirements.
5. The main features of this system are easy operation, inexpensive, simple and efficient to use, requires small power and simple electronics elements.
6. Due to the inexpensive materials used in the construction, if the device is taken to the market it finds application in a wide area.

### **4.2. Future Works**

The future works of this project are as follows:

1. Use IoT (Internet of Things) technology to controlling home appliances from anywhere around the world.

2. Increasing the controlling distance by using Wi-Fi instead of Bluetooth technology.
3. Many of sensors can be used to develop the project such as the soil moisture sensor, passive infrared sensor, temperature sensor, and etc.
4. The security for the house can be added by using a laser beam or infrared sensor which interfacing with Arduino.

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VII. <http://arduino.cc/en/Reference/HomePage>

## المخلص

ان موضوع التحكم الالكتروني ظهر في القرن ال(٢١) وقد اخذ حيز كبير من الاهتمام في حياتنا اليومية. من اهم ما يمتاز به نظام التحكم الالكتروني تقليل كل من الجهد البشري المبذول و الوقت والاختاء الناتجة عن الالهال البشري. بسبب الاسباب اعلاه وبما ان الهواتف المحمولة اصبحت جزءاً لا يتجزا من حياتنا لذا جرى تطوير تطبيقات كثيرة على نظام الاندرويد مما جعلها مفيدة لحياتنا بشكل اكبر .

ان الهدف من هذا المشروع هو تصميم وتنفيذ نظام التحكم الاوتماتيكي بالأجهزة المنزلية عن طريق الأوامر الصوتية و ذلك باستخدام الهواتف الذكية. ومثل هذا النظام يمكن المستخدمين من السيطرة على كل الأجهزة في المنزل عبر الاوامر الصوتية. كل ما يحتاجه المستخدم لبناء المشروع هو الهاتف الذكي ، متحكم اردوينو أونو و جهاز بلوتوث. يهدف النظام للسيطرة على الأجهزة الكهربائية في المنزل مع تصميم منخفضة التكلفة نسبياً، واجهة سهلة الاستخدام وسهولة التركيب.

## تصميم و بناء التحكم الاوتوماتيكي بالأجهزة المنزلية عن طريق الأوامر الصوتية

مشروع مقدم لقسم هندسة تقنيات الحاسوب كجزء من متطلبات درجة البكالوريوس في علوم  
هندسة تقنيات الحاسوب

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حزيران ٢٠٢١



Entering the images taken from the surveillance cameras into the supporting vector machine (SVM) algorithm to find the license plate number and save it to a specific database

Research submitted to the Dijlah University's College –  
Department of Computer Technology Engineering

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As part of the requirements for awarding a Bachelor of  
Engineering degree in Computer Technologies

---

**By**

1. Bakr Tariq Saadi
2. Ahmed Zahi Jaber
3. Mustafa Refaat Abdel Rahim
4. Anas Salem Mahdi

**Supervised**

Dr. Yasir Dawood Salman



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*Thank you very much, Dr. Yasir Dawood*

## الاهداء

الى من أفضلها على نفسي ، ولم لا ؛ فلقد ضحت من اجلي

ولم تدخر جهداً في سبيل اسعادي على الدوام

( امي الحبيبة ).

نسير في دروب الحياة ، ويبقى من يسيطر على اذهاننا في كل مسلك نسلكه

صاحب الوجه الطيب ، والافعال الحسنة.

فلم ييخل علي طيلة حياته

( والدي العزيز ).

الى اصدقائي ، وجميع من وقفوا بجواري وساعدوني بكل مايملكون ، وفي اصعدة كثيرة

اقدم لكم هذا البحث ، واتمنى ان يحوز على رضاكم.

## **Abstract**

Video surveillance is a mechanism where constant tabs are kept on the environment and processing the attained foreign information. Major domains of implementation include, traffic surveillance, motion detection, vehicle tracking and license plate recognition. This project proposes a method for detection and identification of vehicle license plates. The entire logic is built around morphological operations and OCR edge detection method. Bounding box method is used to single headedly detect and segregate the characters. After segregation, template matching is used to define the characters and identify each one of them separately.

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# **Chapter One**

## **Introduction**

### **Introduction**

License plate recognition (LPR) is an image-processing technology used to identify vehicles by their license plates[1]. This technology is gaining popularity in security and traffic installations. In recent years, with the increase of terrorist activities around the world, security has become a major concern. The demand for security related services has been higher than there ever was, and there is a great need to find new way to protect ourselves or improve the existing methods by using information technology.

One area of interest has been automated surveillance systems controlled by computers that could work independently with minimal human intervention. An automated system that could identity suspect vehicles passing though can issue alerts or report such incidence to corresponding authorities immediately. This will speed up response time and can save lives. The purpose of this paper was to develop a real time application which recognizes license plates from cars at a gate, for example at the entrance of a parking area or a border crossing[2].

The system, based on regular PC with video camera, catches video frames which include a visible car license plate and processes them. Once a license plate is detected, its digits are recognized, displayed on the User Interface or checked against a database. The focus is on the design of algorithms used for extracting the license plate from a single image, isolating the characters of the plate and identifying the individual characters. Methods to locate the license plate region in images or videos

from previous literature can be grouped into the following categories: Binary Image Processing, Gray-Level Processing, Color Processing and Classifiers [3]. Character segmentation is also a very important step before character recognition. The methods for character segmentation can be grouped into Binary Image Processing, Gray-Level Processing and Classifiers. To recognize the segmented characters, a number of algorithms using pattern/template matching or learning-based classification have been developed [4,5].

To extract license plate regions from background images, techniques based on combinations of edge statistics and morphology can achieve good results. In [6], they applied edge operators on a gray image after smoothing and normalization to extract horizontal and vertical edge maps. Statistical analysis of edges was then performed to detect the rectangle of license plate. The procedure was performed in a hierarchical manner at different scales. Several license plate regions were left after the rule-based fusion.

The final decision was made based on the connected component analysis (CCA). They claimed that their algorithm can achieve 99.6% detection rate from 9825 images. Image transformation methods based on Hough transform, Gabor filters and wavelet transform have been applied in license plate detection. Hough transform is a classic algorithm to detect straight lines. Since the shape of license plate can be defined by lines, [7] used the Hough transform to detect the boundary of a license plate. In many countries or regions, the format of license plates is strictly enforced. The color of the text and background is fixed, so that many algorithms use color information to detect license plates [8].

## **Research Topic and Objectives**

LPR is a computer vision method used to identify vehicles by their license plates. During recent years, LPR have been widely used as a core technology for security or traffic applications such as in traffic surveillance, parking lot access control, and information management [1, 2].

This thesis targets at the problem of detecting and recognizing United States license plates from images and videos in real time. This will help us identify and register vehicles and provide the reference for further vehicle tracking and activity analysis. Our license plate detection approach has two major steps. First, we need to extract certain features which encode the images or frames from videos. Second, we need develop a detector, which is a classifier in our case, to determine whether a certain region in the images or frames is license plate.



## **Chapter Two**

### **Basic Concept**

#### **2.1 Introduction**

In this chapter, we introduced some basic concept of our project.

#### **2.2 Image [3]**

A digital image is an image composed of picture elements, also known as pixels, each with finite, discrete quantities of numeric representation for its intensity or gray level that is an output from its two-dimensional functions fed as input by its spatial coordinates denoted with  $x$ ,  $y$  on the  $x$ -axis and  $y$ -axis, respectively.

##### **2.2.1 Types of Digital Images**

###### **a) Binary images**

Binary images are the simplest type of images and can take on two values, typically black and white, or 0 and 1. A binary image is referred to as a 1-bit image because it takes only 1 binary digit to represent each pixel. These types of images are frequently used in applications where the only information required is general shape or outline, for example optical character recognition (OCR). Binary images are often created from the gray-scale images via a threshold operation, where every pixel above the threshold value is turned white ('1'), and those below it is turned black ('0'). In the figure below, we see examples of binary images.



Figure 2. 1 Binary images. (a) Object outline. (b) Page of text used in OCR application.

### b) Gray-scale images

Gray-scale images are referred to as mono chrome(one-color) images.

They contain gray-level information, no color information. The number of bits used for each pixel determines the number of different gray levels available. The typical gray-scale image contains 8bits/pixel data, which allows us to have 256 different gray levels. The figure below shows examples of gray-scale images.



Figure 2. 2 Examples of gray-scale images

### c) Color images

Color images can be modeled as three-band monochrome image data, where each band of data corresponds to a different color. The actual information stored in the digital image data is the gray-level information in each spectral band. Typical color images are represented as red, green, and blue (RGB images). Using the 8-bit monochrome standard as a model, the corresponding color image would have 24-bits/pixel (8-bits for each of the three-color bands red, green, and blue). The figure below illustrates a representation of a typical RGB color image.

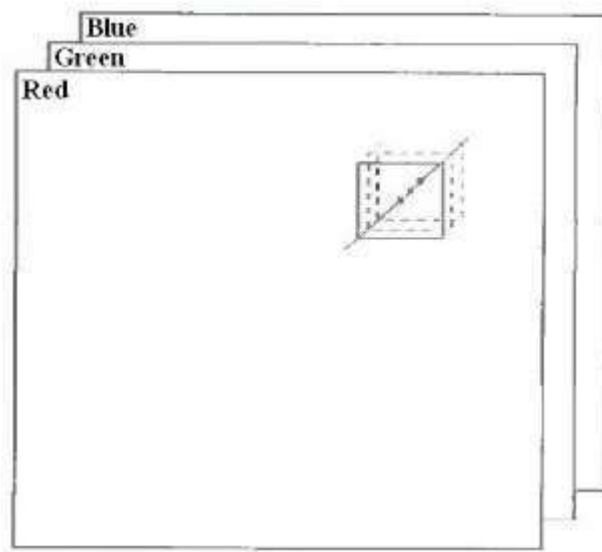


Figure 2. 3Representation of a typical RGB color image.

## 2.3 Edge detection [4]

Edge detection is a fundamental method for feature detection or feature extraction. In the general case, the result of applying edge detection of algorithm is an object boundary with connected curves. It becomes very difficult to apply this method to complex images as it might result with object boundary with not connected curves.

Different edge detection algorithm / operators such as Canny, Canny-Deriche, Differential, Sobel, Prewitt and Roberts Cross are used for edge detection.

## **2.4 Hough Transform [4]**

It is a feature extraction technique initially used for line detection. Later on, it has been extended to find position of arbitrary shape like circle or oval. The original algorithm was generalized by D.H. Ballard.

## **2.5 Blob detection**

Blob detection is used to detect points or regions that differ in brightness or color as compared to surroundings. The main purpose of using this approach is to find complimentary regions which are not detected by edge detection or corner detection algorithms. Some common blob detectors are Laplacian of Gaussian (LoG), Difference of Gaussians (DoG), Determinant of Hessian (DoH), maximally stable extremal regions and Principal curvature-based region detector.

## **2.6 Connected Component Analysis (CCA)**

CCA or blob extraction is an approach to uniquely label subsets of connected components based on a given heuristic. It scans binary image and labels pixel as per connectivity conditions of current pixel such as North-East, North, North-West and West of the current pixel (8-connectivity). 4-connectivity is used for only north and west neighbors of current pixel. The algorithm gives better performance and it is very useful for automated image analysis. This method can be used in plate segmentation as well as character segmentation.

## **2.7 Template matching**

Template matching is useful for recognition of fixed sized characters. It can be also used for detection of objects generally in face detection and medical image

processing. It is further divided in two parts: feature-based matching and template-based matching. Feature based approach is useful when template image has strong features otherwise template-based approach can be useful. In [34] statistical feature extraction method is applied for achieving 85% of character recognition rate. In [15], several features are extracted and salient is computed based on training characters. A linear normalization algorithm is used to adjust all characters with uniform size. The recognition rate of 95.7% is achieved among 1176 images. An SVM based approach is used for feature extraction of Chinese, Kana and English, Numeric characters. The authors achieved success rate of 99.5%, 98.6%, and 97.8% for numerals, Kana, and address recognition respectively. A template-based approach is proposed in [16]. The authors used low-resolution template matching method to work with lower resolution image such as 4 X 8. The authors used similarity function to measure similarity between patterns

## **2.8 Optical character recognition (OCR)**

OCR is the process of converting an image into a computer editable text. The text and numbers in an image are not editable, the letters, characters and numbers are made of tiny dots (pixels) that together form a picture of text and numbers. OCR is classified into two types, offline recognition and online recognition. In offline recognition the source is either an image or a scanned form of the document whereas in online recognition the successive points are represented as a function of time and the order of strokes are also available. Here in this paper only offline recognition is used [4][13].

## Chapter three

### Methodology

#### 3.1 Introduction

In this chapter we introduced methodology and implementation of detection of LPR based on OCR and we used MATLAB 2020a for implement. A logical block diagram of the entire process is as shown in Figure 3.1. and **Algorithm 3.1**

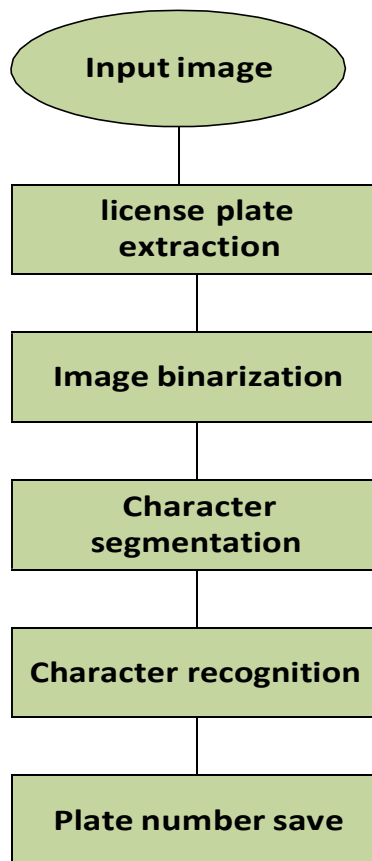


Figure 3.1 A logical block diagram of the entire process

**Algorithm 3.1** A logical block diagram of the entire process

- 1- Input image  $x$
- 2- license plate extraction
- 3- Convert the image to grayscale  $x_g$ .
- 4- Filter to remove noise.
- 5- Convert the image to binary image.
- 6- Applied OCR Character segmentation
- 7- Plate number save

### 3.2 Implementation of stages

- **First stage: Read image**

To read image via MATLAB using this function:

```
[FileName, folderpath]=uigetfile('*.jpg','Select An Image');  
fullFileName = fullfile(folderpath, FileName);  
myImage = imread(fullFileName);  
%myImage=double(myImage);  
imshow(myImage);
```

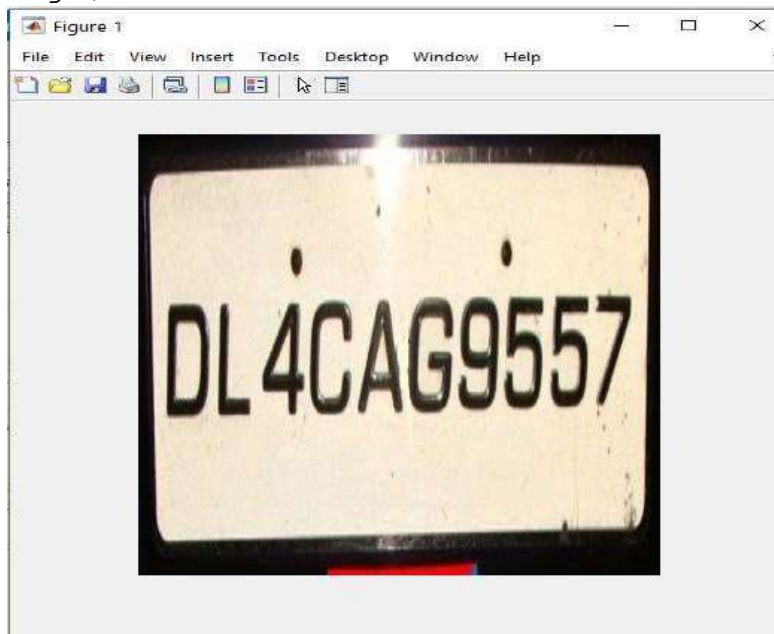


Figure 3. 2 Read Image

- **Second stage: Convert the images to grayscale**

*To Convert the images to grayscale via MATLAB using this function:*

```
imgray = rgb2gray(myImage);
```



Figure 3. 3Convert the images to grayscale

- ***Third stage: Filter to remove noise***

*To remove noise of image we used 2-D median filtering and the code of this function is:*

```
for i = 1:1
    Kmedian = medfilt2(imgray);
    %subplot(6,1,i)
    imshow(imgray)
    title('Filter Image')
end
```

- ***Fourth stage: Convert the images to binary images.***

*To Convert the images to binary images and the code of this function is:*



```
imbin = imbinarize(imgray);
```



Figure 3. 4 Convert the images to binary image

- ***Fifth stage: Applied OCR Character segmentation***

Now applied OCR to extracted character using this code

```
im = edge(imgray, 'sobel');
```

```
im = imdilate(im, strel('diamond', 2));
im = imfill(im, 'holes');
im = imerode(im, strel('diamond', 10));
imshow(im)
```

```
Iprops=regionprops(im, 'BoundingBox', 'Area', 'Image');
area = Iprops.Area;
count = numel(Iprops);
maxa= area;
boundingBox = Iprops.BoundingBox;
for i=1:count
    if maxa<Iprops(i).Area
        maxa=Iprops(i).Area;
```

```

    boundingBox=Iprops(i).BoundingBox;
end
end

%all above step are to find location of number plate
im = imcrop(imbin, boundingBox);
%resize number plate to 240 NaN
im = imresize(im, [240 NaN]);
%clear dust
im = imopen(im, strel('rectangle', [4 4]));
%remove some object if it width is too long or too
small than 500
im = bwareaopen(~im, 500);
%%get width
[h, w] = size(im);
imshow(im);
%read letter
Iprops=regionprops(im, 'BoundingBox', 'Area', 'Image');
count = numel(Iprops);

noPlate=[]; % Initializing the variable of number plate
string.

for i=1:count
    ow = length(Iprops(i).Image(1,:));
    oh = length(Iprops(i).Image(:,1));
    if ow<(h/2) & oh>(h/3)
        letter=READL(Iprops(i).Image);
        figure; imshow(Iprops(i).Image);
        noPlate=[noPlate letter];
        pause(2)
    end
end
end

```

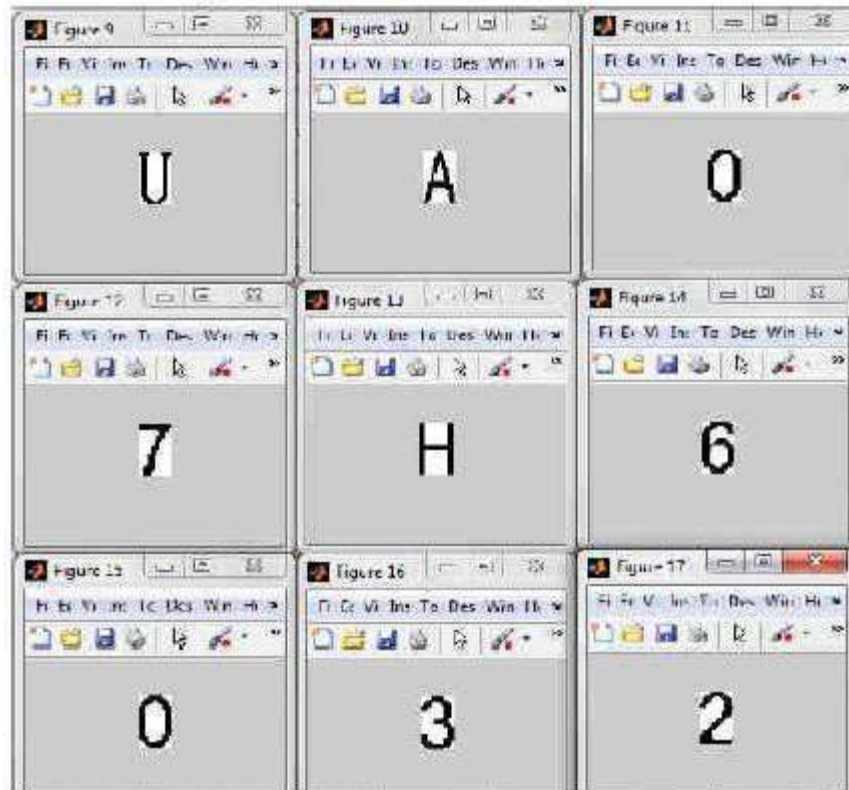


Figure 3. 5image segmentation

Finally, template matching is used to convert the recognized characters to a string of characters.



Figure 3. 6 Templates used

- *Sixth stage: Plate number save*

In this stage we used Excel to save data set of numbers, so we used function to write xls file

```
checkforfile=exist(strcat(pwd,'\','ExcelFile.xls'),'file');
if checkforfile==0; % if not create new one
    header = {'Number'};
    xlswrite('ExcelFile',header,'Sheetname','B1');
    N=0;
else % if yes, count the number of previous inputs
    N=size(xlsread('ExcelFile','Sheetname'),1);
End
% add the new values (your input) to the end of Excel file
AA=strcat('A',num2str(N+2));
BB=strcat('B',num2str(N+2));
xlswrite('ExcelFile',NewName,'Sheetname',AA);
xlswrite('ExcelFile',NewValues,'Sheetname',BB);
```

### 3.3 Results

In this section, we presented some examples of number and save it in Excel sheet.

Extracted some number and save it.



Figure 3. 7 First number

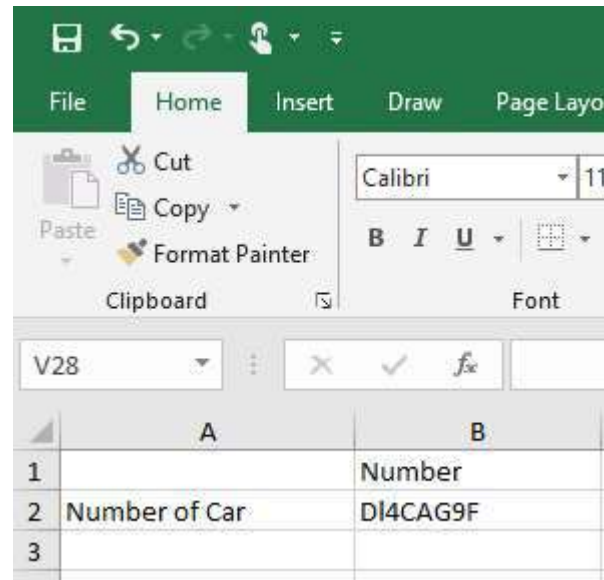


Figure 3. 8 Save first number



Figure 3. 9 Second number

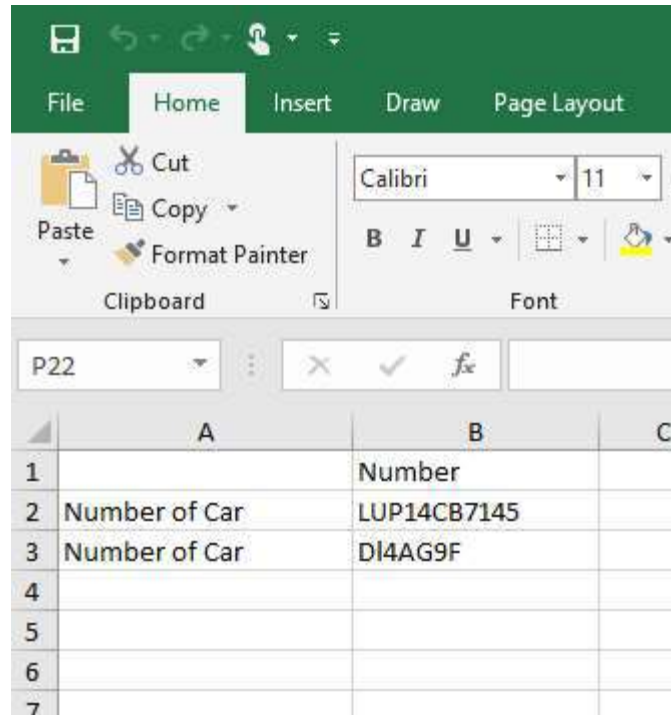


Figure 3. 10 Save first number

## **Chapter Four**

### **Conclusion and Future Work**

#### **4.1 Conclusion**

In this project, an application software is designed for license plate recognition. It gives us an insight into the actual technical aspects of major detection techniques. To sum it all up, the acquired image is first extracted and template matching is performed to extract the image characters.

#### **4.1 Future Work**

In our future work, techniques for deriving intrinsic images (e.g., illumination, reflectance and depth images) from a scene image or a number of input images are recommended. Intrinsic images containing only one intrinsic characteristic of the scene are viewpoint dependent and can be of great use for many visual inferences, such as image segmentation, view-based template matching, and object reconstruction.

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Ministiy of Higher Education  
& Scientific Research  
Dijlah University College  
Computer Techs.Eng.Dep.



# **Fast And Robust Approach Data Security**

**A project Submitted to the Department of Computer Techniques  
Engineering**

**Dijlah University College**

**In Partial Fulfillment of the Requirement for the Degree of B.Eng.**

**In**

**Computer Techniques**

**By**

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**JUNE 2021**

### **SUPERVISOR CERTIFICATION**

**I certify that this Thesis entitled**

**” Fast and robust approach data security ”**

**was prepared under my supervision at the Department of Computer  
Techniques Engineering, Dijlah University College - Baghdad, in  
partial fulfillment of the requirements for the degree of .Eng. in  
computer techniques engineering.**

**Signature:**

**NAME: ODAY KAMIL**

**DATA: 17 / 6 /2021**

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

{ وَقُلْ رَبِّ زِدْنِي عِلْمًا }

[طه: ١١٤]

صَدَقَ اللَّهُ الْعَلِيِّ الْعَظِيمِ

## الاهداء

إلى الحبيب المصطفى محمد صلى الله عليه وآله وسلم  
إلى الذين وجوههم لغير الله ما توجهت ..  
إلى كل من في الوجود بعد الله ورسوله والأئمة الميامين  
إلى النور الذي ينير لنا درب النجاح ..  
إلى من كان له الفضل في المساعدة على انجاز هذا البحث  
إلى أساتذتنا الكرام  
أولهم الدكتور الفاضل  
( عدي كامل )

المشرف على البحث الذي كان له الفضل الكبير  
من خلال ملاحظاته الدقيقة بشأن فقرات البحث  
وإبداء الآراء الشافية لكثير من الجوانب

# **Abstract**

The aim of this object is introduce a way of encryption and show the result when apply this method on plain text (original message) and how will form the intelligible plain text to be unintelligible plain text to secure information from unauthorized access and from steel information an encryption scheme usually uses a pseudo-random encryption key generated by an algorithm.

All this done by using unicode2native which is convert Arabic and English character to numeric byte in MATLAB application. English and Arabic plaintext had been used to encrypt and decrypt respectively, then these plaintexts had been encrypted and decrypted together with the addition of numbers.

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# Chapter- One

## 1.1 Introduction

Cryptography is a method of storing and transmitting data in a particular form so that only those for whom it is intended can read and process it. The term is most often associated with scrambling plaintext (ordinary text, sometimes referred to as cleartext) into ciphertext (a process called encryption), then back again (known as decryption) as shown the concept in the figure (1).

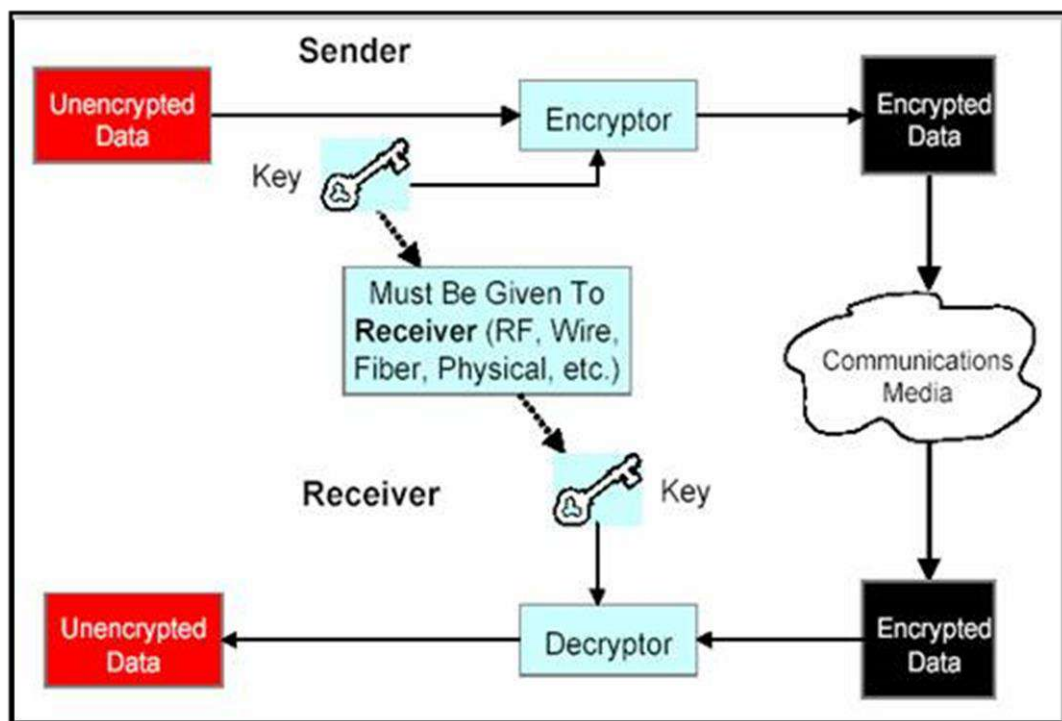


Figure (1) concept of Cryptography

## **1.2 History of cryptography**

The earliest known use of cryptography is found in non-standard hieroglyphs carved into monuments from the Old Kingdom of Egypt circa 1900 BC.<sup>[1]</sup> These are not thought to be serious attempts at secret communications, however, but rather to have been attempts at mystery, intrigue, or even amusement for literate onlookers.<sup>[1]</sup> These are examples of still other uses of cryptography, or of something that looks (impressively if misleadingly) like it. Some clay tablets from Mesopotamia somewhat later are clearly meant to protect information—one dated near 1500 BCE was found to encrypt a craftsman's recipe for pottery glaze, presumably commercially valuable.<sup>[2][3]</sup> Later still, Hebrew scholars made use of simple monoalphabetic substitution ciphers (such as the Atbash cipher) beginning perhaps around 500 to 600 BC.<sup>[4][5]</sup>

The ancient Greeks are said to have known of ciphers. The scytale transposition cipher was used by the Spartan military,<sup>[5]</sup> however it is disputed whether the scytale was for encryption, authentication, or avoiding bad omens in speech.<sup>[6][7]</sup> Herodotus tells us of secret messages physically concealed beneath wax on wooden tablets or as a tattoo on a slave's head concealed by regrown hair, though these are not properly examples of cryptography *per se* as the message, once known, is directly readable; this is known as steganography. Another Greek method was developed by Polybius (now called the "Polybius Square").<sup>[5]</sup> The Romans knew something of cryptography (e.g., the Caesar cipher and its variations).

### **1.3 Cryptographic Functions**

Cryptographic systems can provide one or more of the following four services. It is important to distinguish between these, as some algorithms are more suited to particular tasks, but not to others.

When analyzing your requirements and risks, you need to decide which of these four functions should be used to protect your data<sup>[8][9]</sup>.

**Authentication:-** Using a cryptographic system, we can establish the identity of a remote user (or system). A typical example is the SSL (Secure Socket Layer) certificate of a web server providing proof to the user that he or she is connected to the correct server. The identity is not of the user, but of the cryptographic key of the user. Having a less secure key lowers the trust we can place on the identity<sup>[8][9]</sup>.

**Non-Repudiation:-** The concept of non-repudiation is particularly important for financial or e-commerce applications. Often, cryptographic tools are required to prove that a unique user has made a transaction request. It must not be possible for the user to refute his or her actions. For example, a customer may request a transfer of money from her account to be paid to another account. Later, she claims never to have made the request and demands the money be refunded to the account. If we have non-repudiation through cryptography, we can prove – usually through digitally signing the transaction request, that the user authorized the transaction<sup>[8][9]</sup>.

**Confidentiality:** - More commonly, the biggest concern will be to keep information private. Cryptographic systems were originally developed to function in this capacity. Whether it be passwords sent during a log on process, or storing confidential medical records in a database, encryption can assure that only users who have access to the appropriate key will get access to the data<sup>[8][9]</sup>.

**Integrity:** - We can use cryptography to provide a means to ensure data is not viewed or altered during storage or transmission. Cryptographic hashes for example, can safeguard data by providing a secure checksum<sup>[8][9]</sup>.

### **1.4 The aim of the project**

The aim of this project makes presentation of Encryption and how to do that and what will show after Encryption after using one of many method all that by using MATLAB 2011 R2 and OS using windows 7 and Notepad ++ to write the input text .

This will help us to show what happen after Encryption the original message (Arabic and English) all that explained in details with the algorithm and of applying this method.

## **1.5 Project Layout**

This project consists of five chapters:

**Chapter one :-** describe an introduction to cryptography and reasons of using encryption techniques.

**Chapter two :-** contains the theoretical information about the classical encryption methods and the block diagrams of these encryption methods.

**Chapter three :-** describes in details the algorithms and software design of the tow classical encryption method and the proposed method.

**Chapter four :-** presents the result of applying the classical encryption and the proposed method of encryption.

**Chapter five :-** summarizes the main conclusions of the work presented in this project, and give suggestions for further work.

# Chapter – Two

## **2.1 Cryptography system**

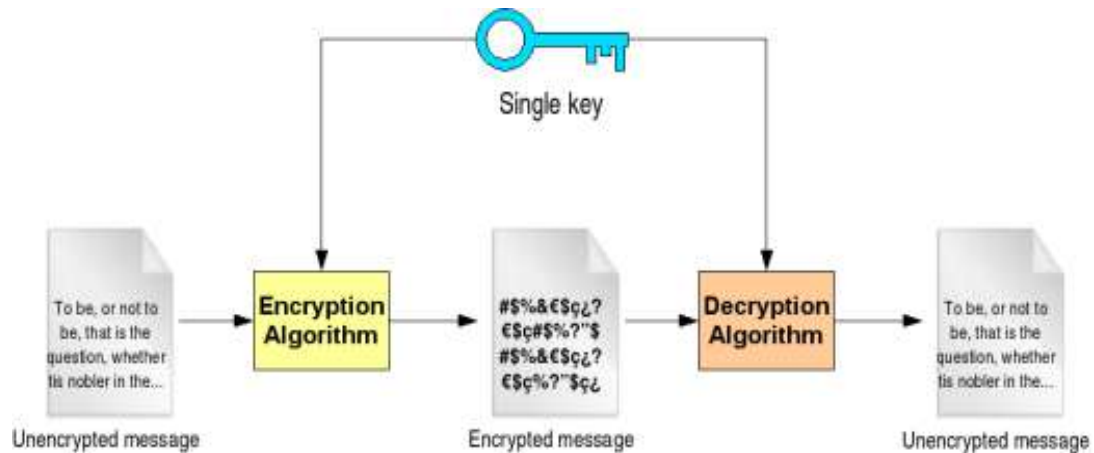
First will settle upon the meaning of cryptography, which is the study of methods for sending messages in secret (namely, in enciphered or disguised form) so that only the intended recipient can remove the disguise and read the message (or decipher it). Cryptography has, as its etymology, kryptos from the Greek, meaning hidden, and graphein, meaning to write. The original message is called the plaintext, and the disguised message is called the ciphertext. The final message, encapsulated and sent, is called a cryptogram. The process of transforming plaintext into ciphertext is called encryption or enciphering. The reverse process of turning ciphertext into plaintext, which is accomplished by the recipient who has the knowledge to remove the disguise, is called decryption or deciphering<sup>[14]</sup>.

## **2.2 Type of Cryptography**

### **(2.2.1) Symmetric-key algorithm:-**

are a class of algorithms for cryptography that use the same cryptographic keys for both encryption of plaintext and decryption of ciphertext. The keys may be identical or there may be a simple transformation to go between the two keys. The keys, in practice, represent a shared secret between two or more parties that can be used to maintain a private information link.<sup>[10a]</sup> This requirement that both parties have access to the secret key is one of the main

drawbacks of symmetric key encryption, in comparison to public-key encryption<sup>[10b]</sup> as shown in figure (2) .

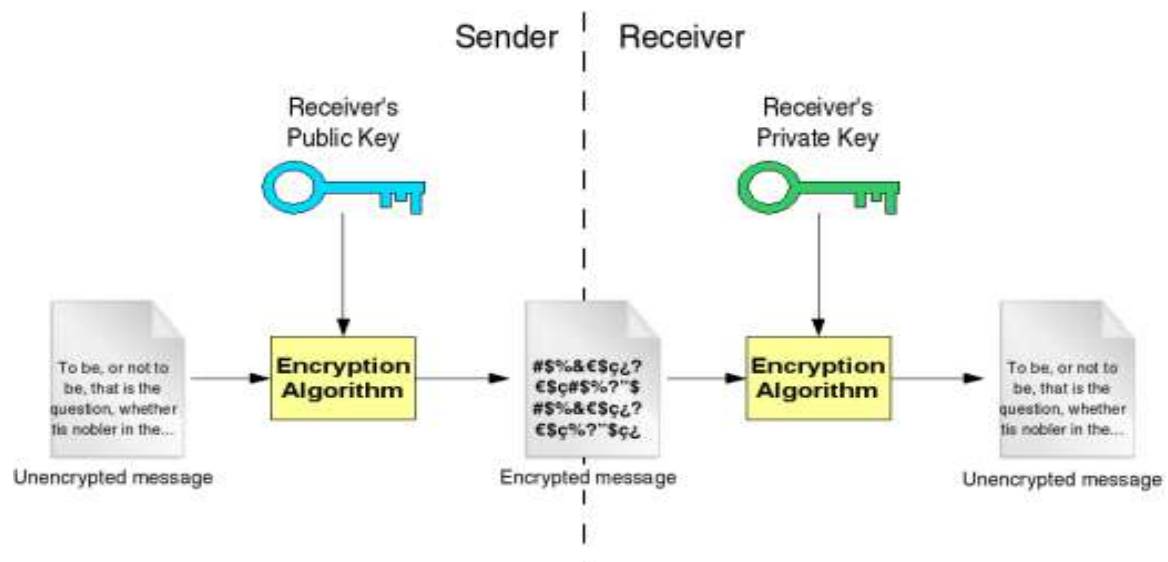


**Figure (2)**  
**Symmetric-key algorithm**

### **(2.2.2) Asymmetric-key algorithm:-**

Public-key cryptography, also known as asymmetric cryptography, is a class of cryptographic algorithms which requires two separate keys, one of which is secret (or private) and one of which is public. Although different, the two parts of this key pair are mathematically linked. The public key is used to encrypt plaintext or to verify a digital signature; whereas the private key is used to decrypt ciphertext or to create a digital signature. The term "asymmetric" stems from the use of different keys to perform these opposite functions, each the inverse of the other – as contrasted with conventional

("symmetric") cryptography which relies on the same key to perform both<sup>[11]</sup>.  
as show in figure (3)



**Figure (3)**  
**Asymmetric -key algorithm**



## **2.3 Comparing between Symmetric and Asymmetric Algorithms**

Since the Public key set as standard but not mean not use symmetric key because both have some advantage and disadvantage benefit .

## **2.4 Symmetric versus asymmetric algorithms**

When using symmetric algorithms, both parties share the same key for encryption and decryption. To provide privacy, this key needs to be kept secret. Once somebody else gets to know the key, it is not safe anymore. Symmetric algorithms have the advantage of not consuming too much computing power. A few well-known examples are: DES, Triple-DES (3DES), IDEA, CAST5, BLOWFISH, TWOFISH<sup>[12]</sup>.

Asymmetric algorithms use pairs of keys. One is used for encryption and the other one for decryption. The decryption key is typically kept secretly, therefore called "private key" or "secret key", while the encryption key is spread to all who might want to send encrypted messages, therefore called "public key". Everybody having the public key is able to send encrypted messages to the owner of the secret key. The secret key can't be reconstructed from the public key. The idea of asymmetric algorithms was first published 1976 by Diffie and Hellmann<sup>[12]</sup>.

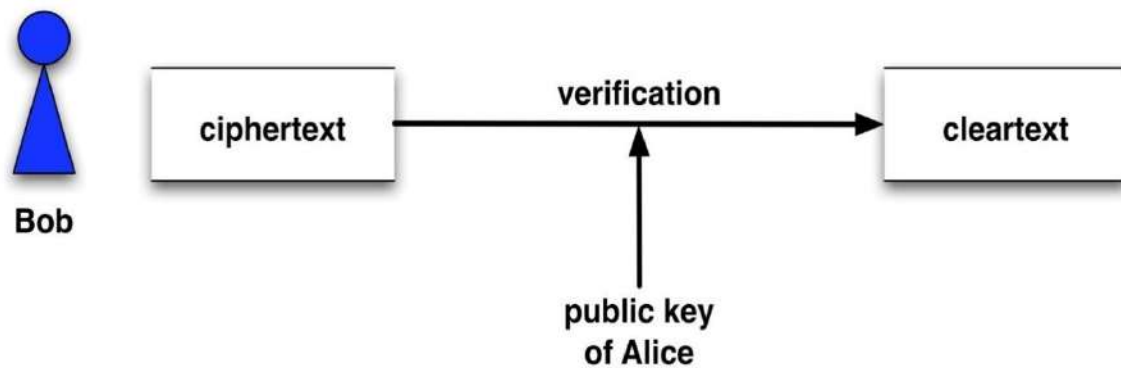
Asymmetric algorithms seem to be ideally suited for real-world use: As the secret key does not have to be shared, the risk of getting known is much smaller. Every user only needs to keep one secret key in secrecy and a

collection of public keys, that only need to be protected against being changed. With symmetric keys, every pair of users would need to have an own shared secret key. Well-known asymmetric algorithms are RSA, DSA, ELGAMAL<sup>[12]</sup>.

However, asymmetric algorithms are much slower than symmetric ones. Therefore, in many applications, a combination of both is being used. The asymmetric keys are used for authentication and after this has been successfully done, one or more symmetric keys are generated and exchanged using the asymmetric encryption. This way the advantages of both algorithms can be used. Typical examples of this procedure are the RSA/IDEA combination of PGP2 or the DSA/BLOWFISH used by GnuPG<sup>[12]</sup>.

## **2.5 Public Key**

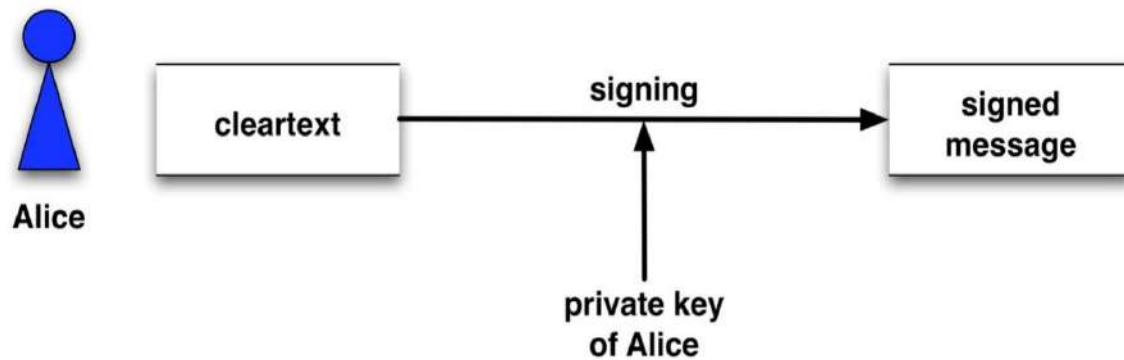
In public key encryption, data encrypted using the recipient's public key cannot be decrypted without using a matching private key. On the other hand, the public key can be used to decrypt data encrypted by the matching private key. However, public key cannot be used in the place of the private key. If the locking key is made public, then this system can be used by anybody to send private communication to the holder of the unlocking key. This makes sure that the legal recipient (one who has the matching private key) is the only person able to read the message. As appear in figure (4) So, this confirms confidentiality of the communication between two parties<sup>[13]</sup>.



**Figure (4)**  
**Appear concept of Puplic key**

## **2.6 Private Key**

In public key encryption, the private key can only be used to decrypt the data that was encrypted using the matching public key. Similarly, data encrypted using private key can only be decrypted using the matching public key. However, the private key cannot be used in the place of the public key. If the locking key is made private, this system makes it possible to verify that the documents were locked by the owner. The reason is that a message encrypted by the sender can only be opened by a person with the matching public key, thus verifying that the sender did actually hold the private key (meaning that the original and non-tampered message has been received). As appear in the figure (5) , Therefore, this is used for digital signatures.



**Figure (5)**  
**Appear concept of Private Key**

## **2.7 difference between Public Key and Private Key**

Public key and private key is the couple of keys used in public key cryptography. If the locking key is made public, then the unlocking key becomes the private key, and vice versa. Public key cannot be used to derive the private key. If the public key is the locking key, then it can be used to send private communication (i.e. to preserve confidentiality). If the private key is the locking key, then the system can be used to verify documents sent by the holder of the private key (i.e. to preserve authenticity) <sup>[13]</sup>.

# **Chapter – Three**

## **procedure For The prop**

### **3.1 introduction**

This chapter show's how the Cryptosystem work from Encryption the message then Decrypt it, the reason for this is to keep data out from any unauthorized access of important information so Notepad ++ was used to create Arabic or English message by using Matlab 2011 and using ASCII cod Table (1) to do both Encryption and Decryption on message. So in this chapter show the encryption and decryption English message, Arabic message and finally both English and Arabic message .

### **3.2 Explaining The Program in Details**

#### **3.2.1 Encryption English text**

First step is reading the English message that want to be encrypted and decryption this will be done by using Matlab instruction (text read). the message that entered to the program is "Data security for arabic and english text encryption"

**(1) `x=textread('English.txt','%s','delimiter','\n','whitespace','');`**

ans:-

'Data security for arabic and english text encryption'

**X :-** Read the text in the (English) which save in the file in folder of Matlab.

**English.txt** :- call the file want to encryption .

**%s** :- Read a white-space or delimiter-separated string.

**delimiter** :- determine the type of file modulation to use it in encryption

**\n** :- down to new row

**whitespace** :- to calculate spaces , characters and numbers in both row and colum plus the numbers of characters in the Unicode.

**(2) s=char(x);**

ans:-

Data security for arabic and english text encryption

Save characters in variable to easy use from Matlab

**(3) [tt,uu]=size(s);**

ans :-

1 52

**tt** :- number of row to encrypted

**uu**:- number of colum to encrypted

**size(s) :-** size of original message

**(4)  $g = tt * uu;$**

ans :-

52

Size of hole matrix

**(5)  $t = [1 \ T];$**

ans :-

1   2   4   13   26   52

numbers that we can divide hole size of original letter (g) and the result is integer .

**(6)  $y = \text{find}(k \leq 24);$**

ans :-

3   4   5   6

position of pascal matrix rang which it is less than 24.

(7) `yy=k(y:end);`

ans:-

13    4    2    1

number of pascal matrix dimension that can be used

(8) `[w,ww]=size(e);`

ans :-

1    52

Read size of matrix for Precaution

(9) `m=Pascal(yy(1),2);`

Answer of this instruction was shown in table (1)

**Table (1) Pascal matrix of English encryption**

1	1	1	1	1	1	1	1	1	1	1	1	1
-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0
66	55	45	36	28	21	15	10	6	3	1	0	0
-220	-165	-120	-84	-56	-35	-20	-10	-4	-1	0	0	0
495	330	210	126	70	35	15	5	1	0	0	0	0
-792	-462	-252	-126	-56	-21	-6	-1	0	0	0	0	0
924	462	210	84	28	7	1	0	0	0	0	0	0
-792	-330	-120	-36	-8	-1	0	0	0	0	0	0	0
495	165	45	9	1	0	0	0	0	0	0	0	0
-220	-55	-10	-1	0	0	0	0	0	0	0	0	0
66	11	1	0	0	0	0	0	0	0	0	0	0
-12	-1	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0



Generate Pascal matrix depended on largest element inside matrix.

**(10) `xx=reshape(e,yy(1),z(y(1)));`**

**ans:-**

```
68  32 110 120
97 102 100 116
116 111  32  32
97 114 101 101
32  32 110 110
115  97 103  99
101 114 108 114
99  97 105 121
117  98 115 112
114 105 104 116
105  99  32 105
116  32 116 111
121  97 101 110
```

Change the shape of matrix mean for each matrix has specific shape in the matrix did not under to any rule.

**(11) nn=xx-00;**

**ans:-**

```
68 32 110 120
97 102 100 116
116 111 32 32
97 114 101 101
32 32 110 110
115 97 103 99
101 114 108 114
99 97 105 121
117 98 115 112
114 105 104 116
105 99 32 105
116 32 116 111
121 97 101 110
```

To change the dimension and save in the variable (nn)

**(12) h=(m)\*double(nn);**

**ans:-**

```
1298    1130    1237    1367
```

-7214	-6683	-7375	-7924
25500	23436	26783	28580
-62442	-55700	-66563	-71543
110644	95102	120461	130718
-145036	-119414	-163186	-178466
141956	111267	166953	183563
-103649	-76781	-128579	-141775
55790	38723	73409	80999
-21552	-13874	-30121	-33201
5671	3345	8392	9228
-913	-486	-1420	-1556
68	32	110	120

To equal dimension with Pascal matrix (m) to make the multiply process.

**(13) ncode=mod(h,255)+00;**

ans :-

23	110	217	92
181	202	20	236
0	231	8	20

33 145 247 112  
 229 242 101 158  
 59 181 14 34  
 176 87 183 218  
 136 229 196 5  
 200 218 224 164  
 123 151 224 204  
 61 30 232 48  
 107 24 110 229  
 68 32 110 120

To return the number into the range of ASCII code

**(14) [w1,w2]=size(ncode);**

**ans:-**

**13 4**

Calculate the size of matrix after (Mode) order

**(15) ee(i,:)=native2unicode(ncode(i,:));**

**ans :-**

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Convert native number to Unicode.

**(16) hh=char(ee);**

ans :-

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Reserve the (ee) matrix in the variable (hh) to deal it by MATLAB.

### **3.2.2 Decryption of English text**

**(1) `scode=wk1read('enc')`**

**ans:**

23 110 217 92

181 202 20 236

0 231 8 20

33 145 247 112

229 242 101 158

59 181 14 34

176 87 183 218

136 229 196 5

200 218 224 164

123 151 224 204

61 30 232 48

107 24 110 229

68 32 110 120

**Scode:-** This file “wk1read “ read contents ( ‘enc’ ) in the form of a matrix and save in the scode.

**(2)key1=wk1read('key1');**

**ans:**

13

**Key1:-** This file “wk1read “ read contents ( ‘key1’ ) in the form of a matrix and save in the key1.

**(3) key2=wk1read('key2');**

**ans:**

4

**Key2:-** This file “wk1read “ read contents ( ‘key2’ ) in the form of a matrix and save in the key2.

**(4) key3=wk1read('key3');**

**ans:**

1

**Key3:-** This file “ wk1read “ read contents ( ‘key3’ ) in the form of a matrix and save in the key3.

**(5) key4=wk1read('key4');**

**ans:**

52

**Key4:-** This file “ wk1read “ read contents ( ‘key4’ ) in the form of a matrix and save in the key4.

**(6) key3=wk1read('key3');**

**ans:**

1

**Key3:-** This file “ wk1read “ read contents ( ‘key3’ ) in the form of a matrix and save in the key3.

**(7) key4=wk1read('key4');**

**ans:**

52



**Key4:-** This file “ wk1read “ read contents ( ‘key4’ ) in the form of a matrix and save in the key4.

**(8) ee=scode;**

**ans:**

23 110 217 92

181 202 20 236

0 231 8 20

33 145 247 112

229 242 101 158

59 181 14 34

176 87 183 218

136 229 196 5

200 218 224 164

123 151 224 204

61 30 232 48

107 24 110 229

68 32 110 120

**ee:-** scode storage in new variable in a ( ee ).

**(9) r=round(inv(pascal((key1),2)));**

**ans:** Show In table (2)

**Table (2)**

0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	-1	-12
0	0	0	0	0	0	0	0	0	0	1	11	66
0	0	0	0	0	0	0	0	0	-1	-10	-55	-220
0	0	0	0	0	0	0	0	1	9	45	165	495
0	0	0	0	0	0	0	-1	-8	-36	-120	-330	-792
0	0	0	0	0	0	1	7	28	84	210	462	924
0	0	0	0	0	-1	-6	-21	-56	-126	-252	-462	-792
0	0	0	0	1	5	15	35	70	126	210	330	495
0	0	0	-1	-4	-10	-20	-35	-56	-84	-120	-165	-220
0	0	1	3	6	10	15	21	28	36	45	55	66
0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12
1	1	1	1	1	1	1	1	1	1	1	1	1

**r:-** Generating inverse matrix Pascal as largest element has been stored in the key1 and a approximated into integers.

**(10) n1=ee-00;**

**ans:**

23 110 217 92

181 202 20 236

0 231 8 20

33 145 247 112

229 242 101 158

59 181 14 34

176 87 183 218

136 229 196 5

200 218 224 164

123 151 224 204

61 30 232 48

107 24 110 229

68 32 110 120

n1:- change dimensions matrix ( ee ) into variable ( n1 ).

**(11) nn1=mod(r\*double(n1),255)+00;**

**ans:-**

68 32 110 120

97 102 100 116

116 111 32 32

97 114 101 101

32 32 110 110

115 97 103 99

101 114 108 114

99 97 105 121

117 98 115 112

114 105 104 116

105 99 32 105

116 32 116 111

121 97 101 110

**nn1:-** Return numbers within Ascii Code Range.

**(12) q=char(e);**

**ans:**

D nx

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aree

nn

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erlr

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t to

yaen

**q:-** Storage variable ( e ) by instruct ( char ) into a variable of ( q ).

**(13) so=reshape(q,key3,key4);**

**ans:**

Data security for Arabic and English text encryption.

**so:-** Re shape the original matrix.

### **3.2.3 Encryption Arabic text**

Second step is reading the Arabic message that want to be encrypted and decryption this will be done by using MATLAB instruction (text read). the message that entered to the program is

هندسة تقنيات الحاسبات

**(1) x=textread('Arabic.txt','%s','delimiter','\n','whitespace','');**

**ans:-**

'هندسة تقنيات الحاسبات'

**X :-** Read the text in the (English) which save in the file in folder of matlab.

**English.txt** :- call the file want to encryption .

**%s** :- Read a white-space or delimiter-separated string.

**delimiter** :- determine the type of file modulation to use it in encryption

**\n** :- down to new row

**whitespace** :- to calculate spaces , characters and numbers in both row and column plus the numbers of characters in the Unicode.

**(2) s=char(x);**

ans:-

هندسة تقنيات حاسبات / فرع شبكات

Save characters in variable to easy use from Matlab

**(3) [tt,uu]=size(s);**

ans:-

1 32

**tt** :- number of row to encrypted

**uu**:- number of column to encrypted

**size(s)** :- size of original message

**(4) `g=tt*uu;`**

ans:-

32

Size of hole matrix.

**(5) `t=[1 T];`**

ans :-

1   2   4   8   16   32

Numbers that we can divide hole size of original letter (g) and the result is integer.

**(6) `y=find(k<=24);`**

ans :-

2   3   4   5   6

position of pascal matrix rang which it is less than 24.

**(7) `yy=k(y:end);`**

ans:-

16 8 4 2 1

Number of pascal matrix dimension that can be used.

**(8) [w,ww]=size(e);**

ans:-

1 32

Read size of matrix for Precaution

**(9) m=pascal(yy(1),2);**

**ans :-**

**Table (3)**

-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-105	-91	-78	-66	-55	-45	-36	-28	-21	-15	-10	-6	-3	-1	0	0
455	364	286	220	165	120	84	56	35	20	10	4	1	0	0	0
-1365	-1001	-715	-495	-330	-210	-126	-70	-35	-15	-5	-1	0	0	0	0
3003	2002	1287	792	462	252	126	56	21	6	1	0	0	0	0	0
-5005	-3003	-1716	-924	-462	-210	-84	-28	-7	-1	0	0	0	0	0	0
6435	3432	1716	792	330	120	36	8	1	0	0	0	0	0	0	0
-6435	-3003	-1287	-495	-165	-45	-9	-1	0	0	0	0	0	0	0	0
5005	2002	715	220	55	10	1	0	0	0	0	0	0	0	0	0
-3003	-1001	-286	-66	-11	-1	0	0	0	0	0	0	0	0	0	0
1365	364	78	12	1	0	0	0	0	0	0	0	0	0	0	0
-455	-91	-13	-1	0	0	0	0	0	0	0	0	0	0	0	0
105	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-15	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Generate Pascal matrix depended on largest element inside matrix in table(3)

**(10) xx=reshape(e,yy(1),z(y(1)));**

**ans:-**

229 200

228 199

207 202

211 32

201 47

32 32

202 221

222 209

228 218

237 32

199 212

202 200

32 223

205 199

199 202

211 32

change the shape of matrix mean for each matrix has specific shape in the matrix did not under to any rule .

**(11) nn=xx-32;**

ans:-

229 200

228 199

207 202

211 32

201 47

32 32

202 221

222 209

228 218

237 32

199 212

202 200

32 223

205 199

199 202

211 32

To change the dimension and save in the variable (nn).

**(12) h=(m)\*double(nn);**

ans:-

-3045 -2460

23501 18141

-112694 -84056

374764	281524
-920037	-706545
1722883	1358626
-2505604	-2029205
2857881	2371140
-2565798	-2171804
1808603	1553994
-991286	-860232
414456	361623
-127845	-111767
27444	23988
-3663	-3199
229	200

To equal dimension with Pascal matrix (m) to make the multiply process

**(13) ncode=mod(h,223)+32;**

**ans:-**

15 90

41 36

16 94

169 4

3 60

103 241

26 85

96 150

12 31

143 24

154 138

81 33

165 178

159 18

162 116

229 200

To return the number to in the range of ASCII code

**(14) [w1,w2]=size(ncode);**

**ans:-**

**16 2**

Calculate the size of matrix after (Mode) order

**(15) ee(i,:)=native2unicode(ncode(i,:));**

ans:-

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Convert native number to Unicode

**(16) hh=char(ee);**

ans:-

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Reserve the (ee) matrix in the variable (hh) to deal it by MATLAB.

### **3.3.2 Decryption of Abrbic text:-**

**(1) scode=wk1read('enc')**

**ans :-**

15 90

41 36

16 94

169 4

3 60

103 241

26 85

96 150

12 31

143 24

154 138

81 33

165 178

159 18

162 116

229 200

**Scode:-** This file “ wk1read “ read contents ( ‘enc’ ) in the form of a matrix and save in the scode.

**(2) key1=wk1read('key1');**

**ans:**

16

**Key1:-** This file “ wk1read “ read contents ( ‘key1’ ) in the form of a matrix and save in the

**(3) ke1.key2=wk1read('key2');**

**ans:-**

2

**Key2:-** This file “ wk1read “ read contents ( ‘key2’ ) in the form of a matrix and save in the key2.

**(4) key3=wk1read('key3');**

**ans:      1**

**Key3:-** This file “ wk1read “ read contents ( ‘key3’ ) in the form of a matrix and save in the key3.

**(5) key4=wk1read('key4');**

**ans:**

32

**Key4:-** This file “ wk1read “ read contents ( ‘key4’ ) in the form of a matrix and save in the key4.

**(6) ee=scode;**

**ans:**

15    90



41 36

16 94

169 4

3 60

103 241

26 85

96 150

12 31

143 24

154 138

81 33

165 178

159 18

162 116

229 200

**ee:-** scode storage in new variable in a ( ee ).

**(7) r=round(inv(pascal((key1),2)));**

**ans:** Show In table (4).

**Table (4)**

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-15
0	0	0	0	0	0	0	0	0	0	0	0	0	1	14	105
0	0	0	0	0	0	0	0	0	0	0	0	-1	-13	-91	-455
0	0	0	0	0	0	0	0	0	0	0	1	12	78	364	1365
0	0	0	0	0	0	0	0	0	0	-1	-11	-66	-286	-1001	-3003
0	0	0	0	0	0	0	0	0	1	10	55	220	715	2002	5005
0	0	0	0	0	0	0	0	-1	-9	-45	-165	-495	-1287	-3003	-6435
0	0	0	0	0	0	0	1	8	36	120	330	792	1716	3432	6435
0	0	0	0	0	0	-1	-7	-28	-84	-210	-462	-924	-1716	-3003	-5005
0	0	0	0	0	1	6	21	56	126	252	462	792	1287	2002	3003
0	0	0	0	-1	-5	-15	-35	-70	-126	-210	-330	-495	-715	-1001	-1365
0	0	0	1	4	10	20	35	56	84	120	165	220	286	364	455
0	0	-1	-3	-6	-10	-15	-21	-28	-36	-45	-55	-66	-78	-91	-105
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

**r:-** Generating inverse matrix Pascal as largest element has been stored in the key1 and a approximated into integers.

**(8) n1=ee-00;**

**ans:**

15 90

41 36

16 94

169 4

3 60

103 241

26 85

96 150

12 31

143 24

154 138

81 33

165 178

159 18

162 116

229 200

n1:- change dimensions matrix ( ee ) into variable ( n1 ).

**(9) nn1=mod(r\*double(n1),255)+00;**

**ans:-**

229 200

228 199

207 202

211 32

201 47

32 32

202 221

222 209

228 218

237 32

199 212

202 200

32 223

205 199

199 202

**nn1:-** Return numbers within Ascii Code Range.

**(10) q=char(e);**

**ans :-**

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**q:-** Storage variable ( e ) by instruct ( char ) into a variable of ( q ).

**(11) so=reshape(q,key3,key4);**

**ans:**

هندسة تقنيات حاسبات

**so:-** Re shape the original matrix.

### **3.2.4 Encryption a text contain Arabic and English letters**

Third step is reading the Arabic and English message that want to be encrypted this will be done by using MATLAB instruction (text read). The message that entered to the program is.

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هندسة تقنيات حاسبات

اسم المشروع :

Data security for arabic and english text encryption

اسماء الطلاب :

(١) مصطفى فارس طارش

(٢) ياسر جاسم مطلب

(٣) محمد براء هاشم

(٤) حسين محمد منديل

**(1) x=textread('Arabic.txt','%s','delimiter','\n','whitespace','');**

ans:-

'Dijlah university college'

'هندسة تقنيات حاسبات'

'اسم المشروع'

'Fast and robust approach data security'

'اسماء الطلاب'

'مصطفى فارس طارش (1)'

'ياسر جاسم مطلب (2)'

'محمد براء هاشم (3)'

'حسين محمد منديل (4)'

**X :-** Read the text in the (English) which save in the file in folder of Matlab.

**English.txt :-** call the file want to encryption .

**%s :-** Read a white-space or delimiter-separated string.

**delimiter :-** determine the type of file modulation to use it in encryption

**\n :-** down to new row

**whitespace :-** to calculate spaces , characters and numbers in both row and colum plus the numbers of characters in the Unicode.

**(2) s=char(x);**

ans:-

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هندسة تقنيات حاسبات / فرع شبكات

اسم المشروع :

Fast and robust approach data security

اسماء الطلاب :

(١) مصطفى فارس طارش

ياسر جاسم مطلب (٢)

(٣) محمد براء هاشم

(٤) حسين محمد منديل

**s:-** Save characters in variable to easy use from Matlab

**(3) [tt,uu]=size(s);**

Ans:-

9 52

**tt :-** number of row to encrypted



**uu:-** number of column to encrypted

**size(s) :-** size of original message

**(4)  $g=tt*uu;$**

ans:-

468

**g:-** Size of hole matrix.

**(5)  $t=[1\ T];$**

ans :-

1   2   3   4   6   9   12   13   18   26   36   39   52   78   117   156  
234   468

**t:-** numbers that we can divide hole size of original letter (g) and the result is integer

**(6)  $y=find(k\leq 24);$**

ans :-

10 11 12 13 14 15 16 17 18

y;- position of pascal matrix rang which it is less than 24.

**(7) yy=k(y:end);**

ans:-

18 13 12 9 6 4 3 2 1

yy;- number of pascal matrix dimension that can be used

**(8) [w,ww]=size(e);**

ans:-

9 52

[w,ww]:- Read size of matrix for Precaution

**(9) m=pascal(yy(1),2);**

ans :-

**Table (5)**

-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-136	-120	-105	-91	-78	-66	-55	-45	-36	-28	-21	-15	-10	-6	-3	-1	0	0
680	560	455	364	286	220	165	120	84	56	35	20	10	4	1	0	0	0
-2380	-1820	-1365	-1001	-715	-495	-330	-210	-126	-70	-35	-15	-5	-1	0	0	0	0
6188	4368	3003	2002	1287	792	462	252	126	56	21	6	1	0	0	0	0	0
-12376	-8008	-5005	-3003	-1716	-924	-462	-210	-84	-28	-7	-1	0	0	0	0	0	0
19448	11440	6435	3432	1716	792	330	120	36	8	1	0	0	0	0	0	0	0
-24310	-12870	-6435	-3003	-1287	-495	-165	-45	-9	-1	0	0	0	0	0	0	0	0
24310	11440	5005	2002	715	220	55	10	1	0	0	0	0	0	0	0	0	0
-19448	-8008	-3003	-1001	-286	-66	-11	-1	0	0	0	0	0	0	0	0	0	0
12376	4368	1365	364	78	12	1	0	0	0	0	0	0	0	0	0	0	0
-6188	-1820	-455	-91	-13	-1	0	0	0	0	0	0	0	0	0	0	0	0
2380	560	105	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-680	-120	-15	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
136	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-17	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

m:- generate Pascal matrix depended on largest element inside matrix

**(10) xx=reshape(e,yy(1),z(y(1)));**

**ans:-**

*Columns 1 through 18*

```

68 106 97 32 110 118 114 105 121 99 108 101 101 32 32 32 32 32
229 207 201 202 228 202 202 205 211 199 32 221 218 212 223 202 32 32
199 227 199 227 209 218 58 32 32 32 32 32 32 32 32 32 32 32
68 116 32 101 117 105 121 102 114 97 97 105 32 110 32 110 108 115
199 227 193 199 216 199 32 32 32 32 32 32 32 32 32 32 32 32
40 41 225 32 205 228 218 237 32 32 32 32 32 32 32 32 32 32
40 41 213 221 32 221 193 32 32 32 32 32 32 32 32 32 32 32
40 41 200 32 225 229 200 211 207 32 32 32 32 32 32 32 32 32
40 41 205 207 200 222 32 199 209 32 32 32 32 32 32 32 32 32
105 108 104 117 105 101 115 116 32 111 108 103 32 32 32 32 32 32
228 211 32 222 237 199 32 199 200 202 47 209 32 200 199 32 32 32
211 32 225 212 230 32 32 32 32 32 32 32 32 32 32 32 32 32
97 97 115 99 114 116 32 111 32 114 98 99 97 100 101 103 105 104
211 199 32 225 225 200 58 32 32 32 32 32 32 32 32 32 32 32
49 218 237 227 211 32 225 32 32 32 32 32 32 32 32 32 32 32
50 227 216 236 213 199 32 32 32 32 32 32 32 32 32 32 32 32
51 218 207 199 230 199 32 218 32 32 32 32 32 32 32 32 32 32
52 227 227 32 199 209 221 206 32 32 32 32 32 32 32 32 32 32

```

32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	101	116	101	99	121	116	111
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
116	120	32	110	114	112	105	110
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32

```
(11) nn=xx-32;
```

Columns 1 through 18

[illegible]

*Columns 19 through 26*

32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	101	116	101	99	121	116	111
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
116	120	32	110	114	112	105	110
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32

**nn**:- To change the dimension and save in the variable (nn)

**(12)  $h=(m)*double(nn);$**

**ans:-** Columns 1 through 5

-1977	-2584	-2960	-2822	-3306
18353	19956	24154	22689	26599
-100739	-110615	-128346	-114674	-139078
390194	438637	474735	417255	517145
-1126239	-1281006	-1300219	-1138473	-1437977
2488213	2843846	2749053	2394525	3087832
-4289030	-4916940	-4602246	-3955390	-5228319
5849837	6731430	6188207	5192801	7072912
-6369857	-7371574	-6727461	-5453546	-7701503
5558696	6487338	5918984	4589144	6766449
-3881995	-4585061	-4198284	-3084223	-4785731
2154269	2586350	2379690	1641114	2704477
-936924	-1149501	-1062247	-680751	-1204395
312126	393886	364956	214728	413279
-76773	-100441	-93097	-49506	-105412
13111	17955	16607	7811	18817
-1385	-2009	-1850	-746	-2098
68	106	97	32	110

Columns 6 through 10

-3029	-1949	-2133	-1446	-1206
26486	17676	18060	14940	11849
-143897	-100243	-97416	-84933	-67781
535690	385696	361867	330276	271854
-1470587	-1089631	-1005073	-958790	-814531
3111998	2368958	2178376	2160746	1876306
-5209638	-4075807	-3761969	-3852304	-3383493
7000403	5633816	5230011	5487852	4837634
-7604307	-6298015	-5878307	-6278874	-5529174
6687872	5698239	5341203	5777697	5069636
-4746861	-4155846	-3907235	-4264929	-3723785
2696973	2421719	2281100	2507232	2176356
-1209384	-1111107	-1047335	-1158150	-998627
418519	392256	369520	411128	351810
-107855	-102751	-96582	-108194	-91777
19498	18794	17592	19864	16680
-2208	-2140	-1990	-2268	-1882
118	114	105	121	99

Columns 11 through 15

-874	-1222	-896	-1070	-1003
8141	12257	9370	10384	9466
-45466	-71194	-58466	-59018	-53229
178701	288093	249650	233672	211415
-526296	-866949	-777241	-686074	-627986
1199103	2000478	1833533	1540040	1431912
-2156372	-3608270	-3361800	-2695218	-2549065
3102007	5155609	4870008	3727320	3585463
-3598671	-5884950	-5627050	-4106674	-4014010
3377946	5385952	5205486	3615612	3585296
-2561481	-3946865	-3849768	-2537886	-2547896
1558284	2300116	2260440	1408680	1428336
-750379	-1051771	-1039668	-608874	-621796
279710	369002	366300	199812	204880
-77857	-95785	-95352	-47790	-49032
15232	17304	17256	7776	7952
-1868	-1938	-1935	-756	-767
108	101	101	32	32



Columns 16 through 20

-895	-725	-731	-660	-733
9063	6325	6418	5316	6302
-54320	-33758	-34385	-26952	-33271
222222	126314	128852	98760	123916
-662009	-350617	-357619	-274596	-343685
1492835	746273	760286	594132	732274
-2613962	-1246596	-1267617	-1018368	-1225575
3612752	1661088	1685112	1400256	1637064
-3977974	-1784068	-1805089	-1555840	-1763047
3501212	1552408	1566422	1400256	1538394
-2457806	-1094444	-1101451	-1018368	-1087437
1365000	621712	624260	594048	619164
-590674	-281092	-281729	-274176	-280455
194212	98984	99082	97920	98886
-46590	-26188	-26195	-26112	-26181
7616	4896	4896	4896	4896
-746	-576	-576	-576	-576
32	32	32	32	32

Columns 21 through 25

-660	-723	-725	-745	-733
6072	6252	6244	6542	6437
-33756	-33171	-33029	-35011	-34486
128496	123816	123128	131116	129226
-358260	-343635	-341653	-363665	-358625
762216	732264	728264	772306	762289
-1270620	-1225575	-1219569	-1285635	-1270620
1688544	1637064	1630200	1705704	1688544
-1808092	-1763047	-1757041	-1823107	-1808092
1568424	1538394	1534390	1578434	1568424
-1102452	-1087437	-1085435	-1107457	-1102452
624624	619164	618436	626444	624624
-281820	-280455	-280273	-282275	-281820
99096	98886	98858	99166	99096
-26196	-26181	-26179	-26201	-26196
4896	4896	4896	4896	4896
-576	-576	-576	-576	-576
32	32	32	32	32

Column 26

-733  
6392  
-34081  
127456  
-353645  
752284  
-1255605  
1671384  
-1793077  
1558414  
-1097447  
622804  
-281365  
99026  
-26191  
4896  
-576  
32

h:- To equal dimension with Pascal matrix (m) to make the multiply process

**(13) ncode=mod(h,223)+32;**

**ans:-**

*Columns 1 through 15*

63	221	100	238	9	31	91	162	84	69	146	53	124	205	17
248	66	184	249	79	221	81	210	150	119	236	17	190	184	31
241	55	174	76	152	178	227	249	237	49	179	206	184	142	66
44	37	180	75	5	190	136	22	51	24	201	198	5	92	20
96	114	26	102	223	253	239	137	10	194	24	51	254	131	79
178	86	153	75	37	233	8	166	131	16	93	3	83	95	87
70	225	249	170	201	12	113	46	236	102	163	235	120	132	170
137	195	122	236	232	143	101	216	252	29	187	19	18	240	163
43	221	204	139	7	48	230	208	246	246	144	195	35	101	200
206	138	179	164	24	242	9	228	162	236	216	97	171	222	251
125	94	36	2	109	219	144	130	201	235	249	25	222	129	64
29	140	30	189	202	93	239	125	72	186	234	16	120	60	81
201	39	83	99	225	81	183	205	60	208	86	104	222	66	149
6	166	51	18	179	64	66	25	68	165	230	17	120	147	115
237	29	233	219	158	10	14	63	181	23	173	95	18	150	183
106	105	32	161	202	118	179	252	229	105	187	219	171	126	47
145	31	190	19	197	87	155	50	27	158	172	102	105	9	253
68	106	97	32	110	118	114	105	121	99	108	101	101	32	32



Columns 16 through 26

125	40	34	105	32	105	42	40	20	32	32
138	205	43	216	182	207	132	124	167	62	17
250	157	40	78	134	159	234	121	179	194	89
117	89	77	75	241	231	141	218	46	196	211
226	8	146	39	55	15	105	47	220	160	40
65	143	131	237	169	21	159	239	166	94	34
43	99	243	102	210	45	210	96	75	45	15
167	18	72	51	219	189	219	240	9	189	114
26	167	56	170	23	113	23	164	143	113	83
62	223	212	51	234	174	234	55	239	174	109
139	16	149	102	138	168	138	100	8	168	73
240	22	20	153	24	129	24	61	164	129	94
161	173	46	204	45	210	45	227	10	210	155
157	44	142	0	201	156	201	173	226	156	86
75	77	70	153	84	69	84	86	64	69	74
221	51	51	51	51	51	51	51	51	51	51
19	189	189	189	189	189	189	189	189	189	189
32	32	32	32	32	32	32	32	32	32	32

**ncode:-** To return the number to in the range of ASCII code

**(14) [w1,w2]=size(ncode);**

**ans:-**

18 26

**[w1,w2]:-** Calculate the size of matrix after (Mode) order

**(15) ee(i,:)=native2unicode(ncode(i,:));**

**ans:-**



' $\frac{3}{4}$ |W>2-fi  $\frac{1}{2}\frac{1}{2}\frac{1}{2}\frac{1}{2}\frac{1}{2}\frac{1}{2}\frac{1}{2}\frac{1}{2}\frac{1}{2}$

Dja nvriyclee

Reserve the (ee) matrix in the variable (hh) to deal it by MATLAB

### 3.2.5 Decryption of a text that contain Arabic and English letters

(1) `scode=wk1read('enc')`

ans:-

*Columns 1 through 15*

63	221	100	238	9	31	91	162	84	69	146	53	124	205	17
248	66	184	249	79	221	81	210	150	119	236	17	190	184	31
241	55	174	76	152	178	227	249	237	49	179	206	184	142	66
44	37	180	75	5	190	136	22	51	24	201	198	5	92	20
96	114	26	102	223	253	239	137	10	194	24	51	254	131	79
178	86	153	75	37	233	8	166	131	16	93	3	83	95	87
70	225	249	170	201	12	113	46	236	102	163	235	120	132	170
137	195	122	236	232	143	101	216	252	29	187	19	18	240	163
43	221	204	139	7	48	230	208	246	246	144	195	35	101	200
206	138	179	164	24	242	9	228	162	236	216	97	171	222	251
125	94	36	2	109	219	144	130	201	235	249	25	222	129	64
29	140	30	189	202	93	239	125	72	186	234	16	120	60	81
201	39	83	99	225	81	183	205	60	208	86	104	222	66	149
6	166	51	18	179	64	66	25	68	165	230	17	120	147	115
237	29	233	219	158	10	14	63	181	23	173	95	18	150	183
106	105	32	161	202	118	179	252	229	105	187	219	171	126	47
145	31	190	19	197	87	155	50	27	158	172	102	105	9	253
68	106	97	32	110	118	114	105	121	99	108	101	101	32	32

Columns 16 through 26

125	40	34	105	32	105	42	40	20	32	32
138	205	43	216	182	207	132	124	167	62	17
250	157	40	78	134	159	234	121	179	194	89
117	89	77	75	241	231	141	218	46	196	211
226	8	146	39	55	15	105	47	220	160	40
65	143	131	237	169	21	159	239	166	94	34
43	99	243	102	210	45	210	96	75	45	15
167	18	72	51	219	189	219	240	9	189	114
26	167	56	170	23	113	23	164	143	113	83
62	223	212	51	234	174	234	55	239	174	109
139	16	149	102	138	168	138	100	8	168	73
240	22	20	153	24	129	24	61	164	129	94
161	173	46	204	45	210	45	227	10	210	155
157	44	142	0	201	156	201	173	226	156	86
75	77	70	153	84	69	84	86	64	69	74
221	51	51	51	51	51	51	51	51	51	51
19	189	189	189	189	189	189	189	189	189	189
32	32	32	32	32	32	32	32	32	32	32

**Score:-** This file “wk1read “ read contents ( ‘enc’ ) in the form of a matrix and save in the score.

**(2) key1=wk1read('key1');**

**ans:**

18

**Key1:-** This file “ wk1read “ read contents ( ‘key1’ ) in the form of a matrix and save in the key1.

**(3) key2=wk1read('key2');**

**ans:**

26

**Key2:-** This file “ wk1read “ read contents ( ‘key2’ ) in the form of a matrix and save in the key2.

**(4) key3=wk1read('key3');**

ans:

9

**Key3:-** This file “ wk1read “ read contents ( ‘key3’ ) in the form of a matrix and save in the key3.

**(5) key4=wk1read('key4');**

ans:

52

**Key4:-** This file “ wk1read “ read contents ( ‘key4’ ) in the form of a matrix and save in the key4.

**(6) ee=score;**

ans:-

Columns 1 through 15

63	221	100	238	9	31	91	162	84	69	146	53	124	205	17
248	66	184	249	79	221	81	210	150	119	236	17	190	184	31
241	55	174	76	152	178	227	249	237	49	179	206	184	142	66
44	37	180	75	5	190	136	22	51	24	201	198	5	92	20
96	114	26	102	223	253	239	137	10	194	24	51	254	131	79
178	86	153	75	37	233	8	166	131	16	93	3	83	95	87
70	225	249	170	201	12	113	46	236	102	163	235	120	132	170
137	195	122	236	232	143	101	216	252	29	187	19	18	240	163
43	221	204	139	7	48	230	208	246	246	144	195	35	101	200
206	138	179	164	24	242	9	228	162	236	216	97	171	222	251
125	94	36	2	109	219	144	130	201	235	249	25	222	129	64
29	140	30	189	202	93	239	125	72	186	234	16	120	60	81
201	39	83	99	225	81	183	205	60	208	86	104	222	66	149
6	166	51	18	179	64	66	25	68	165	230	17	120	147	115
237	29	233	219	158	10	14	63	181	23	173	95	18	150	183
106	105	32	161	202	118	179	252	229	105	187	219	171	126	47
145	31	190	19	197	87	155	50	27	158	172	102	105	9	253
68	106	97	32	110	118	114	105	121	99	108	101	101	32	32

Columns 16 through 26

125	40	34	105	32	105	42	40	20	32	32
138	205	43	216	182	207	132	124	167	62	17
250	157	40	78	134	159	234	121	179	194	89
117	89	77	75	241	231	141	218	46	196	211
226	8	146	39	55	15	105	47	220	160	40
65	143	131	237	169	21	159	239	166	94	34
43	99	243	102	210	45	210	96	75	45	15
167	18	72	51	219	189	219	240	9	189	114
26	167	56	170	23	113	23	164	143	113	83
62	223	212	51	234	174	234	55	239	174	109
139	16	149	102	138	168	138	100	8	168	73
240	22	20	153	24	129	24	61	164	129	94
161	173	46	204	45	210	45	227	10	210	155
157	44	142	0	201	156	201	173	226	156	86
75	77	70	153	84	69	84	86	64	69	74
221	51	51	51	51	51	51	51	51	51	51
19	189	189	189	189	189	189	189	189	189	189
32	32	32	32	32	32	32	32	32	32	32

ee:- scode storage in new variable in a ( ee ).

(7) r=round(inv(pascal((key1),2)));

ans:-

Columns 1 through 7

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	-1
0	0	0	0	0	1	6
0	0	0	0	-1	-5	-15
0	0	0	1	4	10	20
0	0	-1	-3	-6	-10	-15
0	1	2	3	4	5	6
-1	-1	-1	-1	-1	-1	-1

Columns 8 through 14

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	1
0	0	0	0	0	-1	-13
0	0	0	0	1	12	78
0	0	0	-1	-11	-66	-286
0	0	1	10	55	220	715
0	-1	-9	-45	-165	-495	-1287
1	8	36	120	330	792	1716
-7	-28	-84	-210	-462	-924	-1716
21	56	126	252	462	792	1287
-35	-70	-126	-210	-330	-495	-715
35	56	84	120	165	220	286
-21	-28	-36	-45	-55	-66	-78
7	8	9	10	11	12	13
-1	-1	-1	-1	-1	-1	-1



Columns 15 through 18

0	0	0	1
0	0	-1	-17
0	1	16	136
-1	-15	-120	-680
14	105	560	2380
-91	-455	-1820	-6188
364	1365	4368	12376
-1001	-3003	-8008	-19448
2002	5005	11440	24310
-3003	-6435	-12870	-24310
3432	6435	11440	19448
-3003	-5005	-8008	-12376
2002	3003	4368	6188
-1001	-1365	-1820	-2380
364	455	560	680
-91	-105	-120	-136
14	15	16	17
-1	-1	-1	-1

r:- Generating inverse matrix Pascal as largest element has been stored in the key1 and a approximated into integers.

(8) n1=ee-00;

ans:-

Columns 1 through 15

63	221	100	238	9	31	91	162	84	69	146	53	124	205	17
248	66	184	249	79	221	81	210	150	119	236	17	190	184	31
241	55	174	76	152	178	227	249	237	49	179	206	184	142	66
44	37	180	75	5	190	136	22	51	24	201	198	5	92	20
96	114	26	102	223	253	239	137	10	194	24	51	254	131	79
178	86	153	75	37	233	8	166	131	16	93	3	83	95	87
70	225	249	170	201	12	113	46	236	102	163	235	120	132	170
137	195	122	236	232	143	101	216	252	29	187	19	18	240	163
43	221	204	139	7	48	230	208	246	246	144	195	35	101	200
206	138	179	164	24	242	9	228	162	236	216	97	171	222	251
125	94	36	2	109	219	144	130	201	235	249	25	222	129	64
20	140	20	100	202	02	220	125	72	106	224	16	120	60	01

6	166	51	18	179	64	66	25	68	165	230	17	120	147	115
237	29	233	219	158	10	14	63	181	23	173	95	18	150	183

Columns 16 through 26

125	40	34	105	32	105	42	40	20	32	32
138	205	43	216	182	207	132	124	167	62	17
250	157	40	78	134	159	234	121	179	194	89
117	89	77	75	241	231	141	218	46	196	211
226	8	146	39	55	15	105	47	220	160	40
65	143	131	237	169	21	159	239	166	94	34
43	99	243	102	210	45	210	96	75	45	15
167	18	72	51	219	189	219	240	9	189	114
26	167	56	170	23	113	23	164	143	113	83
62	223	212	51	234	174	234	55	239	174	109
139	16	149	102	138	168	138	100	8	168	73
240	22	20	153	24	129	24	61	164	129	94
161	173	46	204	45	210	45	227	10	210	155
157	44	142	0	201	156	201	173	226	156	86
75	77	70	153	84	69	84	86	64	69	74
221	51	51	51	51	51	51	51	51	51	51
19	189	189	189	189	189	189	189	189	189	189
32	32	32	32	32	32	32	32	32	32	32

n1:- change dimensions matrix ( ee ) into variable ( n1 ).

(9) nn1=mod(r\*double(n1),255)+00;

ans:-

Columns 1 through 15

68	106	97	32	110	118	114	105	121	99	108	101	101	32	32
229	207	201	202	228	202	202	205	211	199	32	221	218	212	223
199	227	199	227	209	218	58	32	32	32	32	32	32	32	32
68	116	32	101	117	105	121	102	114	97	97	105	32	110	32
199	227	193	199	216	199	32	32	32	32	32	32	32	32	32
40	41	225	32	205	228	218	237	32	32	32	32	32	32	32
40	41	213	221	32	221	193	32	32	32	32	32	32	32	32
40	41	200	32	225	229	200	211	207	32	32	32	32	32	32
40	41	205	207	200	222	32	199	209	32	32	32	32	32	32
105	108	104	117	105	101	115	116	32	111	108	103	32	32	32
228	211	32	222	237	199	32	199	200	202	47	209	32	200	199
211	32	225	212	230	32	32	32	32	32	32	32	32	32	32
97	97	115	99	114	116	32	111	32	114	98	99	97	100	101
211	199	32	225	225	200	58	32	32	32	32	32	32	32	32
49	218	237	227	211	32	225	32	32	32	32	32	32	32	32
50	227	216	236	213	199	32	32	32	32	32	32	32	32	32
51	218	207	199	230	199	32	218	32	32	32	32	32	32	32



*Columns 16 through 26*

32	32	32	32	32	32	32	32	32	32	32
202	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
110	108	115	32	101	116	101	99	121	116	111
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
103	105	104	116	120	32	110	114	112	105	110
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32
32	32	32	32	32	32	32	32	32	32	32

**nn1:-** Return numbers within Ascii Code Range.

**(10) q=char(e);**

**ans:**

Dja nvriyclee

هدةنتنتحسا فعشكت

امامرع:

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امءاطا

ل حنعي()

صف فء()

ب لهبسد()

حديق ار()

ilhuiest olg

نس قيا ابت/ر با

س لشو

aascrt o rbcadegihtx nrpin

سا للب:

عيمس ل 1

مطنصا 2

عداوا ع 3

مم ارفخ 4

q:- Storage variable ( e ) by instruct ( char ) into a variable of ( q ).

**(11) so=reshape(q,key3,key4);**

**ans:**

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اسم المشروع :

Fast and robust approach data security

اسماء الطلاب :

(1) مصطفى فارس طارش

(2) ياسر جاسم مطلب

(3) محمد براء هاشم

(4) حسين محمد مندیل

**so:-** Re shape the original matrix.

# Chapter – Four

## 4.1 Result for Encryption & Decryption message

Default message.

(Fast and robust approach data security)

Encryption English message.

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D nx )

Decryption English message.

(Fast and robust approach data security)

## **4.2 Resulte for Encryption & Decryption Arabic message.**

Default message.

( هندسة تقنيات حاسبات )

Encryption Arabic message.

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(هـب)

Decryption Arabic message.

(هندسة تقنيات حاسبات)

### **4.3 Resulte for Encryption & Decryption English and Arabic message.**

Default English & Arabic message.

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(4) حسين محمد منديل

Encryption English & Arabic message.

(i i\*{"ح|5TE' [فد?



Dja nvriyclee

Decryption English and Arabic message as show on command window of matlab program.

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# Chapter –Five

## **Conclusion And Recommendation :-**

### **5.1 conclusion**

1. The encryption and decryption system is has been very fast ( which mean plaintext contain to from 52,640 characters , 8,960 words and 3,000 lines take 28.85 seconds to encrypted it and 1.25 seconds to decrypted ) and the usage MATLAB instruction codes make building algorithm simple.
2. The size of input text can up to be very large.
3. The encryption is very strong and none could understand it.

### **5.2 Recommendation**

1. Text encryption using additive cipher artificial.
2. Text encryption using neural network.
3. Hide the encryption text obtained from the proposed method in image so that it will not be clear for any receiver.
4. Text encryption by changing between letters as example ( ا → ج , ع → ح ).

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## الخلاصة

الهدف من البحث هو تقديم طريقة في التشفير وأظهار النتائج عند تطبيق هذه الطريقة على الرسالة ( النص ) المراد تشفيرها وكيف سيكون شكل الرسالة لحماية المعلومات من الدخول الغير المصرح به او من السرقة ويستخدم مولد للمفاتيح باستخدام خوارزمية وهذا كله يتم باستخدام Unicode2native والتي تحول الأحرف العربيه والانكليزيه الى ارقام ( bytes ) في برنامج MATLAB حيث تم العمل على رسالة (النص المراد تشفيرها) انكليزية حيث يتم تشفيرها وفك تشفيرها وكذلك على النص العربي حيث يتم تشفيره وفك تشفيره وبعدها يتم دمج النصين العربي والانكليزي مع اضافة الارقام حيث يتم تشفيرها وفك تشفيرها أيضاً .

قسم هندسة تقنيات حاسبات

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# طريقة فعالة وسريعة لأمنية المعلومات

البحث مقدم الى كلية دجلة – قسم هندسة تقنيات حاسبات كجزء من متطلبات منح درجة  
البكالوريوس هندسة في تقنيات الحاسوب

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حزيران ٢٠٢١

جامعة دجلة  
فَكِّرْ لِمَا بَعْدَ



**Dijlah University**  
Think Beyond

# GPS Tracking System For Cars

**BY**

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زهراء مالك جاسم

**SUPERVISED BY :**

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الاية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

هُوَ الَّذِي جَعَلَ الشَّمْسَ ضِيَاءً وَالْقَمَرَ  
نُورًا وَقَدَّرَهُ مَنَازِلَ لِتَعْلَمُوا عَدَدَ السِّنِينَ  
وَالْحِسَابَ مَا خَلَقَ اللَّهُ ذَلِكَ إِلَّا بِالْحَقِّ  
يُفَصِّلُ الْآيَاتِ لِقَوْمٍ يَعْلَمُونَ

[يونس: 5]

## شكر وتقدير

نتوجه بفائق الشكر و التقدير الى استاذنا الفاضل الاستاذ (م. صبار نصيف جاسم ) لما ابداه من توجيهات سديدة و سعة صدر طول مدة البحث فكان للمساته و توجيهاته العلمية في اثراء و اغناء موضوع البحث . كذلك نتقدم بخالص الشكر و التقدير الى اساتذتنا الفاضل الذين تتلمذنا على ايديهم خلال رحلتنا الدراسية. كما نتقدم بخالص شكرنا و تقديرنا الى رئاسة جامعة دجلة و رئاسة قسم هندسة تقنيات الحاسوب لما لمسته منهم عطا و علما و نسأل الله ان يوفقهم في مجال عملهم. و نختم شكرنا و تقديرنا الى كل الناس الطيبين الذين كانوا معنا في متابعة مستمرة خلال فترة كتابة البحث لما قدموه من عون و نسأل الله تعالى ان يوفق الجميع و يجزيهم خير الجزاء.

## الاهداء

إليك أنت وحدك يا صاحب السيرة العطرة وصاحب الفكر  
المستنير، فأنت وحدك من كان له الفضل الأول على لأبلغ  
التعليم العالي، لك أنت والدي الحبيب الذي أتمنى من الله أن  
يطيل عمره لنت وامي الغالية . إلى جميع أخواتي الذين كان  
لهم الفضل في إزالة الكثير من العقبات والصعوبات من  
طريقي، أليكم أساتذتي الكرام، فكنتم دائماً تقدمون لي يد العون.

**فأني أهدي لكم جميعاً بحثي هذا**



## **Abstract**

Automobiles are necessary for the movement of goods from one location to another. Consumers may face several problems as a result of delays in the delivery of goods. This delay may be due to drivers choosing incorrect or longer routes when delivering. To avoid these challenges, the Global Positioning System (GPS) is increasingly being used for management of vehicle fleets, recovery of stolen vehicles, mapping and surveillance. This paper outlines the design and implementation of a real time GPS tracker system using Arduino. When a user makes a call on the number that is registered on the GPS-GSM shield attached to Arduino, the user receives the location coordinates with data being stored continuously on an SD card simultaneously. This proposal has significant application for vehicle security, salesman tracking and private drivers.

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# **chapter one**

## **An overview**

### **1.1introduction**

With advancements in technology, there has been an increase in the usage of vehicle tracking systems. The design of vehicle tracking systems enable the display of a vehicle's position on Google Maps. The GPS, GSM/GPRS modules controlled by Arduino UNO are placed inside the vehicle. In this way, the vehicle position is updated vehicle is moving. Vehicle tracking systems are very useful nowadays. This system enables the owner to observe and track the vehicle and find out about vehicle movement and past activities of automobile. This technology popularly called real time Vehicle Tracking Systems has proved useful in ensuring the security of vehicles. This hardware is fitted onto the vehicle in such a manner that persons who are in or outside of the vehicle cannot see it. Thus, it is used as a covert unit which continuously, or as a result of interruptions to the system, sends location data to the monitoring unit. When a vehicle is stolen, the location data from the tracking system can be used to find the location and so inform the police for further action. When users make a request, the GPS coordinates of the vehicle are sent to a specified mobile. The user will be provided with the position of the vehicle in terms of latitude and longitude which can be viewed using Google Maps[1].

This project proposes a vehicle tracking system for tracking vehicle theft using GPS and GSM technology. The GPS receiver and GSM modem utilizes Arduino UNO. The system is affixed to the vehicle. A GSM mobile phone can be used to send and receive the information. Therefore, the GPS system will send the longitudinal and latitudinal values corresponding to the position of

vehicle to the GSM Modem. If for example, an individual forgets where their vehicle is parked, an SMS can be sent to the vehicle GPS, The SMS sent would be transmitted through the GSM service provider, thereby reaching the vehicle. The vehicle will have a GSM device installed, which includes a SIM card. Through the GSM modem, the SMS will be received and sent to the Arduino UNO in the vehicle. Upon receipt of the message, the Arduino UNO checks the password and the request. If everything matches then it will perform the request required by the owner by sending a link that has longitude & latitude through Google Maps, showing the location of the vehicle[2]

## **1.2 Aim of the work**

The main goal of building a location tracking system is to monitor people, cars, and many other mobile issues, while through that it helps us to obtain its location at high speed and with extreme accuracy, and also if there is a vehicle theft case, it can be stopped and followed up, so it is a very important system. vehicle tracking system for tracking vehicle theft using GPS and GSM technology. The GPS receiver and GSM modem utilizes Arduino UNO. The system is affixed to the vehicle. A GSM mobile phone can be used to send and receive the information. Therefore, the GPS system will send the longitudinal and latitudinal values corresponding to the position of vehicle to the GSM Modem. If for example, an individual forgets where their vehicle is parked, an SMS can be sent to the vehicle GPS, The SMS sent would be transmitted through the GSM service provider, thereby reaching the vehicle. The vehicle will have a GSM device installed, which includes a SIM card. Through the GSM modem, the SMS will be received and sent to the Arduino uno in the vehicle. Upon receipt of the message, the Arduino uno checks the

password and the request. If everything matches then it will perform the request required by the owner by sending a link that has longitude & latitude through Google Maps, showing the location of the vehicle

### **1.3literature review**

The hardware and software of the GPS and GSM network have already been developed. The proposed GPS/GSM based System has two parts. The first is a mobile unit and the second is a controlling station. All system processes including the various interfaces for transmission of data have worked successfully. These results are compatible with current GPS technologies . A Vehicle Tracking System is a device that is fitted in a vehicle, to enable the vehicle owner to identify the vehicle's location. This project proposes the design of a vehicle tracking system that utilizes GPS and GSM technology. This system built based on an embedded system, can be used for tracking and any car through GPS - Global Positioning System and GSM - Global System for Mobile Communication. This design will continuously monitor the location of a moving vehicle and report the status of the vehicle on demand [3].

Face Detection System will be used to detect the face of the driver, and compare with a predefined face. If for example a car owner is sleeping while an individual steals the car, the Face Detection System will obtain images via a tiny web camera that is hidden in the car. The Face Detection System will compare the obtained images with the stored images. If the images do not match, then the information is sent to the owner through MMS. The owners will receive the images of the thief on their mobile phone, and will be able to trace the vehicle location through GPS. The location of the car and its speed can also be displayed to the owner through SMS.

The owner will be able to see images of the thief, as well as the vehicle location. As can be seen, this system can be utilized in our day-to-day life [4].

#### **1.4project outline**

The rest of this graduation research project (design and implementation GPS system) is composed of three major parts, the importing of necessary theoretical background, the developing of concepts and techniques (where the majority of the work has been done), and at least the conclusions and recommendations for the future works. The general roadmap for the graduation research project is organized as follows:

- Chapter 1:** Introduction to the graduation research project (design and implementation GPS system) is highlighted in the beginning of this chapter, in the literature review of chapter 1.
- Chapter 2:** In this chapter, the proposed system is designed to achieve its goal.
- Chapter 3:** Introduces the implementation of the designed system. Which is given in details in chapter two.
- Chapter 4:** Presents some conclusions, and recommendations for future works that can improve and augment this graduation research project.



## Chapter Two

### The System Design

#### 2.1 Introduction

The conceptual design of the proposed system was carried out using the activity diagram and data flow diagram as shown in the following parts.

##### 2.1.1 The Activity Diagram

now how learning about “How to interface GPS module with Computer and How to make a GPS updated Clock. In this project we are going one step ahead with GPS and going to track a vehicle using GPS and GSM. This Vehicle Tracking System can also be used for Accident Detection Alert System, Soldier Tracking System and many more, by just making few changes in hardware and software[4]. Figure (2.1) shown block diagram.

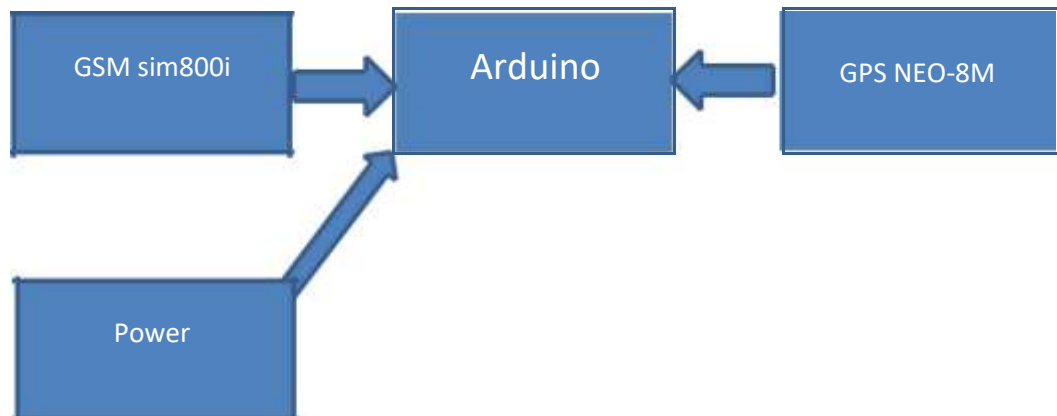


Figure (2.1) .black diagram

Tracking of vehicle is a process in which we track the vehicle location in form of Latitude and Longitude (GPS coordinates). GPS Coordinates are the value of a location. This system is very efficient for outdoor application purpose.

## 2.1 GPS UBLOX NEO-6M

GPS NEO-6M is one in a million GPS Module that one of GPS UBLOX Series. It can track up to 22 satellites on 50 channels and achieves the industry's highest level of sensitivity i.e. -161 dB tracking, while consuming only 45mA supply current. Unlike other GPS modules, it can do up to 5 location updates a second with 2.5m Horizontal position accuracy. The u-blox 6 positioning engine also boasts a Time-To-First-Fix (TTFF) of under 1 second. One of the best features the chip provides is Power Save Mode(PSM). It allows a reduction in system power consumption by selectively switching parts of the receiver ON and OFF. This dramatically reduces power consumption of the module to just 11mA making it suitable for power sensitive applications like GPS wristwatch[4]. Figure (2.2) shown GPS UBLOX NEO-6M

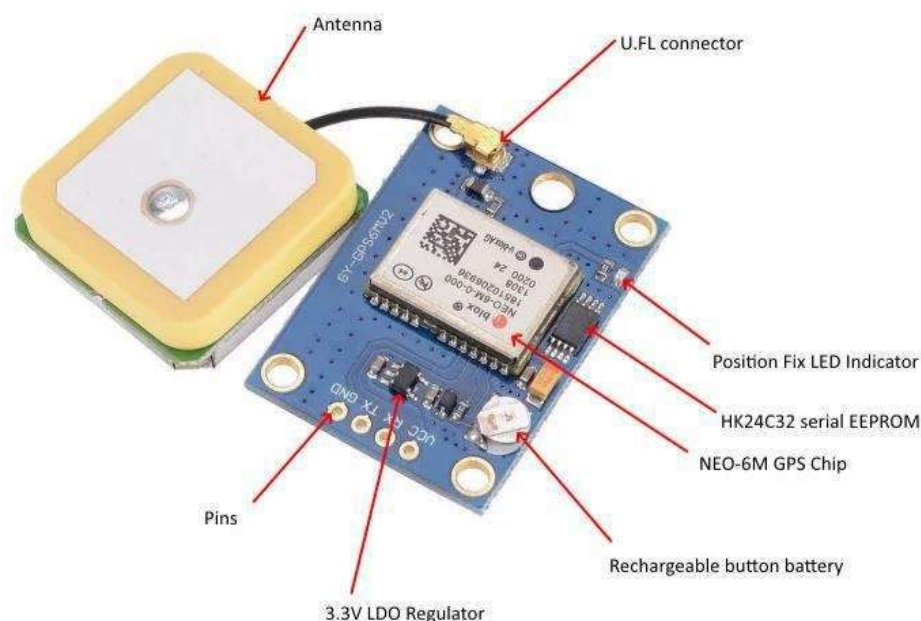


Figure (2.2) GPS UBLOX NEO-6M

### 2.2.1 NEO-6M GPS Chip

The heart of the module is a NEO-6M GPS chip from u-blox. It can track up to 22 satellites on 50 channels and achieves the industry's

highest level of sensitivity i.e. -161 dB tracking, while consuming only 45mA supply current. The u-blox 6 positioning engine also boasts a Time-To-First-Fix (TTFF) of under 1 second. One of the best features the chip provides is Power Save Mode(PSM) . It allows a reduction in system power consumption by selectively switching parts of the receiver ON and OFF. This dramatically reduces power consumption of the module to just 11mA making it suitable for power sensitive applications like GPS wristwatch. The necessary data pins of NEO-6M GPS chip are broken out to a "0.1" pitch headers. This includes pins required for communication with a microcontroller over UART[4]. Figure (2.3)shown NEO-6M GPS Chip

**Note:-** The module supports baud rate from 4800bps to 230400bps with default baud of 9600.



Figure(2.3) NEO-6M GPS Chip

#### Position Fix LED Indicator

There is an LED on the NEO-6M GPS Module which indicates the status of Position Fix. It'll blink at various rates depending on what state it's in

- No Blinking ==> means It is searching for satellites
- Blink every 1s – means Position Fix is found



Figure(2.4) Position Fix LED Indicator

### 2.2.2 3.3V LDO Regulator

The operating voltage of the NEO-6M chip is from 2.7 to 3.6V. But, the module comes with MIC5205 ultra-low dropout 3V3 regulator from MICREL. The logic pins are also 5-volt tolerant, so we can easily connect it to an Arduino or any 5V logic microcontroller without using any logic level converter[5]. Figure (2.5) shown LDO regulator.



Figure(2.5) LDO Regulator

### 2.2.3 Battery & EEPROM

The module is equipped with an HK24C32 two wire serial EEPROM. It is 4KB in size and connected to the NEO-6M chip via I2C. The module also contains a rechargeable button battery which acts as a super-capacitor.

An EEPROM together with battery helps retain the battery backed RAM (BBR). The BBR contains clock data, latest position data (GNSS or bit data) and module configuration. But it is not meant for permanent data storage.

As the battery retains clock and last position, time to first fix (TTFF) significantly reduces to 1s. This allows much faster position locks.

Without the battery the GPS always cold-start so the initial GPS lock takes more time. The battery is automatically charged when power is applied and maintains data for up to two weeks without power[5]. Figure (2.5) shown battery & EEPROM



Figure(2.6) Battery & EEPROM

## 2.4 Module SIM800i

SIM800L GSM/GPRS module is a miniature GSM modem, which can be integrated into a great number of IoT projects. You can use this module to accomplish almost anything a normal cell phone can; SMS text messages, Make or receive phone calls, connecting to internet through GPRS, TCP/IP, and more! To top it off, the module supports quad-band GSM/GPRS network, meaning it works pretty much anywhere in the world[5].

### 2.4.1 Hardware Overview of SIM800L GSM/GPRS module

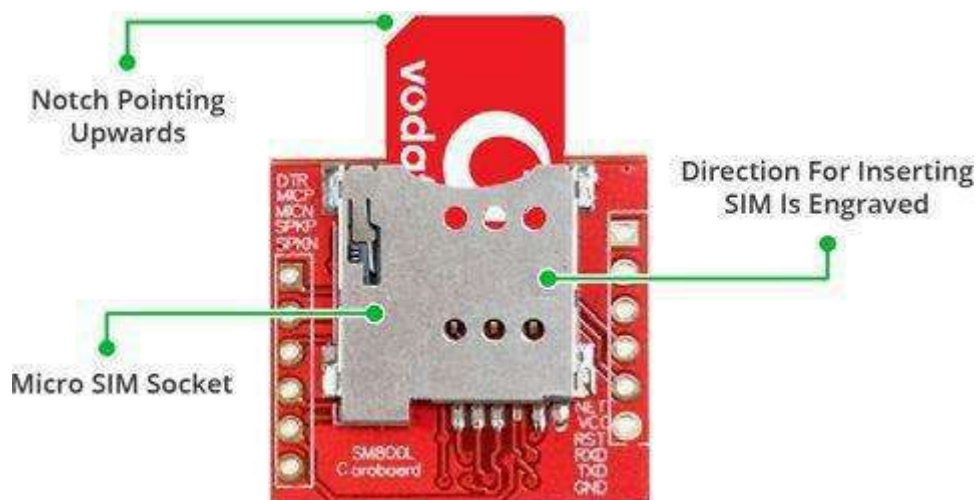
At the heart of the module is a SIM800L GSM cellular chip from SIM COM. The operating voltage of the chip is from 3.4V to 4.4V, which makes it an ideal candidate for direct LIBO battery supply. This makes it

a good choice for embedding into projects without a lot of space. Figure (2.7) shown GSM SIM 800i



Figure(2.7) GSM SIM 800i

All the necessary data pins of SIM800L GSM chip are broken out to a 0.1" pitch headers. This includes pins required for communication with a microcontroller over UART. The module supports baud rate from 1200bps to 115200bps with Auto-Baud detection. The module needs an external antenna to connect to a network. The module usually comes with a Helical Antenna and solders directly to NET pin on PCB. The board also has a U.FL connector facility in case you want to keep the antenna away from the board[6]. Figure (2.8) shown SIM SOKET.



Figure(2.8) SIM socket

There's a SIM socket on the back! Any activated, 2G micro SIM card would work perfectly. Correct direction for inserting SIM card is normally engraved on the surface of the SIM socket[6].

This module measures only 1 inch<sup>2</sup> but packs a surprising amount of features into its little frame. Some of them are listed below:

- Supports Quad-band: GSM850, EGSM900, DCS1800 and PCS1900
- Connect onto any global GSM network with any 2G SIM
- Make and receive voice calls using an external 8Ω speaker & electret microphone
- Send and receive SMS messages
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- Scan and receive FM radio broadcasts
- Transmit Power:
  - Class 4 (2W) for GSM850
  - Class 1 (1W) for DCS1800
- Serial-based AT Command Set
- FL connectors for cell antennae
- Accepts Micro SIM Card

#### **2.4.2 LED Status Indicators**

There is an LED on the top right side of the SIM800L Cellular Module which indicates the status of your cellular network[6]. It'll blink at various rates to show what state it's in. Figure (2.9) shown blink every 1s.



Figure(2.9) Blink every 1s



The module is running but hasn't made connection to the cellular network yet. Figure (2.10) shown blink every 2s.



Figure(2.10) Blink every 2s

The GPRS data connection you requested is active. Figure (2.11) shown blink every 3s.



Figure(2.11) Blink every 3s

The module has made contact with the cellular network & can send/receive voice and SMS.

### 2.4.3 Selecting Antenna

An antenna is required to use the module for any kind of voice or data communications as well as some SIM commands. So, selecting an antenna could be a crucial thing. There are two ways you can add an antenna to your SIM800L module. The first one is a Helical GSM antenna which usually comes with the module and solders directly to NET pin on PCB. This antenna is very useful for projects that need to save space but struggles in getting connectivity especially if your project is indoors[7]. Figure (2.11) shown Antenna.





Figure(2.12) Antenna

The second one is any 3dBi GSM antenna along with a U.FL to SMA adapter which can be obtained online for less than \$3. You can snap-fit this antenna to small connector located on the top-left corner of the module. This type of antenna has a better performance and allows putting your module inside a metal case – as long the antenna is outside. Figure (2.12) shown Antenna.



Figure(2.13) long the antenna

#### 2.4.4 Supplying Power for SIM800L module

One of the most important parts of getting the SIM800L module working is supplying it with enough power. Depending on which state it's in, the

SIM800L can be a relatively power-hungry device. The maximum current draw of the module is around 2A during transmission burst. It usually won't pull that much, but may require around 216mA during phone calls or 80mA during network transmissions[7]. This table from the datasheet summarizes what you may expect:

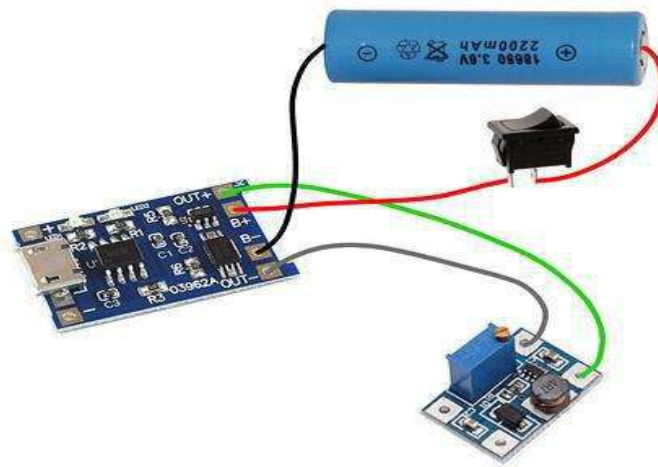
<b>Modes</b>	<b>Frequency</b>	<b>Current Consumption</b>
Power down		60 uA
Sleep mode		1 mA
Stand by		18 mA
Call	GSM850	199 mA
GPRS	EGSM900	216 mA
	DCS1800	146 mA
	PCS1900	131 mA
Transmission burst		2 A

Since SIM800L module doesn't come with onboard voltage regulator, an external power supply adjusted to voltage between 3.4V to 4.4V (Ideal 4.1V) is required. The power supply should also be able to source 2A of surge current, otherwise the module will keep shutting down. Here are some options you can consider to correctly power your GSM module[8].

### 2.4.5 3.7v Li-Po Battery (Recommended)

One of the cool things about Li-Po batteries is that their voltage is generally in the range of 3.7V – 4.2V, perfect for SIM800L Module.

Any 1200mAh or larger sized Lithium ion/polymer battery is best since it can provide the correct voltage range even during 2 Amp spikes. Figure (2.14) shown lithium battery include charging circuit.



Figure(2.14) lithium battery include charging circuit

### 2.4.6 DC-DC Buck Converter

Any 2A-rated DC-DC buck converter like LM2596 would work. These are much more efficient than a liner voltage regulator like LM317 or LM338. Figure (2.15) shown DC to DC converter step down.



Figure (2.15) DC to DC converter step down

### 2.4.7 SIM800L GSM Module Pin out

The SIM800L module has total 12 pins that interface it to the outside world. The connections are as follows[9].Figure (2.16) shown GSM pin out.



Figure (2.16) GSM pin out

**NET** is a pin where you can solder Helical Antenna provided along with the module.

**VCC** supplies power for the module. This can be anywhere from 3.4V to 4.4 volts. Remember connecting it to 5V pin will likely destroy your module! It doesn't even run on 3.3 V! An external power source like Li-Po battery or DC-DC buck converters rated 3.7V 2A would work[10].

## 2.5 ARDUINO UNO

ARDUINO Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator

(CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards[11]. Figure (2.4) Arduino UNO.

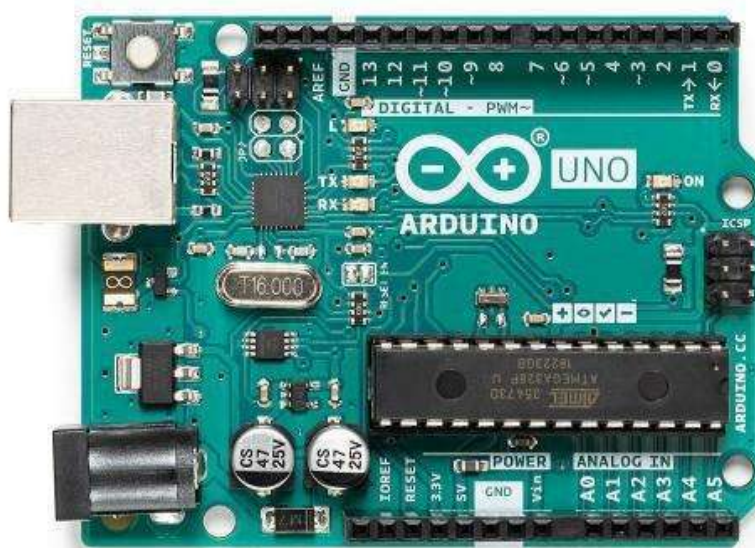


Figure (2.4) ARDUINO UNO

### Pin Description

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components

such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

The 14 digital input/output pins can be used as input or output pins by using `pinMode()`, `digitalRead()` and `digitalWrite()` functions in Arduino programming. Each pin operate at 5V and can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50 KOhms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below

- Serial Pins 0 (Rx) and 1 (Tx) ==> Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
- External Interrupt Pins 2 and 3 ==> These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- PWM Pins 3, 5, 6, 9 and 11 ==> These pins provide an 8-bit PWM output by using `analogWrite()` function.
- SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK) ==> These pins are used for SPI communication.
- In-built LED Pin 13 ==> This pin is connected with an built-in LED, when pin 13 is HIGH – LED is on and when pin 13 is LOW, its off.
- There are 6 analog input pins, each of which provide 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using AREF pin with `analogReference()` function.

- Analog pin 4 (SDA) and pin 5 (SCA) also used for TWI communication using Wire library.
- AREF ==> Used to provide reference voltage for analog inputs with analogReference() function.
- Reset Pin ==> Making this pin LOW, resets the microcontroller.

## 2.6 IDE Arduino compiler

To use the I2C protocol with an LCD display and Arduino, there is a special library to be downloaded and included in the code. The name of this library is Liquid Crystal I2C. Download the library, a zip file and extract the contents in the libraries folder of the Arduino IDE. You can do directly from the Arduino IDE, select Sketch > include Library > Add .ZIP library from the menu [11]. Figure (2.5) Add library GSM for IDE.

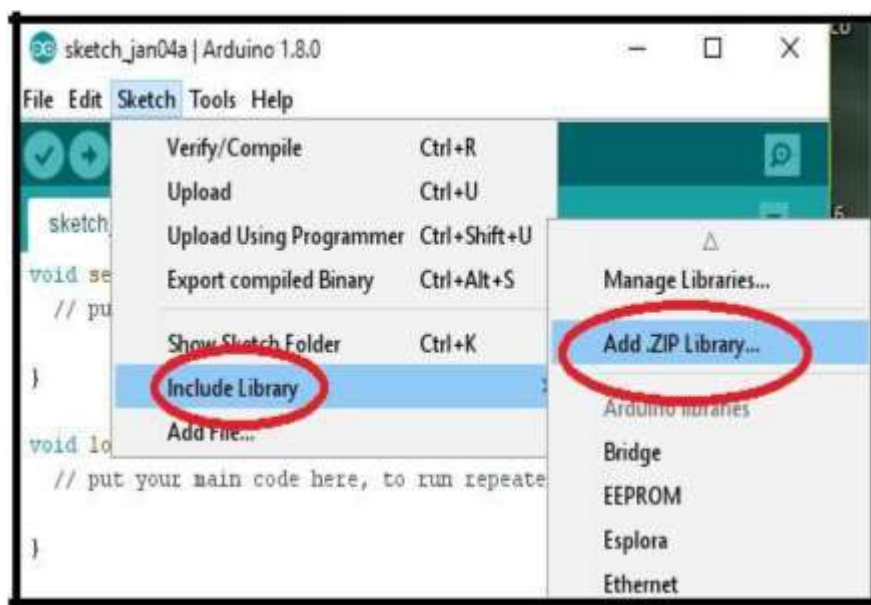


Figure (2.5). Add library GSM for IDE



## **Chapter three**

### **Practical work**

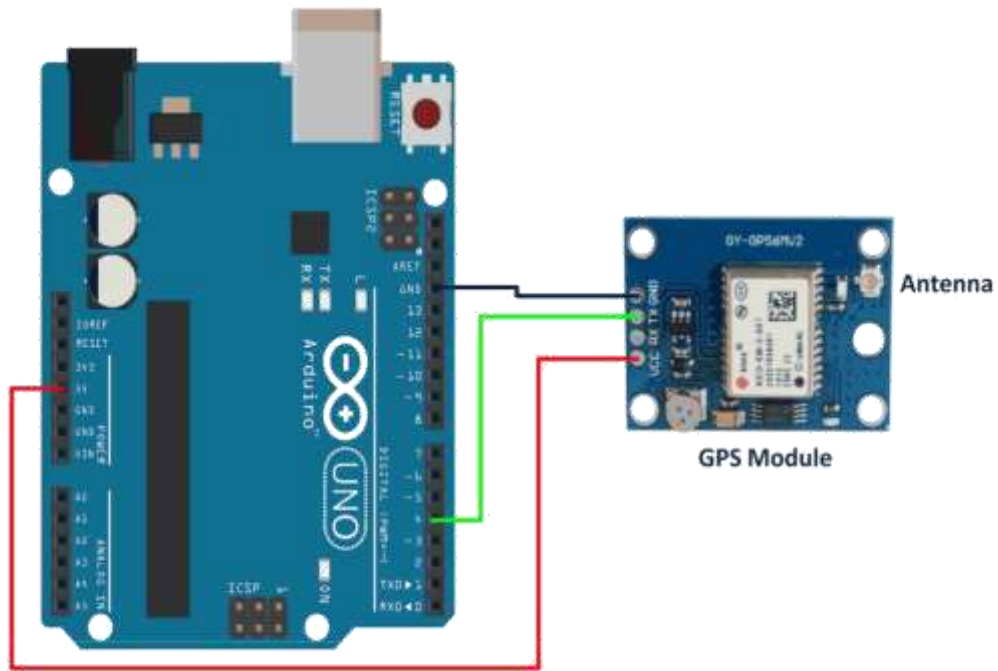
#### **3.1GPS Module and Its Working**

GPS stands for Global Positioning System and used to detect the Latitude and Longitude of any location on the Earth, with exact UTC time (Universal Time Coordinated). GPS module is the main component in our vehicle tracking system project. This device receives the coordinates from the satellite for each and every second, with time and date[7].

#### **3.2 Circuit Explanation**

Circuit Connections of this Vehicle Tracking System Project is simple. Here Tx pin of GPS module is directly connected to digital pin number 10 of Arduino. By using Software Serial Library here, we have allowed serial communication on pin 10 and 11, and made them Rx and Tx respectively and left the Rx pin of GPS Module open. By default Pin 0 and 1 of Arduino are used for serial communication but by using SoftwareSerial library, we can allow serial communication on other digital pins of the Arduino. 5 Volt supply is used to power the GPS Module[7]. Figure(3.1) shown circuit diagram of the system

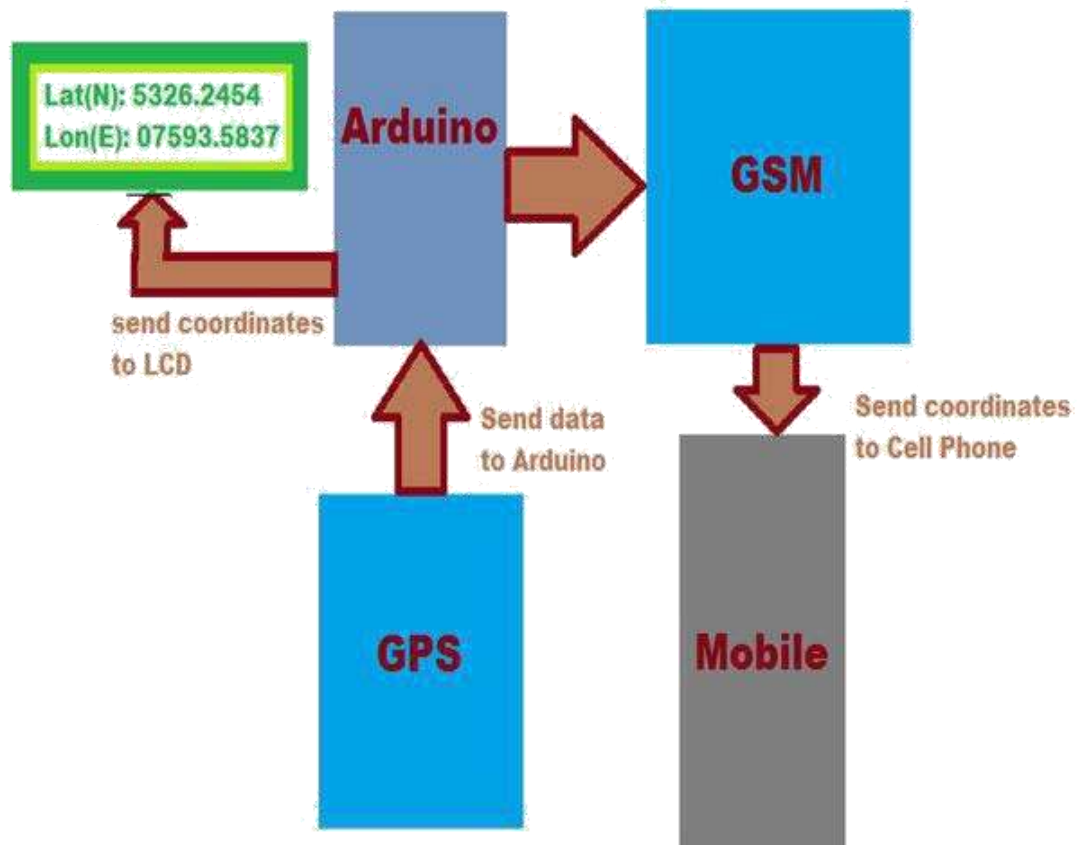




Figure(3.1) circuit diagram of the system

### 3.2.2 Working Explanation

Arduino is used for controlling whole the process with a GPS Receiver and GSM module. GPS Receiver is used for detecting coordinates of the vehicle, GSM module is used for sending the coordinates to user by SMS. And an optional 16x2 LCD is also used for displaying status messages or coordinates. We have used GPS Module NEO -6M GSM Module SIM900A[8]. Figure(3.3) shown working explanation.



Figure(3.3) Working Explanation

When we ready with our hardware after programming, we can install it in our vehicle and power it up. Then we just need to send a SMS, (L) to the system that is placed in our vehicle. Sent message is received by GSM module which is connected to the system and sends message data to Arduino. Arduino reads it and extract main message from the whole message. And then compare it with predefined message in Arduino. If any match occurs then Arduino reads coordinates by extracting GPS .encoder string from GPS module data and send it to user by using GSM module. This message contains the coordinates of vehicle location[9].

### 3.3Programming Explanation

In programming part first we include libraries and define pins for LCD & software serial communication. Also define some variable

with arrays for storing data. Software Serial Library is used to allow serial communication on pin 2 and 3.[9]

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(7, 6, 5, 4, 3, 2);

#include <SoftwareSerial.h>
SoftwareSerial gps(10,11); // RX, TX
char str[70];
String gpsString="";
... ....
.... ....
```

Figure(3.4) Serial connection other pins

Here array str[70] is used for storing received message from GSM module and gpsString is used for storing GPS string. *char \*test="\$GPGGA"* is used to compare the right string that we need for coordinates. After it we have initialized serial communication, LCD, GSM & GPS module in setup function and showed a welcome message on LCD[10]. Figure

(3.5) shown set baud rate of serial connection

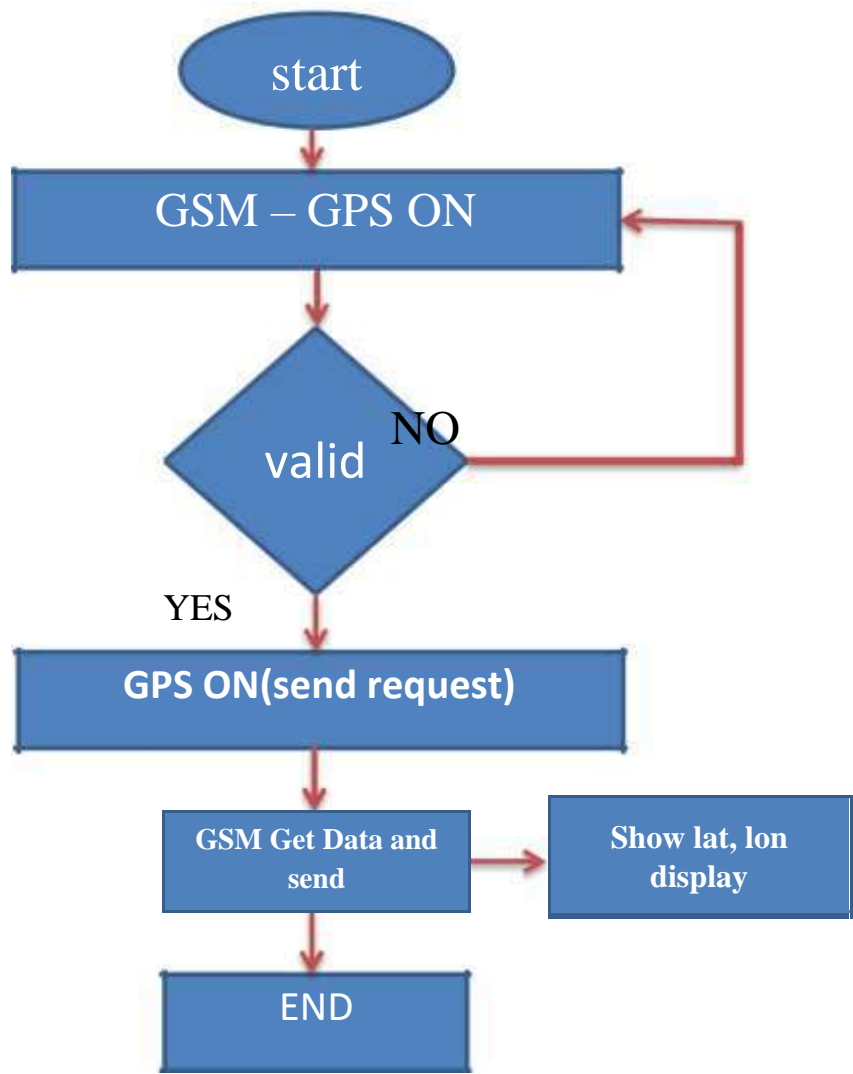
```
void setup()
{
  lcd.begin(16,2);
  Serial.begin(9600);
  gps.begin(9600);

  lcd.print("Vehicle Tracking");
  lcd.setCursor(0,1);
  ... ....
  .... ....
```

Figure(3.5) set baud rate of Serial connection

### 3.4 Flowchart

This flow chart explain how this project is work and shown when GPS & GSM is ON also when sending message.



Figure(3.6) flowchart GPS tracking system

## **Chapter four**

### **Conclusion and future work**

#### **4.1 conclusion**

This project notes the increased demand for vehicle tracking systems for tracking the theft of vehicles through GPS and GSM technology. This system can be used for both personal and business purposes to improve safety and security, communication, and performance monitoring. Vehicle tracking systems have become increasingly important in large cities and are more secured than many other systems. Nowadays, vehicle theft is rapidly increasing. With this technology however, vehicle theft can be better controlled. This technology can also help to advance transportation systems, and can be used in many organizations for security and tracking purposes. Also, the proposed system is more useful, as a result of the addition of different types of sensors which help to protect the owner and other users of the vehicle by reducing the possibility of collisions. In the event of an accident, the system will send the location to designated numbers so assistance can be provided as soon as possible. This will be particularly useful in instances where accidents occur in deserted places and midnights. In the future, this vehicle tracking and accident alert feature will play an important role in day-to-day life.

## **4.2 future work**

It is possible in the future to use this device in a large and large scale in cars and ships as well and many things that we need to track and monitor as well, and the developers in the next time should include this work in a large way and use it very widely

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**Dijlah University College**  
**Computer Techs. Eng. Dept.**



**Image compression based on Discrete Cosine Transform (DCT)**

**A Project Submitted to the Department of Computer Techniques Engineering**

**Dijlah University College**  
**In partial Fulfillment of the Requirement for the**  
**Degree of B. Eng.**  
**In**  
**Computer Techniques.**

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## Abstract

In recent years, the development of multimedia product grows increasingly fast, contributing to insufficient bandwidth of network and storage of memory device. Therefore, the data compression becomes more and more significant for reducing the data redundancy to save more hardware space and transmission through the limited available bandwidth. In general, data compression or source coding is the process reduce repetitive information in a file. Compression is useful because it helps reduce the consumption of expensive resources such as hard disk space or transmission bandwidth. In this report, we briefly introduce the fundamental theory of image compression and proposed image compression algorithm based on DCT.

The main interest of this report is to explore the current suitable technologies that can be used for digital image transmission, compression and storage. Therefore, that data can be exchanged information rapidly with accepted quality.

## Dedicated

I dedicate the result of this achievement to my family and to those who stood by me throughout the study period and supported me with all their love and moral support in order to rise in this life and did their best, patience and prayers for achievement.this work

## Acknowledgments

At first, I thank Almighty Allah for his graces that enabled me to continue the requirements of my study and overcome the difficulties during the research.

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My sincere thanks and greetings to the Head of the Department of Computer Techniques Engineering. the prof .Dr. Majed Salal for his help and all the department employees to get this work done.

## Abbreviations

$C_{(B)}$ $C_{(R)}$	chrominance components
CR	Compression Ratio
DCT	Discrete cosine Transform
DWT	Discrete wavelet transform
JPEG	Joint Picture Expert Group
MPEG	Motion Picture Expert Group
MSE	Mean Square Error
PSNR	Peak Signal to Noise Ratio
RGB	Red, Green and Blue
RLE	Run-Length Encoding
Y	luminance
HI	Histogram Intersection

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# Chapter 1

## Introduction

Compression is the process of encoding data more efficiently to achieve a reduction in file size. One type of compression available is referred to as lossless compression. This means the compressed file will be restored exactly to its original state with no loss of data during the decompression process. This is essential to data compression as the file would be corrupted and unusable should data be lost.

Lossless compression algorithms use statistic modelling techniques to reduce repetitive information in a file. Some of the methods may include removal of spacing characters, representing a string of repeated characters with a single character or replacing recurring characters with smaller bit sequences [1] [2].

Compression of data offer many advantages. When compressed, the quantity of bits used to store the information is reduced. data that are smaller in size will result in shorter transmission times when they are transferred on the channel. Compressed data also take up less storage space. Data compression can zip up several small data into a single file for more convenient data transmission [3].

For example, if a digital monochrome video of spatial resolution of  $320 \times 240$  pixels is to be displaying at the standard rate of 25 frames per second (fps), then the corresponding bit rate is  $320 \times 240 \times 25 \times 8 = 15360000$  bits per second (bps). Now assuming the availability of a 56000 bps telephone network link , then we need to



compress the video data by at least 275 times in order to accomplish the data transmission in real-time. Real-time is mean that the algorithm will run the video at the rate of the source supplying video. It is definitely impossible to transmit such a large volume of data (uncompressed video) over bandwidth-limited networks used in low constraint devices. In terms of storage and bandwidth, the case of colored images/videos is 3 times more demanding.

Therefore, data compression becomes essential before any video storage or transmission because it produces a low bit rates and reduces the time required for sequence video frames to be sent over different network channels [4] [1] [3]

As compression is a mathematically intense process, it may be a time-consuming process, especially when there is a large number of data involved. Some compression algorithms also offer varying levels of compression, with the higher levels achieving a smaller file size but taking up an even longer amount of compression time. A system intensive process takes up valuable resources that can sometimes result in Out of Memory errors. With so many compression algorithm variants, a user downloading a compressed file may not have the necessary program to un-compress it.

However, there is always a trade-off between compression ratio, retrieve data in computational time and quality. The higher compression ratio a chive a small compressed data size and a low required bandwidth but the output will suffer from lower quality.

In 1949, Claude Shannon devised the Shannon-Fano coding and Robert Fano to assign code words based on block probabilities. This technique was only considered fairly efficient in variable-length encodings. In 1951, David Huffman found an optimally efficient method that was better than the Shannon-Fano coding

by using a frequency-sorted binary tree. Huffman coding is often used as a backend to other compression methods today.

In 1977, ground-breaking LZ77 and LZ78 algorithms were invented by Abraham Lempel and Jacob Ziv, which gained popularity rapidly. Some commonly used algorithms used today like DEFLATE, LZMA and LZX are derived from LZ77. Due to patent issues with LZ78 in 1984, UNIX developers began to adopt open source algorithms like the DEFLATE-based gzip and the Burrows-Wheeler Transform-based BZip2 formats, which managed to achieve significantly higher compression than those based on LZ78 [5] [6].

In general, the data compression can be classified into two types:

#### 1- Lossy Image Compression

Lossy compression means that some data from the original image file is lost. This process is irreversible. Once you have compressed an image this way, you can't go back. Well, you can't go back in most cases. With the Imagify WordPress plugin, we've set up your image optimization in a way that lets you revert to your original pictures if you are not satisfied with the results. When optimizing data such as source code on a page, it's critical to ensure that the code isn't altered by the compression. One piece of bad data and your code can break. For other types of data, such as images or video, you can compress it and present an "approximate" representation of the original data without losing its meaning [7].

#### 2- Lossless Image Compression

Lossless compression means that you reduce the size of an image without any quality loss. Usually this is achieved by removing unnecessary meta data from JPEG and PNG files. We say usually, because with some other compression algorithms, like Imagify's, other compression opportunities are leveraged without sacrificing the image's quality. In theory, there are some image formats that are

considered to be “lossless” such as GIF, PNG and BMP. However, depending on how they are optimized for the web, these formats may see a slight loss in quality (that your eyes won’t be able to pick up). The big benefit of lossless compression is that it allows you to retain the quality of your images while reducing their file size [6].

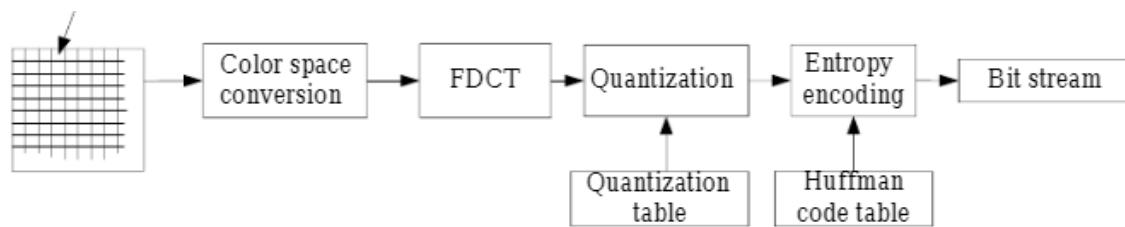
Discrete Cosine Transform (DCT): is an orthogonal transformation method that decomposes an image to its spatial frequency spectrum. It expresses a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. It is using a lot in compression tasks, e.g. image compression where for example high-frequency components can be discarded. It is a type of Fourier-related Transform, similar to discrete Fourier transforms (DFTs), but only using real numbers. In addition there are many transformations for image decomposition but the famous are DCT (Discrete cosine transform) and dwt (Discrete wavelet transform) which are used in JPGE 2000, JPEG and MPEG [4] [8] [7].

## Chapter Two

### Image Compression Based on Discrete Cosine Transform

A digital image is composed of a finite number of elements known as pixels. In grey scale image, pixels are representing by unsigned 8-bits and having values ranging from 0 to 255. Pixels in color images are representing by three colors channels, in Red, Green and Blue (RGB) color space. Each component of RGB required 8-bits in binary representation and thus 24-bits per pixel. There are other color spaces such as  $Y C_B C_R$ . The Y component is luminance and  $C_B C_R$  represents chrominance components, which define the actual color.

Image compression has become an important research area for many years due to increasing demand on transfer and storage of data. The most used and successful image-encoding standard should be joint photographic experts group (JPEG) standard, also known as ITU-81 published at 1991. Because JPEG encoding can be implementing quickly, around 80% of the images on the Internet observe JPEG standard [9] [10] [4]. However, JPEG shows its limitation when it comes to high compression ratio. Users can recognize this defect, also known as blocking artifacts, easily. Lossy JPEG encoding process is shows in Figure 2.1.



8×8 image block

*Figure 2. 1Scheme of JPEG Encoding Process*

The block diagram of image based DCT coding is shown in Figure 1. Firstly, the image data is partitioned into blocks of 8x8 pixels and the DCT is applied to each block. After the DCT is transformed, the transformed blocks are quantized. Finally, the quantized blocks are entropy encoded and output as compressed data.

Vector quantization (VQ) is one of the popular lossy image compression techniques because it has a simple decoding structure and can provide high compression ratio in image coding systems. Vector quantization can be regarded as the process of finding the nearest vector in the codebook to the waiting vector. When the nearest vector is given, only the index of the vector in the codebook is transmitted. Moreover, compared to scale quantization (SQ), VQ is always superior even if the information source is non-memorable. If high compression ratio is required, VQ can be a great choice.

## 2.1 DCT

The image is comprised from pixels and the correlation between neighboring pixels is high. The main work of DCT is de-correlating the neighboring pixels and

concentrating the significance information in low frequency region. The two dimensions (2-D) DCT of 8x8 blocks defined as follows:

$$S_{uv} = \sqrt{\frac{1}{4}} C_u C_v \sum_{i=0}^7 \sum_{j=0}^7 s_{ij} \cos \frac{(2i+1)u\pi}{16} \cos \frac{(2j+1)v\pi}{16} \quad 3.1$$

And the inverse DCT (IDCT)

$$s_{ij} = \sqrt{\frac{1}{4}} \sum_{u=0}^7 \sum_{v=0}^7 C_u C_v S_{uv} \cos \frac{(2i+1)u\pi}{16} \cos \frac{(2j+1)v\pi}{16} \quad 1.2$$

$$C_u C_v = \begin{cases} \frac{1}{\sqrt{2}} & \text{for } u, v = 0 \\ 1 & \text{otherwise} \end{cases}$$

Where

$s_{ij}$  : is the value of the pixel at position ( i, j) in the block.

$S_{uv}$  : is the transformed (u, v) DCT coefficient.

The transform matrix of DCT (DCTM) driven from equation 1.2 we ignore  $s_{ij}$  and varying  $u$  and the DCTM will show as fellow:

$$\text{DCTM} = \begin{bmatrix} 0.3536 & 0.3536 & 0.3536 & 0.3536 & 0.3536 & 0.3536 & 0.3536 & 0.3536 \\ 0.4904 & 0.4157 & 0.2778 & 0.0975 & -0.0975 & -0.2778 & -0.4157 & -0.4904 \\ 0.4619 & 0.1913 & -0.1913 & -0.4619 & -0.4619 & -0.1913 & 0.1913 & 0.4619 \\ 0.4157 & -0.0975 & -0.4904 & -0.2778 & 0.2778 & 0.4904 & 0.0975 & -0.4157 \\ 0.3536 & -0.3536 & -0.3536 & 0.3536 & 0.3536 & -0.3536 & -0.3536 & 0.3536 \\ 0.2778 & -0.4904 & 0.0975 & 0.4157 & -0.4157 & -0.0975 & 0.4904 & -0.2778 \\ 0.1913 & -0.4619 & 0.4619 & -0.1913 & -0.1913 & 0.4619 & -0.4619 & 0.1913 \\ 0.0975 & -0.2778 & 0.4157 & -0.4904 & 0.4904 & -0.4157 & 0.2778 & -0.0975 \end{bmatrix}$$

The values of the DCTM called cosine basis functions. The rows of these basis functions shown in Figure 2.2. It can be see that the frequency is increasing as we advance down the rows .i.e. the frequency of the DCT coefficients increases as we go from top to the bottom. Consequently, the DCT compact the significance coefficients (low frequency) in the top left triangle of blocks. This property exploited in quantization processing to achieve lossy compression [8] [11] [12].

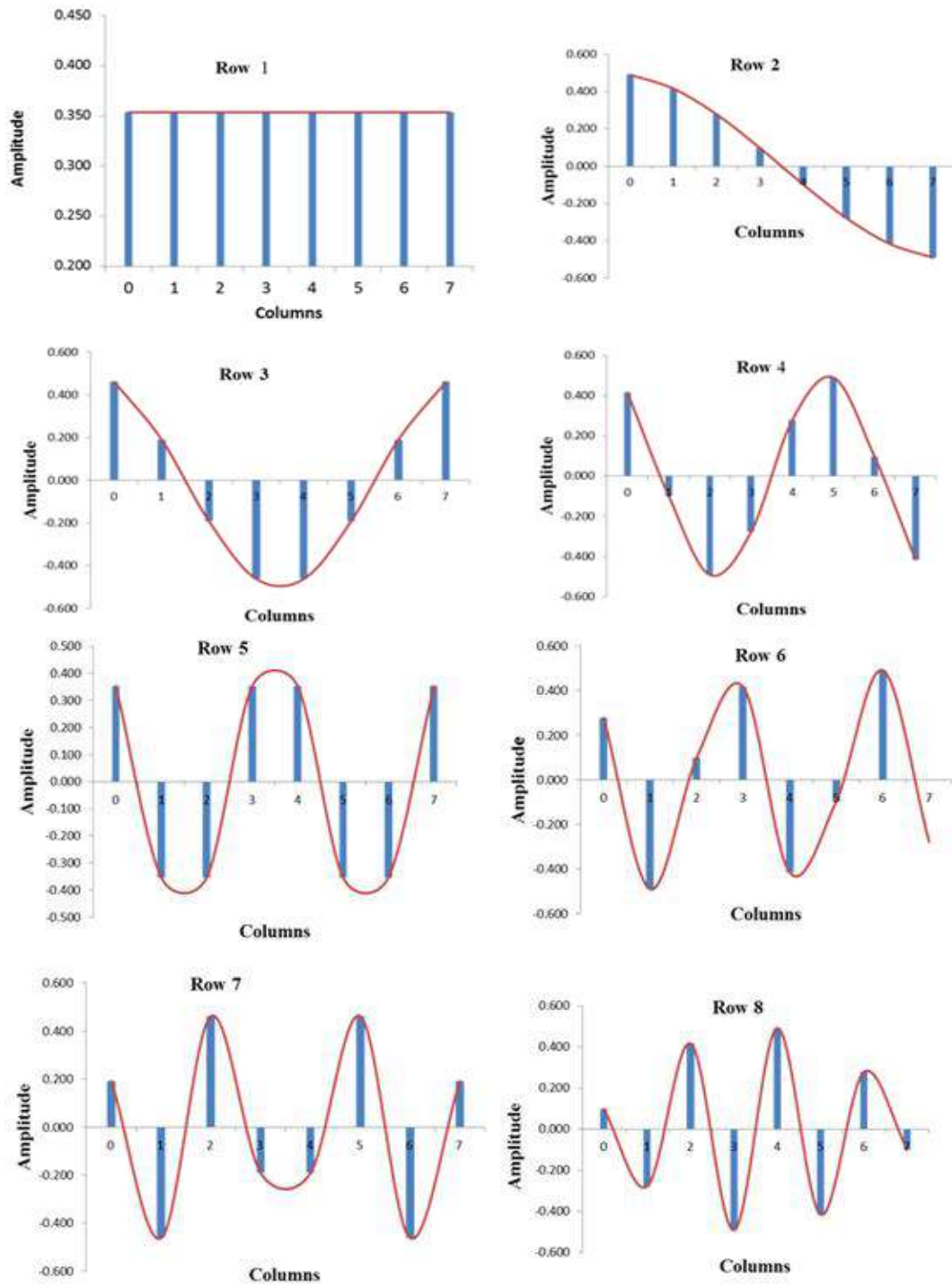


Figure 2. 2 the DCT basis function of 8x8 arrays



After the image transformation, the resulting coefficients have a large numbers; quantization used to reduce the number required for coefficients representation. Small numbers take less space than large ones, so quantization generates compression. Therefore, the transformed blocks quantized by using an 8x8-quantization table. Each value in the transformed block divided by the matching value in the quantization table, and the result rounded to the nearest integer. For instance, two sample quantization tables are shows in Figure1.3. It can see from Figure 2.3 that the quantization factor (step size) generally increases as we progress from the top left corner to bottom right. As a result, the quantization error will be introducing in the high frequency coefficients more than in low frequency coefficients. The decision on the relative size of the step sizes based on how the human visual system will sense these errors in the quantized coefficients. Furthermore, the quantization table will be specified by the required quality of decompressed image [2].

3	2	2	3	5	8	10	12
2	2	3	4	5	12	12	11
3	3	3	5	8	11	14	11
3	3	4	6	10	17	16	12
4	4	7	11	14	22	21	15
5	7	11	13	16	12	23	18
10	13	16	17	21	24	24	21
14	18	19	20	22	20	20	20

80	60	50	80	120	200	255	255
55	60	70	95	130	255	255	255
70	65	80	120	200	255	255	255
70	85	110	145	255	255	255	255
90	110	185	255	255	255	255	255
120	175	255	255	255	255	255	255
245	255	255	255	255	255	255	255
255	255	255	255	255	255	255	255

**A** Figure 2. 3 Quantization tables (A) Low compression high quality (B) high  
**B** compression Low quality

Thus, the quantization process converts many high frequency coefficients (non-significance) to zeroes in the quantized blocks. Finally, the quantized blocks scanned by zigzag scan where the low-frequency coefficients are read first and the high-frequency coefficients last as shown in Figure 2.4. Therefore, the zeroes value data will be clustered at the end of data sequence. These redundant zeroes reduced by the run-length-encoding (RLE). The compressed sequence of RLE encoded by either Huffman or arithmetic encoding (entropy encoding) to form the final compressed data.

It can be seen after quantization the most of coefficients becomes zero specifically the high frequency coefficient. Following, zigzag scanning is performing. Consequently, the zeros sequence are produced. For further compression, the RLE encoding is applying. Finally, the data output from RLE is encoding by Huffman encoder [2] [5] [8].

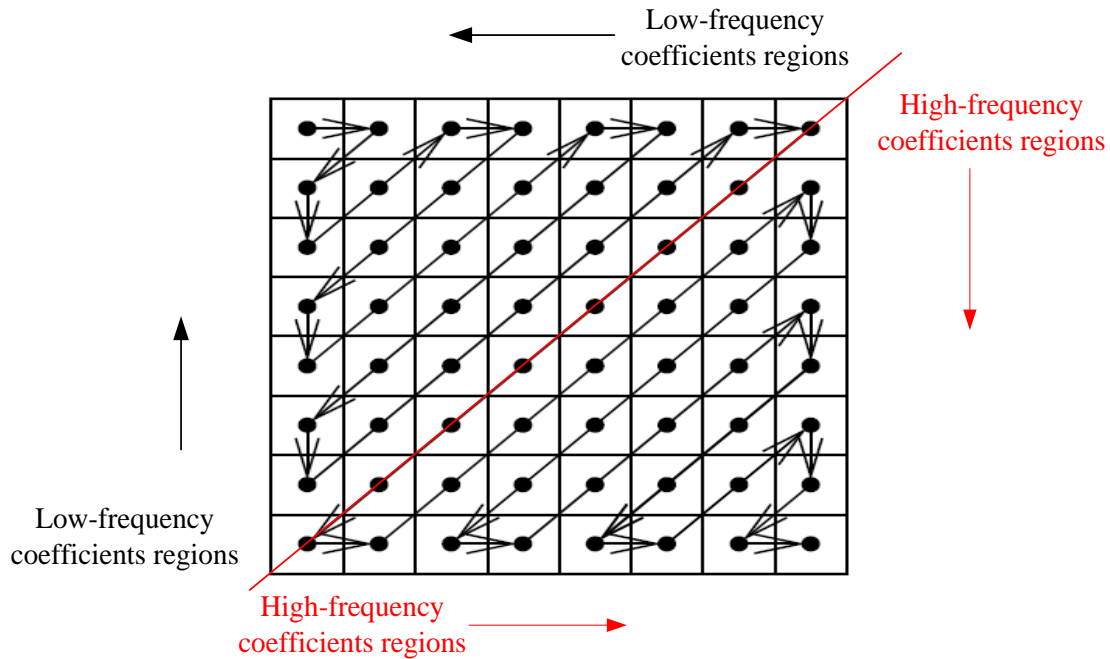


Figure 2. Zigzag scanning order of quantised DCT coefficients sequence

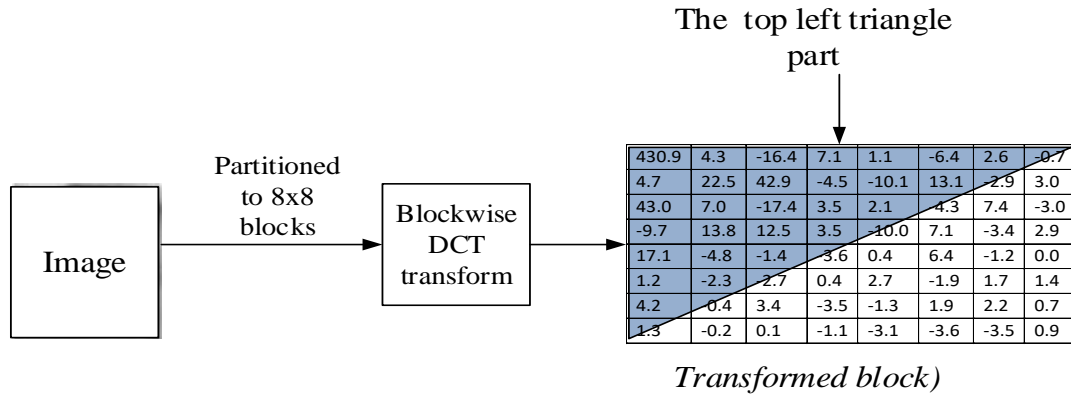
## Chapter 3

### Proposal to image compression based on DCT

The DCT is one of the most commonly used transforms for image compression and it is baseline algorithm of the JPEG coding standard. In this section, we will describe the image compression based on DCT transformation.

#### **3.1 The Compression scheme**

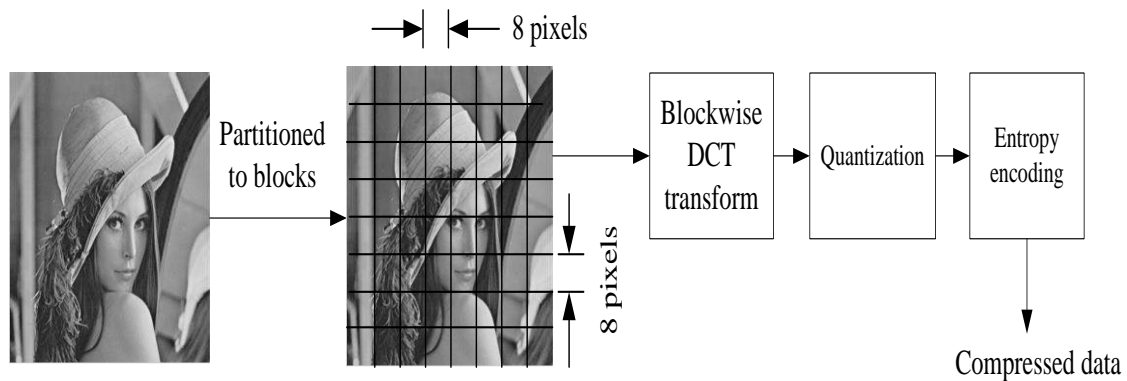
The approach starts by subdividing the raw image into blocks size (8x8) pixels. DCT is applied on each block, which is then quantized. The DCT concentrates the low frequency coefficients in the top left of block. Usually, the lower order coefficients of DCT contain significant information about a particular block and this information is more important in human perception, because human eyes are most sensitive to lower frequencies. Therefore, in this approach we shall be calculating DCT for only the top left triangle part of the block where the energy is located. This method will reduce the computational time of DCT as shown in figure 3.1



**Figure 3. IDCT image encoding**

### 3.1.1 The encoding process

The block diagram of image based DCT coding is shown in Figure 3. 2. Firstly, the image data is divided into blocks of 8x8 pixels and the DCT is applied to each block. After the DCT is transformed, the transformed blocks are quantized ( the quantization processing depending on the quantization table, in this approach three quantization tables are used. Finally, the quantized blocks are entropy encoded and output as compressed data.



*Figure 3. 2 Block diagram of image encoding based DCT coding*

The proposed image compression is described in the following steps:

1. Partition the input image into blocks size (8x8) pixels.
2. Apply DCT to each block respectively.
3. Quantize each transformed block by using quantization table.
4. Apply Run-length- encoding (RLE).

Figure 3.2 illustrates the block diagram of the compression algorithm mentioned above. The image is reconstructed by reversing the compression procedure.

### 3.2 Experimental and Analysis of Results

The performance of proposed for image compression based on DCT are achieved by using the set of still images The size of the tested images was (258x320) pixels and all images were first converted to grayscale as shown in Figure 3. In these experiments, MATLAB V 9.4 (R2018a) has been used for scheme implementation.

We tested the performance of the DCT compression scheme on image quality of reconstructed images, measured the PSNR and Histogram Intersection (HI) with the original image as a reference. The experiments tested the effect of Compression Ratio (CR) when using different quantization tables as shown in figure 3.4.

The PSNR is widely used as objective image quality metric. Normally, when  $PSNR > 30\text{dB}$ , the quality of recovered image is estimated as being of reasonable quality [13]

In order to evaluate the performance of encoding scheme in, the Peak Signal-to-Noise Ratio (PSNR) is used as quality criterion. PSNR is driven from the Mean Square Error (MSE) and defined as:

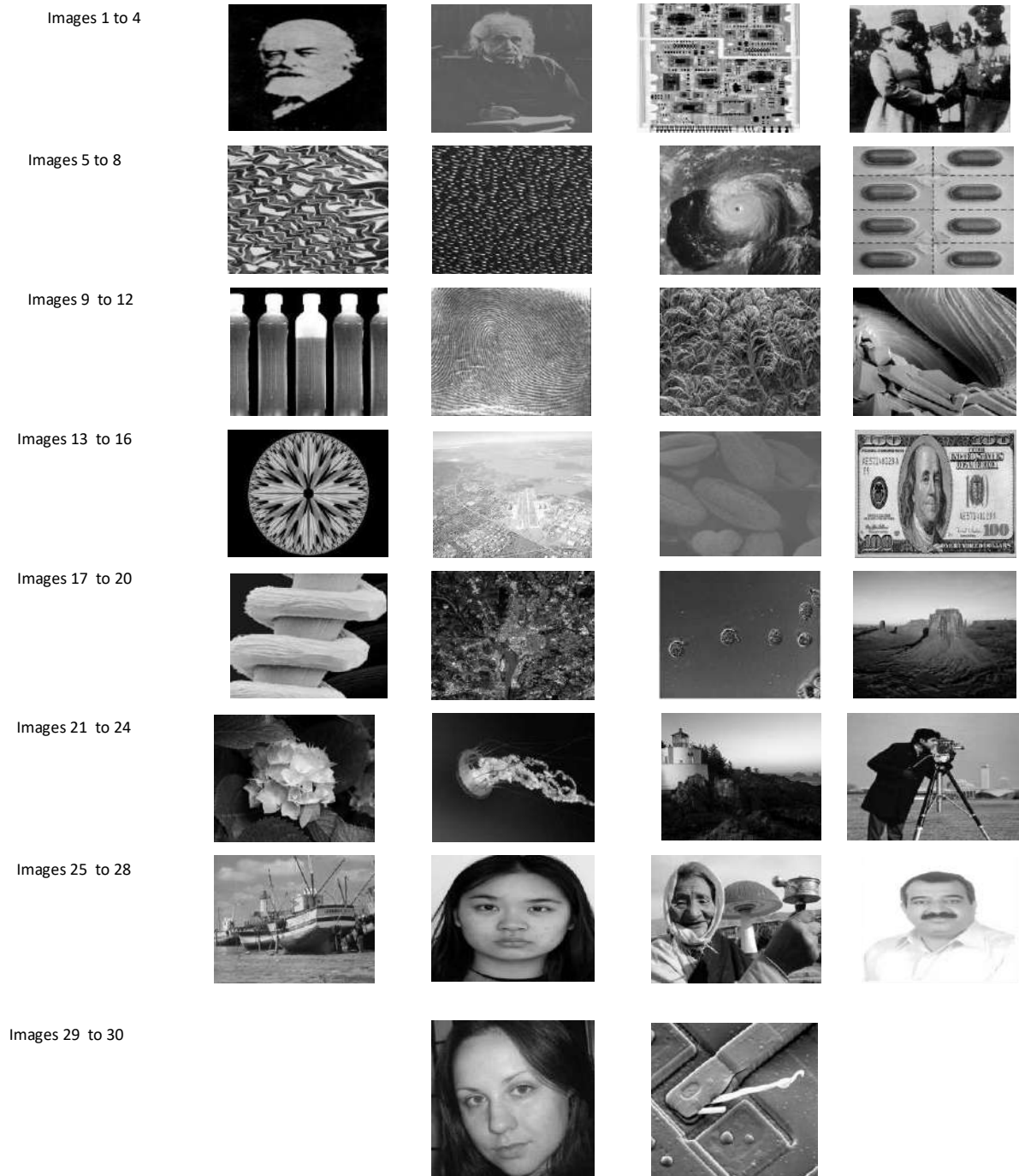
$$PSNR = 10 \log_{10} \frac{255^2}{MSE}$$

MSE between the two images X and Y is thus defined as:

$$MSE = \frac{1}{M \times N} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} (Y - X)^2$$

$M \times N$  is the image size.

Although the MSE is not a perfect criterion for the human vision system, it is still frequently used as a measure of the quality of recovered image.



*Figure 3. 3Test images*



3	2	2	3	5	8	10	12
2	2	3	4	5	12	12	11
3	3	3	5	8	11	14	11
3	3	4	6	10	17	16	12
4	4	7	11	14	22	21	15
5	7	11	13	16	12	23	18
10	13	16	17	21	24	24	21
14	18	19	20	22	20	20	20

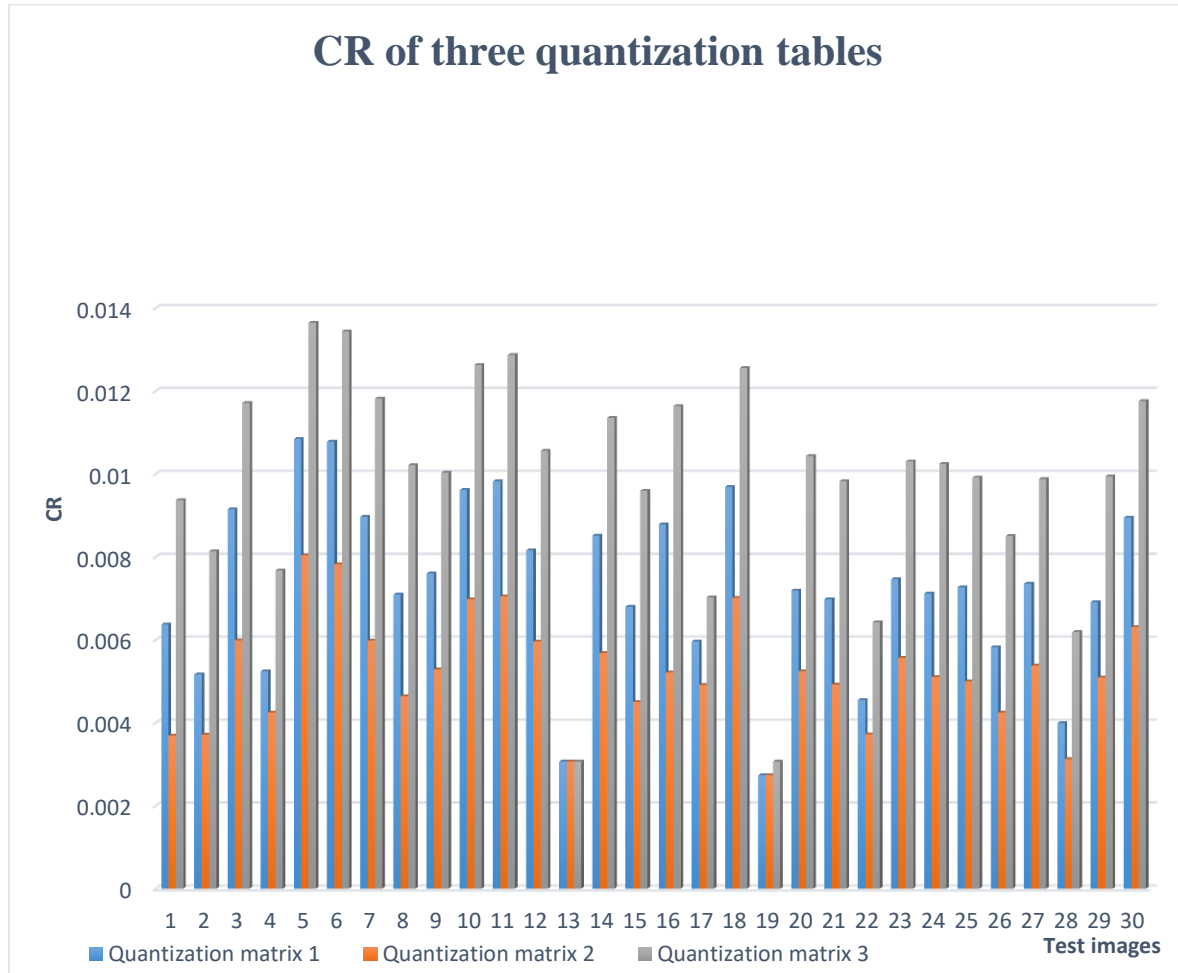
16	11	10	16	24	40	51	61
12	12	14	19	26	58	60	55
14	13	16	24	40	57	69	56
14	17	22	29	51	87	80	62
18	22	37	56	68	109	103	77
24	35	55	64	81	104	113	92
49	64	78	87	103	121	120	101
72	92	95	98	112	100	103	99

80	60	50	80	120	200	255	255
55	60	70	95	130	255	255	255
70	65	80	120	200	255	255	255
70	85	110	145	255	255	255	255
90	110	185	255	255	255	255	255
120	175	255	255	255	255	255	255
245	255	255	255	255	255	255	255
255	255	255	255	255	255	255	255

A  
B  
C

Figure 3. 4 Quantization tables (A) Low compression high quality  
(B) Acceptable compression and quality (C) high compression Low quality

To illustrate the comparison between three quantization matrices, we measured the CR produced after applied the three-quantization matrices in encoding processing as shown in Figure 3.5.



*Figure 3. 5 the comparison results between three-quantization matrices*

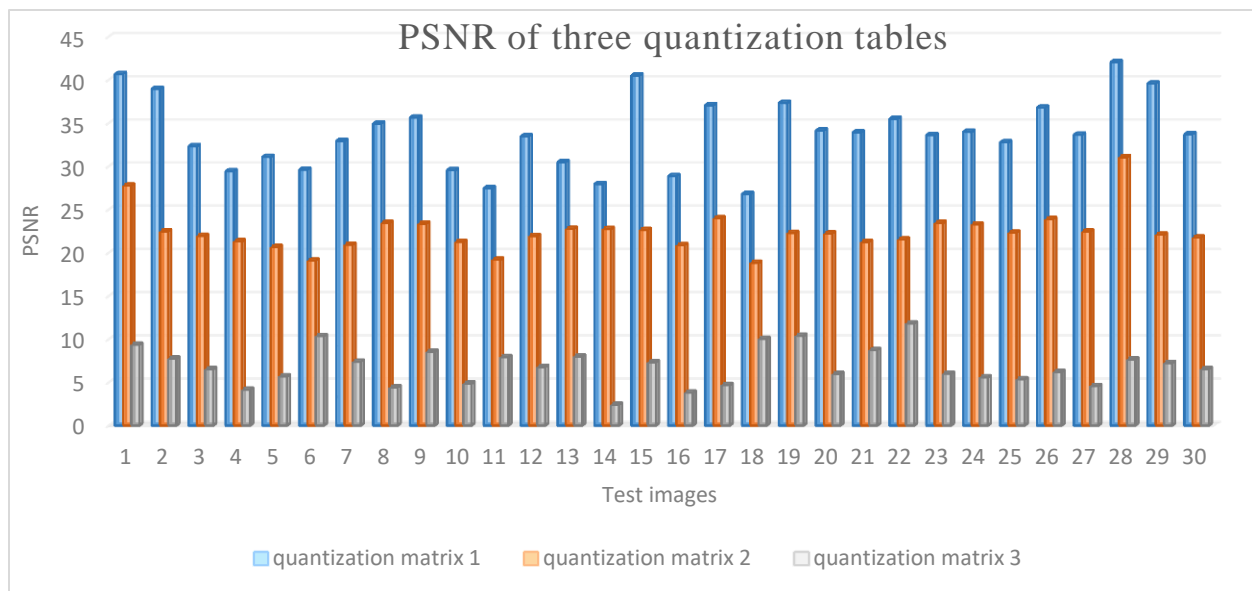


Figure 3. 6the PSNR results of three-quantization matrices

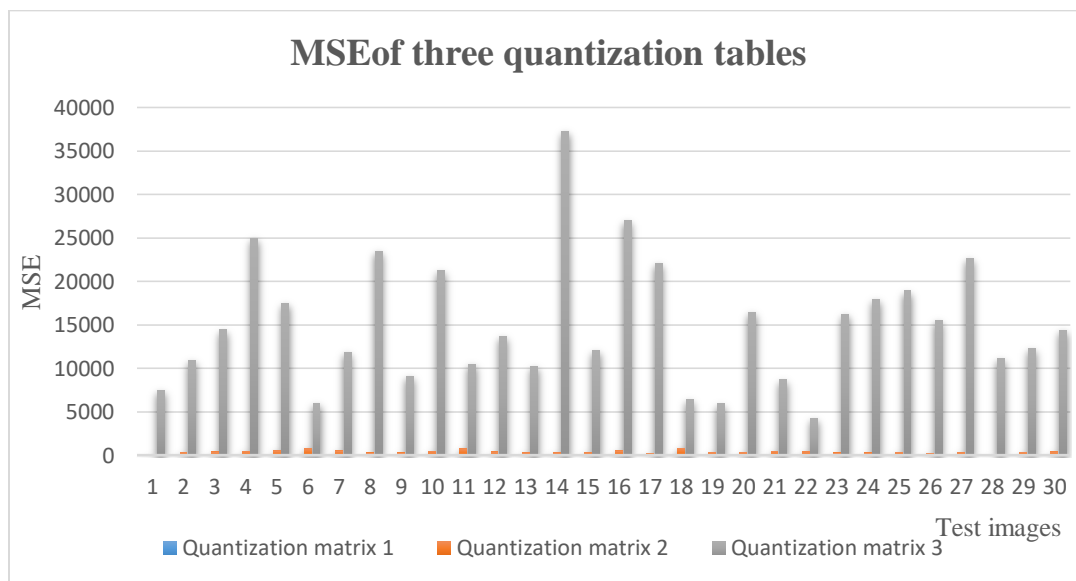


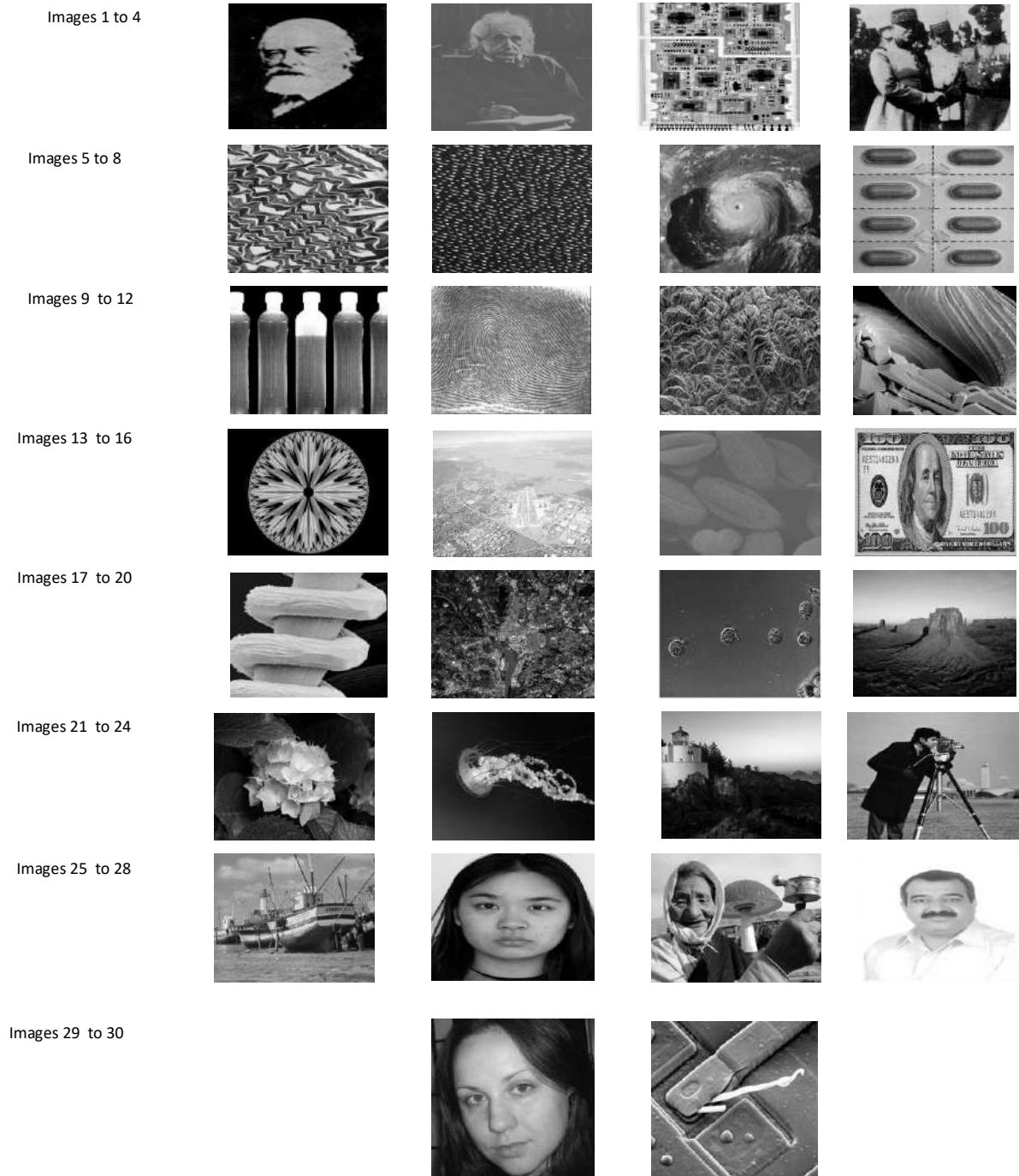
Figure 3. 7the MES results of three-quantization matrices

Figures 3.5, 3.6 and 3.7 compares the PSNR, CR and MES when applied three-quantization matrices to images encoding. It can be seen the PSNR of matrix 1 is generally better quality compared to the matrices 2 and 3. For instance, the PSNR of recovered image 2 in matrix 1 is 38.94db while in matrices 2 and 3 are 22.46 and 7.76 sequentially. On other hand, the CR of image 2 that is achieved in matrix 3 is better than in matrices 2 and 1 as shown in **Error! Reference source not found..** According to **Error! Reference source not found.**, Mean Square Error (MSE) of matrix 1 for all tested image is less than matrices 2 and 3. Generally, the results demonstrated that the DCT encoding using matrix 1 in quantization tends to improve the CR, quality and Histogram Intersection (HI), because the quantization error of will be introduced in the high frequency coefficients of matrix 1 less than in matrices 2 and 3.

**Error! Reference source not found.** shows the achieved PSNR, CR, MSE and Histogram

Images	quantization matrix 1				quantization matrix 2				quantization matrix 3			
	CR	PSNR	MSE	HI	CR	PSNR	MSE	HI	CR	PSNR	MSE	HI
image-1	0.006368183	40.661257	5.58411865	0.929626	0.003695	27.76396	108.8138306	0.438257	0.009372	9.366436	7523.7913	0.29303
image-2	0.005166639	38.954482	8.27241211	0.703735	0.00371	22.46964	368.2273682	0.153662	0.00814	7.762667	10884.6286	0
image-3	0.009146754	32.321193	38.1031616	0.960352	0.005993	21.9452	415.4899536	0.604065	0.011715	6.52748	14465.4626	0.042664
image-4	0.005241736	29.414844	74.4039429	0.911548	0.00425	21.32413	479.3659424	0.813989	7.67E-03	4.15E+00	24984.9319	0.11792
image-5	0.010843934	31.082555	50.6786255	0.948816	0.008035	20.65367	559.3883057	0.795593	0.013653	5.698181	1.75E+04	1.22E-05
image-6	0.010783857	29.608586	71.1576782	0.900342	0.007825	19.08121	803.4510986	0.459253	0.013442	10.36486	5978.53475	0.003125
image-7	0.008966522	32.930335	33.116687	0.951501	0.005978	20.92748	525.2090576	0.676172	0.01182	7.38286	11879.395	0
image-8	0.00708911	34.930881	20.8925903	0.966418	0.004641	23.4648	292.8199097	0.629883	0.010213	4.424475	23476.473	0
image-9	0.007599766	35.63564	17.7630005	0.923535	0.005287	23.3679	299.4263062	0.767554	0.010033	8.55613	9067.0786	0.32467
image-10	0.009612352	29.544705	72.2120728	0.963928	0.006984	21.26463	485.9790771	0.843628	0.012631	4.860082	21235.9724	0.008716
image-11	0.009822622	27.46036	116.692883	0.971509	0.007044	19.20316	781.2038574	0.797681	0.012872	7.925578	10483.8921	0.000134
image-12	0.00815548	33.453245	29.3599854	0.945178	0.005963	21.93473	416.4926514	0.742896	0.010559	6.776549	13659.2067	0.067749
image-13	0.003063937	30.473102	58.3136475	0.93573	0.003064	22.75116	345.1157227	0.845618	0.003064	8.010849	10280.0548	0.449084
image-14	0.008515943	27.944007	104.394995	0.938171	0.005677	22.74276	345.78396	0.688025	0.011355	2.418567	37258.3578	0.044482
image-15	0.006803743	40.497593	5.79857178	0.833423	0.004506	22.63822	354.2081787	0.126489	0.009597	7.328337	12029.4736	0
image-16	0.00878629	28.862789	84.4892456	0.892261	0.005212	20.8591	533.5447388	0.72052	0.01164	3.816324	27005.2337	0.012354
image-17	0.005962662	37.059632	12.7972656	0.916321	0.004911	23.98814	259.5773438	0.517578	0.007029	4.692879	22069.4964	0.035095
image-18	0.009687448	26.792984	136.076135	0.952856	0.007014	18.83672	849.9792603	0.771448	0.012556	10.03493	6450.41057	0.001196
image-19	0.002733513	37.323798	12.0420532	0.840137	0.002734	22.27832	384.811731	0.46759	0.003064	10.38736	5947.63395	0.003101
image-20	0.007194245	34.124661	25.1544189	0.888757	0.005242	22.21503	390.4604004	0.429663	0.010438	5.976779	16421.1094	0.007227
image-21	0.006983974	33.914323	26.4026855	0.935852	0.004926	21.24617	488.0485474	0.577612	9.82E-03	8.74E+00	8700.82834	0.009375
image-22	0.004550848	35.488873	18.3735474	0.648083	0.003725	21.53223	456.9380615	0.245959	0.006428	11.81333	4.28E+03	2.44E-05
image-23	0.007464592	33.613552	28.2960083	0.884509	0.005572	23.44163	294.3858887	0.31228	1.03E-02	6.02E+00	16251.2602	0.085925
image-24	0.007119148	33.984664	25.9784912	0.850427	0.005107	23.27641	305.8011719	0.373047	0.010243	5.589907	1.80E+04	1.22E-05
image-25	0.007269341	32.76997	34.3623901	0.951733	0.005001	22.31976	381.1572144	0.62843	0.009913	5.35902	18931.2101	0
image-26	0.005827488	36.777043	13.6576538	0.908386	0.00425	23.88007	266.1176758	0.40946	0.008501	6.211486	15557.2109	0.041223
image-27	0.007359457	33.647347	28.0766724	0.904102	0.005377	22.464	368.7064941	0.630322	0.009883	4.577629	22663.0037	0.01499
image-28	0.003995134	42.052119	4.05385742	0.838818	0.003124	31.04338	51.1378418	0.785352	0.006188	7.672646	11112.6014	0.217627
image-29	0.006908878	39.561626	7.19312744	0.955945	0.005092	22.09492	401.4103394	0.474316	0.009943	7.240217	12276.0491	0
image-30	0.008951503	33.701262	27.7302734	0.969434	0.006308	21.75253	434.3372437	0.641626	0.01176	6.547486	14398.9803	0.014844

Intersection (HI).



*Figure 3. 8 Decompression images*

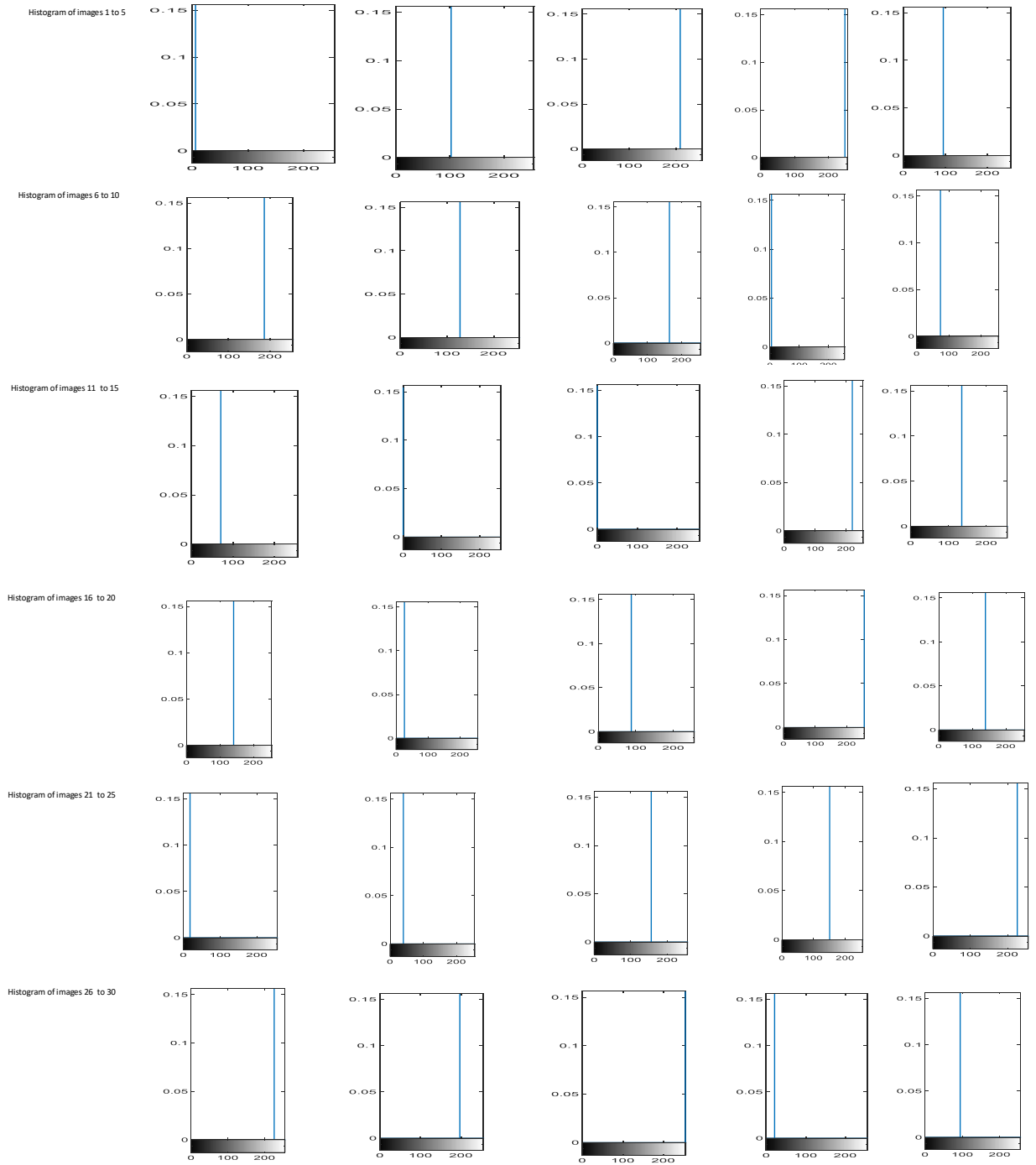


Figure 3. 9Histogram Intersection (HI) of decompression images

## **Chapter 4**

### **Conclusion and Future Work**

This section describes the conclusion of the research and some of achievements. In addition the possible futures work.

#### **4.1 Conclusion**

The data compression is reducing the data size, which corresponds to bandwidth, transfer time, speed efficiency and the storage space area. The compression processing produces a low bit rates and reduces the time required for transmission. All these parameters has influence on digital image transmission and storage. Generally, the data compression can classified into two types; lossy and lossless compression. In the lossless case, the re-construction is perfect, and the image quality is preserved. Lossy compression is irreversible, as some information contained in the original data will be lost primarily during the quantisation step and the original data cannot be recovered exactly. the lossy compression is limited with compression ratio and quality level, it must achieve high compression with acceptable quality.

In this research, the lossy image compression DCT based schemes has been proposed. Compression was applied on high and low frequency coefficients of image DCT decomposition. The compression works block-by-block by DCT, scalar quantization and RLE. The algorithm has high compression ratio and reasonable quality depending on the matrix quantization.



## **4.2 Future Work**

The future work will focus to improve the algorithms for compression ratio to accomplish high compression ratio with acceptable quality, improve quantization processing without degrade compression ratio and quality factor, and improve the compression algorithms based Discrete wavelet transform (DWT) and Hadamard transform.

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DESIGN AND IMPLEMENTATION OF IT SERVICE MANAGEMENT SYSTEM FOR  
ANDROID, IOS, AND WINDOWS

*A project submitted to the department of computer techniques engineering  
as a partial of the requirement to fulfillment the B.Sc. degree in the  
computer techniques engineering*

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## ABSTRACT

This graduation project includes the design and implementation of an Information Technology Service Management (ITSM) Mobile Application. The application works on multiple platforms such as Android, iOS, and Windows. The ITSM application supports three types of activities: Information request, Service request, and Technical Faults (or Incidents). The ITSM application works as a tool that facilitates the operation and strategy of the IT department within an organization. The designed ITSM application helps generating and tracking the tickets and/or requests until they are done. The application generates different types of reminders without burning the IT personnel and to meet the Service Level Agreement (SLA) to ensure a high standard service. The reporting features enables the IT leadership to generate fruitful statistical reports that can be used for decision making and preventive maintenance procedures. The reports show the top repeating issues and the IT management can add the actions to taken. Flutter cross platform have been used along with Dart and Kotlin languages. The design is done close to similar applications. The implementation was done using Google cloud based services. On Google cloud, a database was created with six tables: users, tickets, information requests, service requests, assets, and change management. The application is developed based on Rational Unified Process (RUP) software development method.

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لكل مقام مقال , و لكل مبدع انجاز , و لكل نجاح شكر و تقدير , فجزيل الشكر  
لكل من ساهم و ساند دراستنا العلمية بكل مراحلها و في هذا الصدد نشكر  
الاستاذ الدكتور المشرف ( ليث عبد الأمير ) لنصائحه الثمينة و توجيهاته القيمة  
التي ساعدتنا على اتمام و انجاز هذا المشروع .  
الشكر موصول للاهل و الاخوة الذين سهروا الليالي و كافحوا و قاوموا كافة  
الظروف لتهيئة بيئة دراسية مناسبة و وفروا الدعم النفسي و المعنوي كذلك .  
كما لا ننسى الزملاء الذين رافقونا طيلة السنين الماضية و جمعتنا معهم  
ذكريات جميلة لا تنسى و كانوا لنا خير اصدقاء و صحبة .

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## Chapter 1

### Introduction

IT Service Management (ITSM) is a concept that enables an organization to maximize business value from the use of information technology (Crandall, Steward, & Warf, 2016). To ensure sustainable quality of IT services, ITSM establishes a set of practices, or processes, constituting a service management system. It's simply how IT teams manage the end-to-end delivery of IT services to customers (Gacenga, Cater-Steel, & Toleman, 2010). This includes all the processes and activities to design, create, deliver, and support IT services. The core concept of ITSM is the belief that IT should be delivered as a service and planned as a business partner. A typical ITSM scenario could involve asking for new hardware like a laptop. The user would submit a request through a portal, filling out a ticket with all relevant information, and kicking off a repeatable workflow. Then, the ticket would land in the IT team's queue, where incoming requests are sorted and addressed according to importance (Al Farsi, Jabbar, Tawafak, Malik, Alsidiri, Alsinani, & Sulaiman, 2020).

### **Background of the IT Infrastructure Library**

In order to establish an organizational infrastructure for IT services, IT practitioners strategize IT service delivery by developing and implementing a reference process: The Information Technology Infrastructure Library (ITIL). IT executives worldwide consider ITIL to be a suitable service management standard for IT services (Eikebrokk & Iden, 2017).

The third version of ITIL detailed 25 processes that explain how the various tasks of a supplier of IT services must perform to move an IT service through its life cycle from design, validation, test to deployment, and how events along the path should be handled and operational problems solved (Crandall, Steward, & Warf, 2016).

The latest version, ITIL V3, published in 2007 and revised in 2011, explains in five volumes (Service Strategy, Service Design, Service Transition, Service Operation, and Continual Service Improvement) the set of processes that an IT service must perform (Eikebrokk & Iden, 2017). The five volumes describe a set of processes that suggest how an IT function should design, build, and deliver IT services to its customers. The implementation progress can be tracked by measuring the implementation status of the selected ITIL processes (Eikebrokk & Iden, 2017).

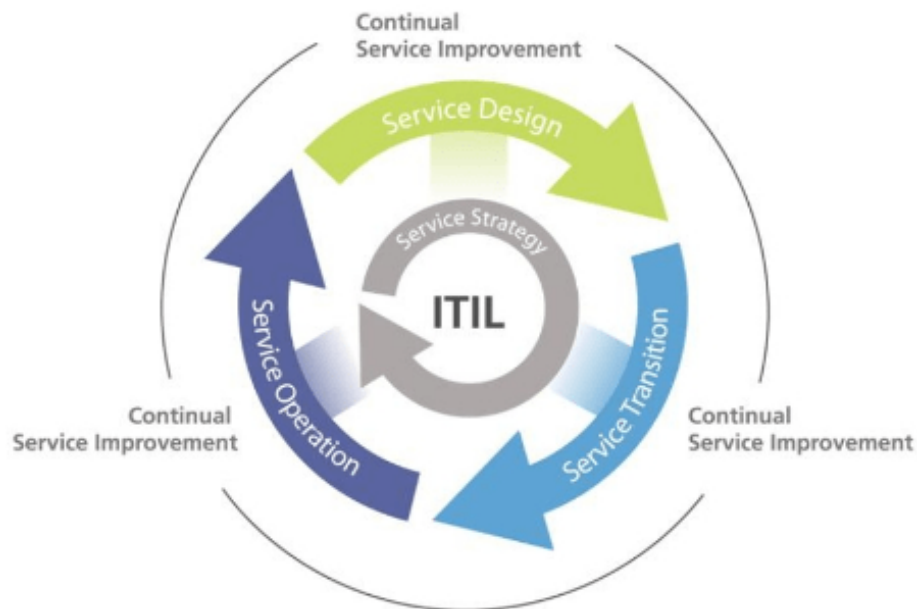


Figure 1. ITIL Process Diagram

## **Problem Statement**

Technology alone does not deliver a good service. technology needs to be managed in order to meet customer needs the problem is the process of identifying and managing the causes of incidents on an IT service (Crandall, Steward, & Warf, 2016). problem isn't just about finding and fixing incidents, but identifying and understanding the underlying causes of an incident as well as identifying the best method to eliminate that root cause.

Moreover, pinpointing the cause has no value to an organization if it's a cut-off process completed by a distributed team, so problem management should be constant and widely practiced across multiple teams, including IT, security, and software developers. An incident may be over once the service is up and running again, but until the underlying causes and contributing factors are addressed, the problem remains.

## **Purpose of the Study**

The purpose of this graduation project is to design and implement a mobile application for managing the IT sector in any organization. The ITSM application include designing, delivering, managing, and improving the IT services an organization provides to its end users (Gacenga, Cater-Steel, & Toleman, 2010). In Dijlah University College, the end users can be the students, the faculty, or the professors. ITSM is focused on aligning IT processes and services with business objectives to help an organization grow.

## **Significance of the Study**

The designed and implemented ITSM application is recommended because of its likelihood to renew, usability, availability, performance, in-person training, online training, product scalability, besides the support rating and implementation rating (Alkhuraiji, 2020; Gacenga, Cater-Steel, & Toleman, 2010).

The designed and implemented ITSM application include the following significant features: (a) Electronic storage, protection of various valuable records in enterprises. (b) Providing the necessary and important information and communication to decision-makers. (c) Mobile/Remote access to the ITSM database, so that employees can utilize it from home or anywhere else.

(d) Facilitating the process of developing mobile applications. (e) Protecting electronic information from hacking or eliminating it during a technological disaster. (f) Reducing employee burdens in performing their duties, ease of tracking tickets, requests, and changes. (g) Safe maintenance of ITSM files. (h) Control over the permission to access the information and data stored in the ITSM databases, and the permission to amend, transfer and delete them.

(i) Activate strong integrated security features in the ITSM, including antivirus scans, patch management, and backup. (j) Gain full oversight of customers' issues and requests and the ability to manage alerts. (k) Provide some automation without having to learn a new scripting language. And (l) Manage hardware and software monitoring as well as full asset management.

### **Definition of Terms**

This section includes the terms that are used in this study.

**ITSM** IT Service Management.

**IS** Information Systems.

**ITIL** IT Infrastructure Library

**API** Application Programming Interface

**SDK** Software Development Kit

**APK** Android Application Package

**APPLICATION** Application

**GUI** Graphical User Interface

**JSON** JavaScript Object Notation

**Wi-Fi** Wireless Fidelity

**XML** eXtensible Markup Language

**DNS** Domain Name Service

### **Assumptions, Limitations, and Delimitations**

This project was limit due to time constrains and because of the COVID-19 related challenges. Lack of developing expertise was another challenge as well. In any organization, a positive relationship between group efficacy and organizational resources are all positively related to implementation progress.

### **Outline of Project**

The outlines of this project can be summarized as follows: **Chapter two** included an explanation, description, and discussion of the software parts of the project as well as the programming languages used to create the project. **Chapter three** included the essential steps for implementing the project. **Chapter four** includes the conclusion, recommendations, and future work.

## Chapter 2

### Theoretical Analysis and Literature Review

ITIL implementation research is increasing (Eikebrokk & Iden, 2017). Through a literature review, Iden and Eikebrokk (2013) find that the research sorts itself into the following categories: antecedents to implementation, implementation progress, and consequences. Existing research studies implementation progress on three different levels of analysis: the national level (if and to what extent IT functions in a country are implementing or planning to implement ITIL); the firm level (the overall implementation progress in firms); and the process level (the implementation progress for each ITIL process in a firm). The relationship between ITIL and process management is less explored (Iden & Eikebrokk, 2013).

### **Title Searches and Documentation**

Several databases were searched such as ProQuest, EBSCO host, Gale PowerSearch, IEEE Xplore, Science Direct, and Association for Information Systems (AIS). The search involved the use of keywords such as: IT Service Management, ITIL, Implementing Mobile Applications, Process Management, Development Life Cycle, ITSM Systems, Cloud Computing, and Cross Platforms (Albertengo, Debele, Hassan, & Stramandino, 2020). This keyword search revealed publications. The advancement of this graduation project was the consequence of researching papers from peer-reviewed articles, thesis and dissertations, and textbooks (Alkhuraiji, 2020).

### **Historical Literature Review**

At its heart, ITIL is service centered and prescribes an organizational infrastructure for delivering IT services through processes (Marrone & Kolbe, 2011). The latest version, ITIL V3, published in 2007 and revised in 2011, explains in five volumes

(Service Strategy, Service Design, Service Transition, Service Operation, and Continual Service Improvement) the set of processes that an IT service must perform (Eikebrokk & Iden, 2017). These processes delineate how an IT service moves through its life cycle: how the IT service should be planned for and built; how the IT service and related changes should be validated, tested, and deployed; how events and requests regarding the IT service should be handled; how the basic configuration supporting the IT service should be controlled; and how operational problems should be solved (Al Farsi et al, 2020).

An important question regarding process reference models such as ITIL is what makes them applicable. An IT department will acknowledge the usefulness of process reference models: using the reference models reduces the effort needed for the construction of its own processes. However, the more specific a reference process model is, the fewer the IT departments to which it can be applied: ‘the dilemma of reference modeling’ (Crandall, Steward, & Warf, 2016). The authors of ITIL have chosen the less specific approach, and thus have made ITIL attractive to a large number of IT departments around the world. Research attests to its attractiveness. In a 2009 survey, 45% of US IT managers were using ITIL and 15% were in the planning stages. Similar evidence is found in other countries.

### **Current Content**

The adopted ITSM depends on ITIL which is a process-based practice intended to align the delivery of information technology (IT) services with needs of the enterprise, emphasizing benefits to customers (Gacenga, Cater-Steel, & Toleman, 2010). The main focus is to deliver satisfactory service to the end user customer (Crandall, Steward, & Warf, 2016). ITSM involves a shift from managing IT as stacks of individual components



to focusing on the delivery of end-to-end services using best practice process models (Eikebrokk & Iden, 2017).

The ITIL contextualizes itself within the perspective and evolution of process reengineering and business process management (BPM) (van Bon, 2002). The process perspective has become an accepted approach to the way organizations think about and manage their business (Harmon, 2010). In its early days, process thinking (then called process reengineering) was positioned as an episodic, rather than an ongoing, effort (Eikebrokk & Iden, 2017). Gradually, process orientation has evolved to what is today understood as BPM, a discipline that encompasses not only the redesign and deployment of business processes, but also the ongoing administrative and supervisory control to ensure that they remain compliant with business objectives and customer needs.

According to a worldwide study Released in February 2021 by S. O'Dea, for a survey time period 2012 to 2021, Android operating system maintained its position as the leading mobile operating system (Al Farsi et al, 2020). The smartphone operating system market share in 2020 was dominated by Android at 71.93 percent share (statista.com). Google Android and Apple iOS jointly possess over 99 percent of the global market share (Alkhuraiji, 2020). The following section includes the current ITSM products (Amjad, & Akter, 2020).

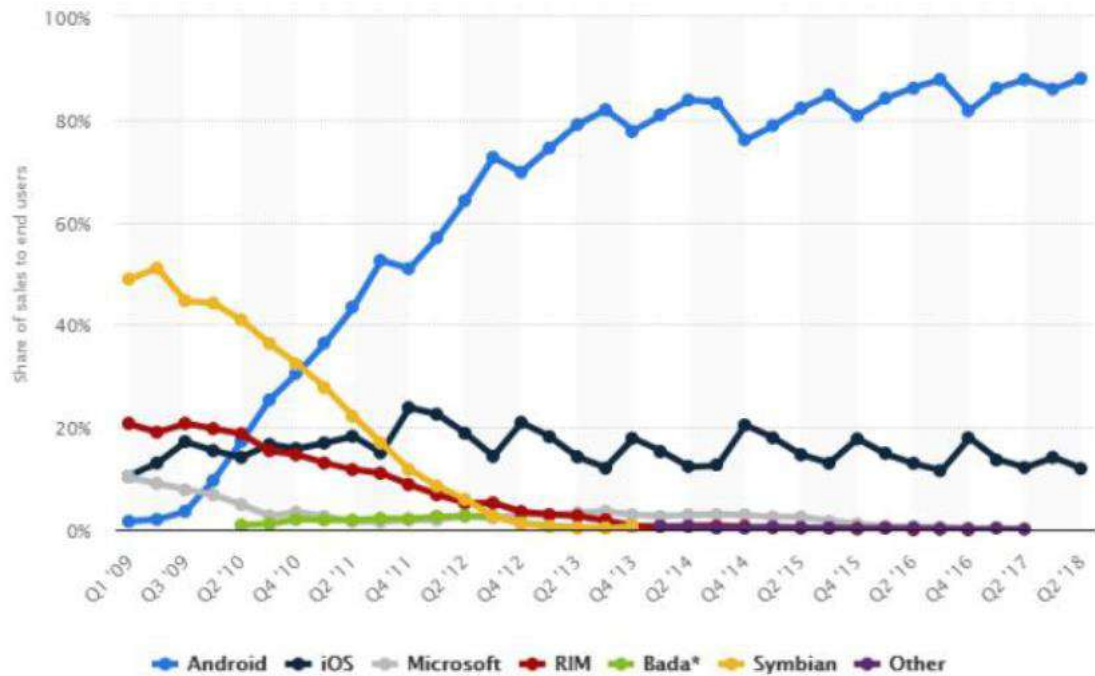


Figure 2. The Evolution of mobile OS used in the world from 2009 to 2018 (Blilat & Ibriz, 2020)

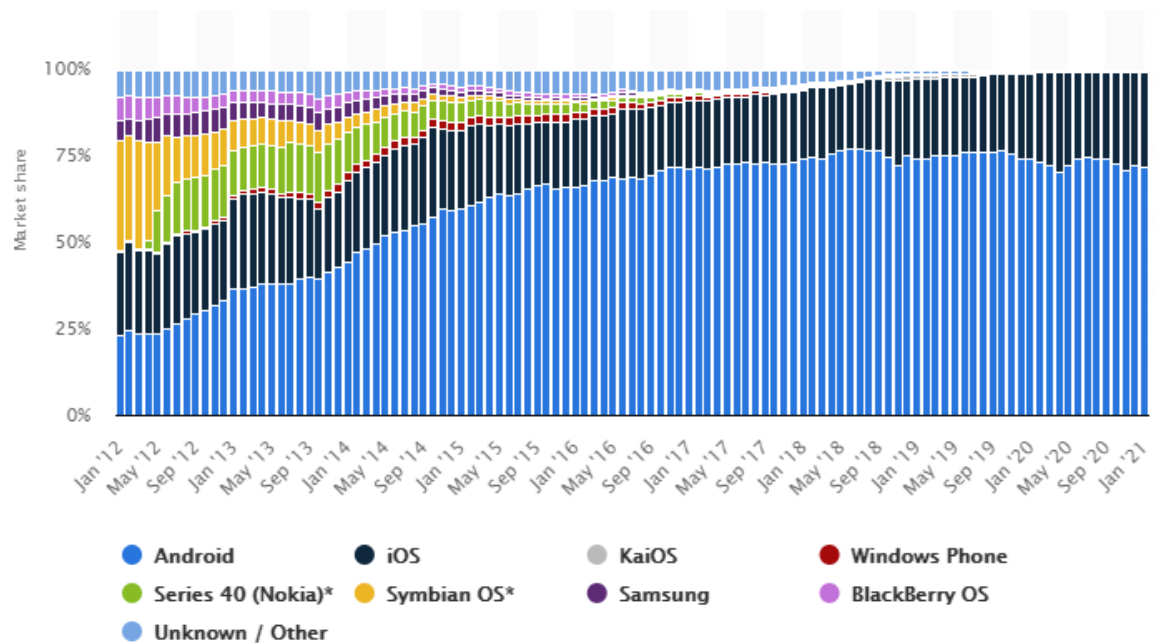


Figure 3. Market share of mobile operating systems worldwide 2012-2021

([www.statista.com](http://www.statista.com))

## Current ITSM Products

The market contains several ITSM products including TOPdesk, SolarWinds Service Desk, Spiceworks Service Desk, SysAid, Freshservice, BMC Helix ITSM, Autotask PSA, BMC Foot Prints, Microsoft System Center Service Manager, and JitBit Help Desk (Gacenga, Cater-Steel, & Toleman, 2010; <https://www.trustradius.com/it-service-management-itsm#products>)

**TOPdesk** is the flagship highly-modular cloud-based or installed ITSM service desk and asset management solution from the Dutch company of the same name, for enterprise companies.

Advantage: The ability to reply to emails to update tickets, both as the person making the support request and as the person Working on the support request, makes it much easier to keep everyone informed as to the progress of the tickets and the eventual resolution.

Disadvantage: The initial setup curve is very high, with it being strongly recommended that you involve the company in the design and setup phases to be able to get the most out of the program. The complexity of the setup is more than offset by the functionality of the product.

**SolarWinds Service Desk** (formerly Samanage) is a cloud-based, multi-tenant IT service desk and asset management software for IT and enterprise service management. Samanage is on a single, always new instance of software. The service desk includes a self-service portal, service catalog.

Advantage: It has empowered me to handle the configuration more precisely.

Disadvantage: It does not help in handling the aggregate links appropriately.

**Spiceworks Service Desk** offers a set of free tools for IT network management and help desk support ticketing. The inventory management system essentially provides comprehensive device information for asset management. The Spiceworks Network Monitor provides information on observed IT for problem.

Advantage: Creating Tickets from multiple sources.

Disadvantage: It does everything I need it to do and pretty well.

**SysAid** is the flagship ITSM and IT help desk software from SysAid Technologies, which offers a rather wide swath of features, supporting asset management (HAM and SAM), remote control, and rich reporting tools.

Advantage: Asset management gives complete Visibility into assets across the organization and reporting.

Disadvantage: The integrated remote control piece Works but we miss some features of a more robust product.

**Freshservice** is a cloud-based service desk and ITSM solution that currently serves more than 10,000 SMB, mid-market, and enterprise customers worldwide.

Advantage: Problems Management.

Disadvantage: Employee Onboarding.

**BMC Helix ITSM** replaces Remedy. It is a broad suite of ITSM, tools with strong integrations to other BMC tools and in-built ITAM. The product is used mainly by global brands and is offered in on-premise and SaaS configurations.

Advantage: End-to-end tracking and follow up makes it easy for the user to prioritize the incident.

Disadvantage: Stage by stage updates should be provided to the incident raiser.

**Autotask PSA** is designed as a complete IT Business Management Platform for MSPs, now from Datto (resulting from the Autotask merger with Datto in 2017).

Advantage: Makes quoting and invoicing very easy and manageable.

Disadvantage: Transferring invoices to QuickBooks can be a little slow sometimes.

**BMC Foot Prints** is an ITSM solution featuring workload automation.

Advantage: Makes life easier with less troubleshooting.

Disadvantage: Performance impact when it comes more documents in the same case sheet.

**Microsoft System Center Service Manager** is an integrated platform that is designed for automating and adapting ITSM best practices to an organization's requirements. The platform includes built-in processes for incident and problem resolution, and change control.

Advantage: Application deployment across Windows machines.

Disadvantage: The software requires a lot of memory to run smoothly, otherwise it will be slow.

**JitBit Help Desk**, from JitBit Software, is a cloud-based or installed help desk solution with a ticketing system, knowledge base, and related features.

Advantage: Historical tracking of issues and requests.

Disadvantage: Better feature request timing.

### **Concepts of IT Service Management**

ITIL implementation is a typical example of how information systems functions are actively approaching the challenge of creating strategic IT benefits. Following Galliers' framework for understanding IS strategizing (Galliers, 2011, p. 331), ITIL

implementation represents the intention to realize benefits through the adoption of reference processes that explain how IT should be exploited and delivered as IT services (Crandall, Steward, & Warf, 2016).

These ITIL processes represent aggregated knowledge of best practice, developed through experience and shared in a community of IT practitioners working to converting the IT function into a service. As such, ITIL implementation can be seen as both an approach and a tool adopted by IT executives for realizing a service-oriented strategy (Eikebrokk & Iden, 2017).

The phenomenon of ITIL – its reference processes, its implementation, and its community – is attractive to the strategic IS field for several reasons. First, ITIL and its implementation are rarely studied within the strategic IS field despite ITIL's popularity among practitioners: 'There is still much potential for further advancing the knowledge base on phenomena related to IT-based services' (Fielt et al., 2013, p. 46). Second, and even more motivating, is the fact that practitioners themselves see ITIL as an important strategic initiative and tool to secure a reliable organisational infrastructure and reliable IT services (Teubner, Pellengahr, & Mocker, 2012). ITIL can increase our understanding of the nature of strategising in general and within ITSM in particular (Eikebrokk & Iden, 2017). Finally, the worldwide community of IT practitioners cooperating in this effort represents a network of practice that undoubtedly influences strategising, and as such should receive increased interest from strategic IS researchers as an example of how collaboration can influence strategising (Blilat, & Ibriz, 2020; Buhl, Fridgen, Ko'nig, Ro'glinger, & Wagner, 2012).

## **ITSM vs. ITIL**

ITSM is often associated or referred to as ITIL, but these two things are not identical (Eikebrokk & Iden, 2017). ITIL is concerned with an integrated set of best-practice processes for delivering IT services to customers, and aligning IT resources with business needs (Gacenga, Cater-Steel, & Toleman, 2010). But it is a highly specific guidance framework that was developed in the UK and contains very specific process descriptions, success factors, and metrics in a series of documents (Crandall, Steward, & Warf, 2016).

ITSM, on the other hand, is a more generic term describing the broad area of providing IT services to users (Gacenga, Cater-Steel, & Toleman, 2010). ITSM projects often implement the ITIL framework for specific guidelines, but they don't have to. There are alternative frameworks like Cobit, Lean Six Sigma, DevOps, and others.

## **Enterprise Service Management (ESM)**

Enterprise Service Management is, in many ways, the next evolution of ITSM just outside of the IT department. The main difference between the two is that enterprise service management has evolved to include non-IT business processes, departments, and business goals within its scope (Eikebrokk & Iden, 2017).

ESM primarily applies ITSM best practices traditionally used in ITSM and confined to IT departments across enterprise businesses. Other teams and departments have been adopting these best practices to help run non-IT business functions more efficiently and deliver business outcomes faster. Traditional ITSM products have substantial overlap in functionality with ESM products and have been applied to broader enterprises successfully (Gacenga, Cater-Steel, & Toleman, 2010). However, traditional

IT-focused service management products may be less optimized or flexible for non-IT users.

Beyond IT and help desk service management, many ESM vendors now offer modules for customer success, field, telecommunication, HR, legal, case management, and financial service management. One of the main benefits ESM provides is the ability to unite service management efforts across the organization under the one platform. This centralization allows for easier scalability and efficiency for IT and business users alike.

### **ITSM Tools vs. Help Desks**

From a software product standpoint, ITSM tools focus on the specific area of what most users think of as help-desk. Within the ITSM world, this is often referred to as a *IT Service Desk* (Gacenga, Cater-Steel, & Toleman, 2010). The main difference between help-desk and service desk as part of an ITSM implementation is that help desk or ticketing software products are typically designed for external users of an application (Gacenga, Cater-Steel, & Toleman, 2010).

The focus of service desk products is on streamlining service delivery within the IT domain. ITSM service desk tools also have broader functionality than standard help desk tools. For example, ITSM tools also have capabilities such as incident management, change management and configuration and asset management (Gacenga, Cater-Steel, & Toleman, 2010). They also have some proactive and monitoring capabilities designed to anticipate problems before they occur.

Convergence between these two markets is beginning to occur. For example, some help desk system vendors are repackaging their products to be used in an IT-centric or ITSM context.



## ITSM Comparison Indicators

When comparing different ITSM tools, consider these aspects of the products:

**IT vs. Enterprise Service Management:** Does the business need a service management platform exclusively for IT processes, or should it be applied elsewhere in the business as well? Many vendors have built out more tailored offerings for ESM, but this functionality may be underutilized if the organization only uses it in the IT department. Buyers should adopt a platform with the scope of functionality that meets the scope of their needs.

**User-friendliness:** How easy is each product to use, learn, and manage? Many ITSM reviewers identify the user-friendliness or usability as a leading pro, or con, for a variety of tools. Consider the ease of use for both routine IT users in your organization, as well as other users in your business and any external customers who will interact with the system. **Customizability:** How flexible is the tool to your business's processes, workflows, and ticketing requirements? ITSM systems can vary in their absolute capacity for customization, how easy they can be customized, and how well customizations will age with new system updates. ITSM systems that can be heavily customized may require more regular reconfigurations when the software vendor pushes an update.

**Integrations:** Your ITSM tools will likely need to integrate with the rest of your business's tech stack. ITSM tools frequently integrate software development platforms, IT monitoring tools, and remote access tools. The more prebuilt integrations a tool has with the rest of your software, the more streamlined IT workflows will become.

## Chapter 3

### Application Design and Implementation

There has been a steady increase in research on the concept of service in the Information Systems (IS) discipline. IT services is one of the fastest-growing sectors of the service economy. One recent stream of this research is ITSM (ITSM), which focuses on delivering of IT function and management of IT service provision. ITSM applications helps facilitate and control the service provided by the IT department in the organization. This chapter includes the design and implementation of the ITSM application (Alkhuraiji, 2020).

#### **Implementation Appropriateness**

To avoid doing double work, Flutter cross platform was used. Google announced Flutter 2.2, an open source toolkit for building mobile applications for any device from a single platform (Alkhuraiji, 2020). Flutter 2.2 is the best version of Flutter yet. Flutter allowed us to connect to cloud services and APIs that extend applications to support new capabilities (Albertengo et al, 2020). On Google cloud, a database was created with six tables: users, tickets, information requests, service requests, assets, and change management. The Flutter platform increased application performance and reduced the package size (Bondarenko, Khotchenko, & Ahieieva, 2020). The Flutter SDK was accessed from the Android studio version 4.1.2 (Al Farsi et al, 2020; Amjad, & Akter, 2020).

According to Tim Sneath from Google: “With Flutter 2.2, enterprises, startups, and entrepreneurs alike can build high-quality solutions that can reach the full potential of their addressable market, allowing creative inspiration (rather than target platform) to be the only limiting factor”. Analyst firm SlashData’s Mobile Developer Population

Forecast 2021 shows that Flutter is now the most popular framework for cross-platform development, with 45% of developers selecting it, representing 47% growth between Q1 2020 and Q1 2021 (<https://medium.com/flutter/announcing-flutter-2-2-at-google-i-o-2021-92f0fcbd7ef9> ; Al Farsi et al, 2020).

Android Studio provides the fastest tools for building applications on every type of Android device (Alkhuraiji, 2020). The visual layout editor feature allows developers to create complex layouts with by adding constraints from each view to other views and guidelines. Then preview your layout on any screen size by selecting one of various device configurations or by simply resizing the preview window (Amjad, & Akter, 2020). With the APK analyzer, we as developers found opportunities to reduce the Android application size by inspecting the contents of the application APK file (Alkhuraiji, 2020). The Fast emulator made the programming process fun. The emulator allowed us to install and run the application faster than with a physical device and simulate different configurations and features, including ARCore, Google's platform for building augmented reality experiences (Bondarenko, Khotchenko, & Ahieieva, 2020). Besides the above features, Android studio includes intelligent code editor, flexible build system, and real-time profilers (<https://developer.android.com/studio>).

### **What Implementing ITSM Requires?**

Implementing ITSM Requires: (a) Senior management support. (b) Organizational commitment. (c) Team work. (d) Project management capability. (e) Software quality. And (f) Organization resources. The following few sections will contain more details about the above points.

**Commitment of senior management to the ITSM implementation effort:** involved in the project, provides continuous feedback and guidance, and a member of senior management champions the ITSM project.

**Organizational commitment:** Sufficient resources have been allocated, Key people are staying on the ITSM project from start to finish to maintain continuity, and the IT staff strongly supports the ITSM project.

**Team work:** The project group need to has sufficient knowledge of ITSM, the project group is using a formalized method for developing the ITSM processes, members are working hard to implement ITSM.

**Project management capability:** Ability of ITSM project to comply with budget, time, and expectations.

**Software quality:** ability of ITSM software to ease, speed up, and improve outcomes of the ITSM project.

**Organization resources:** the organization's access to monetary and human resources to support the project.

## **Hardware Specifications**

The architecture design and back-end application for chat was implemented on a Google virtual server with the following specifications: Intel Core i7 3610 2.3 GHz Processor, 1 TB hard drives, 16 GB RAM, connected to Internet Through 1 Gbps Intel 82579LM Gigabit Network Connection, and Windows Server 2012 R2 operating system 46-bits.

The client application is implemented on Samsung Galaxy S9+ smartphone device with the following specifications: Android operating system version 10, API level 29, Qualcomm Snapdragon 845 2.80 GHz processor, 8 Cores, 720 x1480 pixels touch-screen resolution, Screen density 265 dpi, Kryo 385 architecture, 5579 MB Total RAM, 802.11 b/g/n Wi-Fi or mobile networks (EDGE, with speeds around 384 Kb/s), Screen size 6.20 inches, Java VM ART 2.1.0, OpenGL ES 3.2, Google Play Services 21.18.16.

## **Application Design and Operation**

ITSM as a management concept places emphasis on IT services, customers, service-level agreements, and the handling of the daily activities of an IT department through processes. There is an important need for a positive involvement from the senior management in the ITSM implementation.

The ITSM application can be customized to use preferred communication method. For example, preferring using emails for certain identities. The identity can be a user, an IT manager, or business manager. Some users prefer mobile text messages as a notification method.

### **New Service Request**

When a requester asks for a new service, the following application fields are required to be filled: Requester's Name, Contacts, Service Description, and The Service Details. Then the ITSM application generates a service request with a unique identifier. The related departments can be added to the request so they can see it and add their comments. The related department can help in deciding the required service time and resources.

### **Information Request**

When a requester asks for an information, the following fields are required to be filled: Requester's Name, Contacts, Request Description, and whether it has been answered or not. Then the ITSM application generates an information request with a unique identifier. So this can be shown in the reports. Top management depends on report in some of their decision making process.

## **Technical Issue**

When a user faces a technical issue (or incident), a new ticket will be opened and the following application fields are required to be filled: Requester's Name, Contacts, Problem Description, and The Details. Within a predefined time, the ticket will be assigned to the corresponding team to be addressed. Based on the service level agreement between departments, a period reminder will be generated. Emails, Chatting Systems, or Text Messages can be generated. In our ITSM application, a notification was used.

If the ticket waited without being assigned for an adjustable time, a notification will be sent to both the owning team and the requestor. If no action was taken, the IT operation manager will be informed.

The new feature of our ITSM application is the ability of directly assign the tickets to the corresponding teams without passing through the IT Service Desk. This privilege can be given to certain groups or all groups based on objective evaluation.

The ITSM application strengths include: Flexible and agile design, customizable features with default values, easy to maintain because it is an in-house application, and capable of supporting 10,000 users.

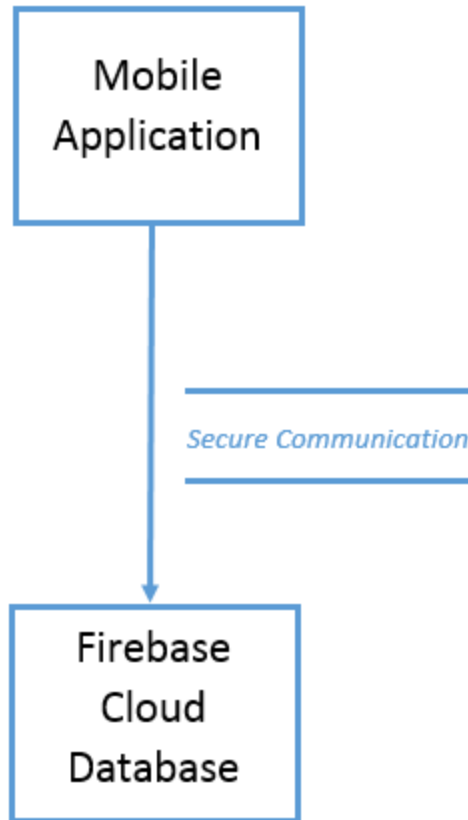


Figure 4. The System Block Diagram



## Operation Flow Chart

The ITSM application flow chart is shown in figure 5. The process starts from the user and ends with closing the inquiry. Different inquiries go through different routes.

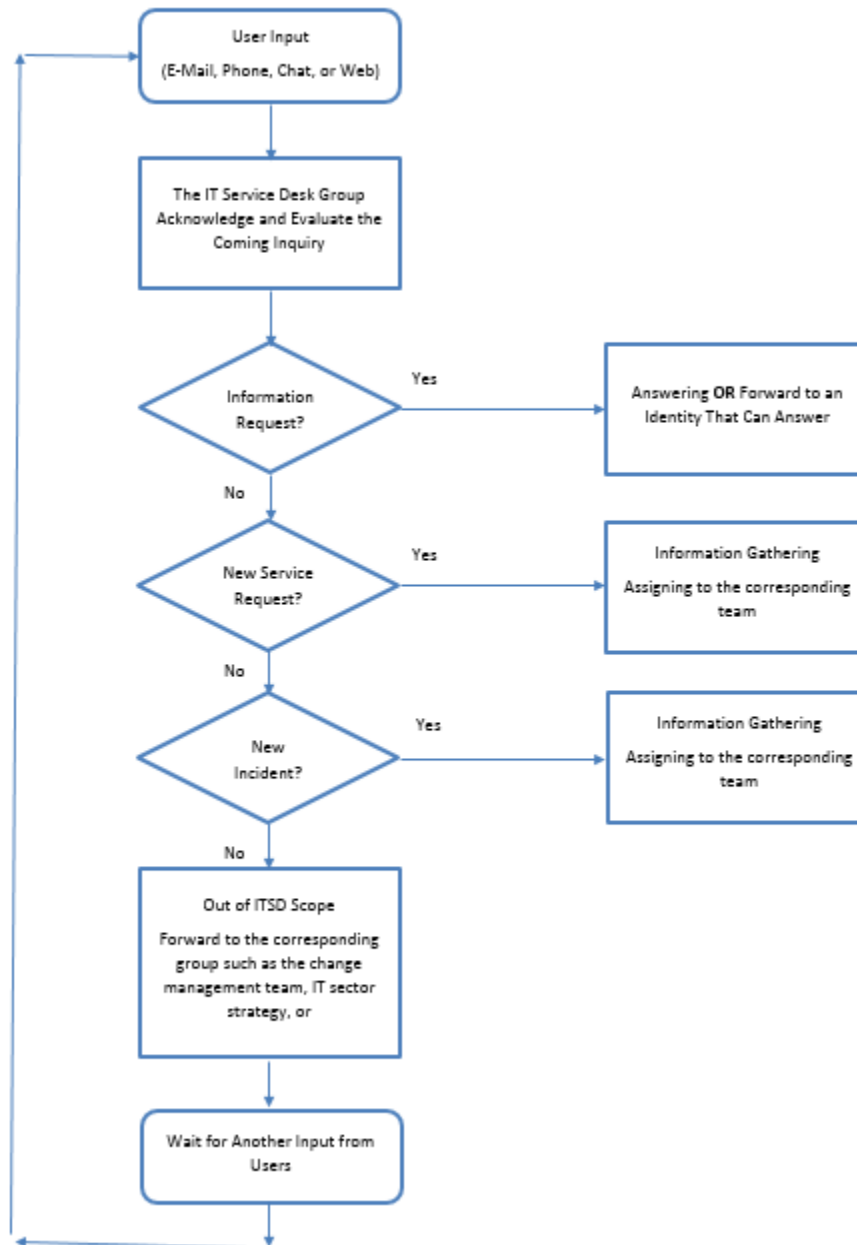


Figure 5. The ITSM Flow Chart

## Implementing the ITSM Application

The application development methodology used in this research is Rational Unified Process (RUP) with 4 phases: inception, elaboration, construction, and transition.

(a) In the inception phase, scope definition and collection requirements were done by distributing questionnaire to students and faculties, and doing interview. (b) In the second phase, remaining requirements were collected and the application was modelled by using Unified Modelling Language (UML). (c) The third phase carried out the development of non-critical features such as group chat, scheduled messages, and broadcast messages. In this phase also made implementation planning, testing and bug fixing, and user manual documents updating. (d) In the fourth phase, implementation of the application was done then released the application to the user for early beta testing.

Figure 5 provides an overview of the ITSM application user interface, introducing the main screen element and tacking detail book at the banner options shown to all users the available option according to use the content frame. Data displayed in the content frame can be in a several formats including lists and forms.

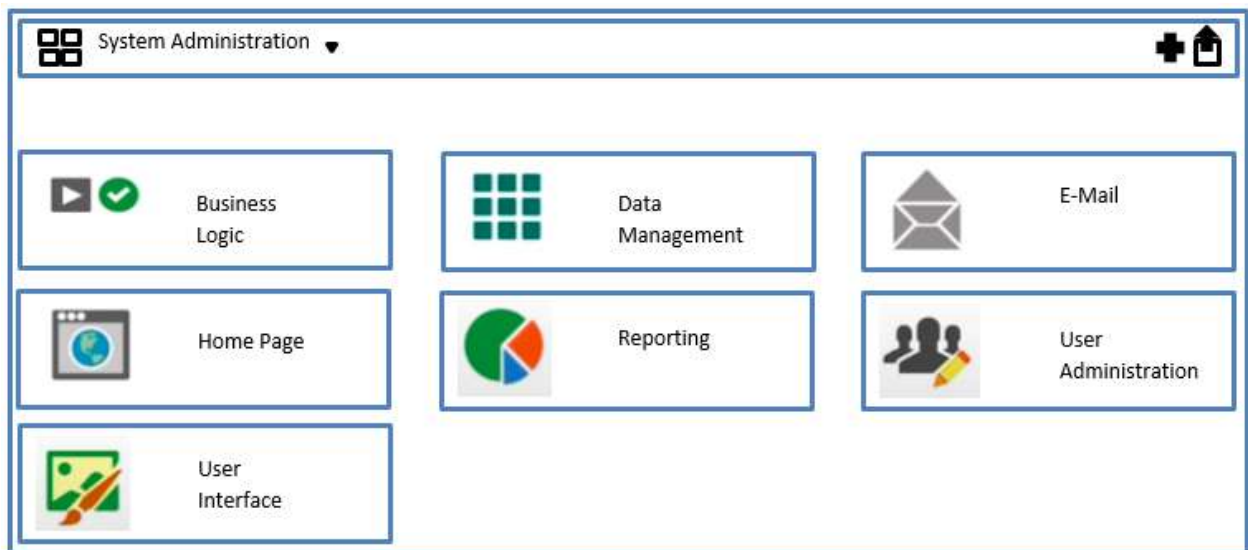


Figure 6. The ITSM Application User Interface

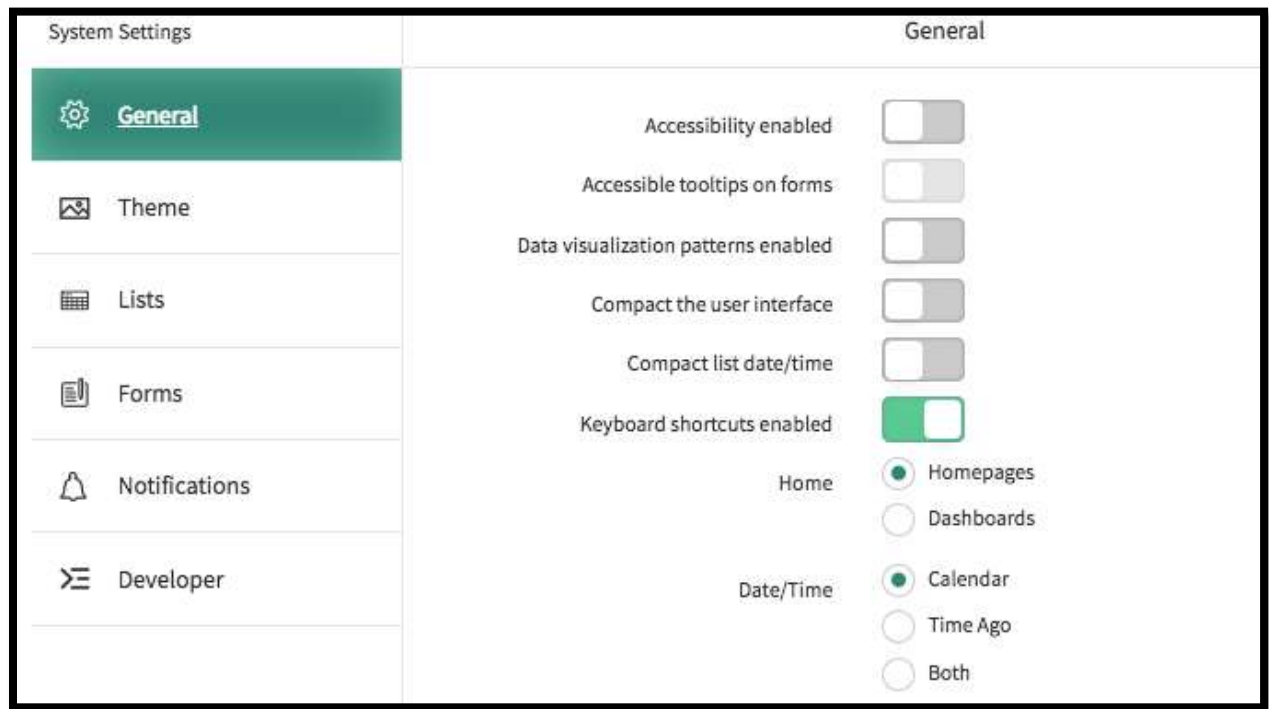


Figure 7. The System Settings Page

### Application Development Cycle

After having the idea, the research team started designing the chatting and file sharing application (Alkhuraiji, 2020). Then the development stage started with several waves. It included fixing common issues and addressing multiple challenges. Then a testing procedures started in different scenarios such as one-to-one, one-to-group, testing in peak hours, testing while the phone is running an application that consume the bandwidth such as playing a YouTube video. The next stage was deploying the application, this was done manually and the application was not published on the Google play store. The final stage is the maintenance stage. Here all the issues are addressed. This stage is still in progress and will continue during the first year. After that, as a future work, the application might be published on the Google play (Alkhuraiji, 2020). At that

stage, it might be restricted only for Dijlah domain i.e. emails end with @duc.edu.iq suffix.

### **Integrated Development Environment**

With regards to the development environment, there were several options to choose from, the selected Integrated Development Environment (IDE) was Flutter. And the selected language was Dart language. Flutter is Google's User Interface (UI) toolkit for building beautiful, natively compiled applications for mobile, web, desktop, and embedded devices from a single codebase (Bondarenko, Khotchenko, & Ahieieva, 2020). Dart is a very young computer language with many interesting features (Al Farsi et al, 2020). Dart is a class-based, object-oriented language with optional types, and it can help you write very powerful programs. On Google cloud, only one database was used that included six tables: users, tickets, information requests, service requests, assets, and change management (Albertengo et al, 2020; Bondarenko, Khotchenko, & Ahieieva, 2020; Cloud Computing Services Overview, 2020).

### **The ITSM Application Features**

The designed and implemented ITSM application include these capabilities: (a) Incident and problem management, (b) Standard processes and procedures for change management, (c) Configuration and inventory/asset management, including application access requests, (d) Knowledge management repository documenting common issues / known resolutions, (e) Service catalog ensuring tickets are routed to appropriate subject management expert, (f) Service level agreement process, (g) Managing ticket workflow, occasionally including project management, (h) Reports and dashboards indicating key performance and capacity data.

## Chapter 4

### Future Work

The ITSM application empowers the IT sector in any organization with technologies that fuel their success. Solutions that integrate layered security, collective intelligence, and smart automation in the cloud, backed by actionable data insights, help IT service providers get the job done easier and faster. The ITSM application helps our users (customers) focus on what matters most--meeting their SLAs and delivering services efficiently and effectively. This chapter includes the limitations, future work, and chapter's summary.

### Limitations

While conducting the study, the main limitation was everybody was busy. All the four students working on this project were busy and the professor Dr. Laith was also busy. Definitely having more time would have helped. But this is something out of the control of the researcher.

### Future Work

If the information saved in a flexible format in the cloud, the possibilities of new features are enormous in the ITSM application, some of them could be: (a) To send warnings to the user in real-time when detecting an incidence around. A Google Cloud Messaging service can be established for this purposes. (b) The ITSM application may predict and detect “usual routes” for each Request/Incident. (c) With the “similar issues” defined, the tickets can be divided into categories where the IT manager can send messages to a group of users faced similar issues. Then, having a significant amount of proposed answers/fixes, that can be modelled with a pattern, which can be used to warn about incidences and provide alternative solutions to the “similar issues” when an

incidence is detected. (d) Improvements on the activity detection algorithms. (e) Take control of customers' desktops with fast remote access, including permission to transfer files and deliver remote commands when there is an issue. (f) the application might be published on the Google play. At that stage, it might be restricted only for Dijlah domain i.e. emails end with @duc.edu.iq suffix. (g) predicting possible issues based on current issues is a possible feature that can be done in future work.

It should be emphasized that the tools used in the development of this project focus on saving resources (money, energy). When the application reaches a wider audience, the tools must be adapted to the new needs which means higher processing power, a more reliable database system and improve the security methods.

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## Abstract

A linear feedback shift register (LFSR) is a shift register whose input bit is a linear function of its previous state. The most commonly used linear function of single bits is XOR. Thus, an LFSR is most often a shift register whose input bit is driven by the exclusive-or (XOR) of some bits of the overall shift register value. Linear feedback shift registers (LFSRs) are essential components of communications systems such as pseudo random bit sequence (PRBS) generators, convolutional encoders, scramblers and randomizers. Therefore, LFSR used maintaining the security of data from eavesdropper of unauthorized access.

In this report, LFSR has been used as technique to retain information security. There are different methods applied for signal encryption. These methods are varying in their complexity and security. Linear Feedback Shift Register (LFSR) is one of these methods and very popular for its simplicity. The main drop back of LFSR is their linearity. As a result, of the presence, the linear part in the LFSR algorithms, not every LFSR is strong enough to stand against algebraic and correlation attacks. Therefore, to reduce this weakness in LFSR, the linear part of algorithms should separate from the output part of algorithms that generates key stream. In this approach, two LFSRs has been used with three secret keys to enhance the linearity weakness in LFSR

*Dedicated to*

*My family*

## Acknowledgments

## Abbreviations

AES	Advanced Encryption Standard
$C_r$	Correlation
A5	Stream cipher
DES	Data Encryption Standard
LFSR	Linear Feedback Shift Register
LSB	Least Significant Bit
MSE	Mean Square Error
HS	Histogram
PSNR	Peak Signal to Noise Ratio
RAS	Ronald Rivest, Adi Shamir and Leonard Adleman
M	Message
MDMF	Maximum Deviation Measuring Factor
GSM	Global System for Mobile communications
NPCR	Number of pixels change rate
XOR	Exclusive Or

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# Chapter 1

## Introduction

Linear Feedback Shift Registers (LFSR) are a collection of cyclic binary states where the current state is a direct computation of its predecessor. A simple XOR of particular bits (the tap positions), and a shifting behavior allows for a uniform serial computation until the start state repeats.

The length of unique states depends on the tap positions that are used to create the ‘feedback’ bit. If the tap positions are maximal (will be discussed later), then there are  $2^n - 1$  possible states, spanning all non-zero  $n$  bit binary numbers. The zero state is not allowed in LFSR because it would infinitely return the zero state since XOR of any number of zeros will always return zero.

These states are useful in digital electronics, and can be used for testing hardware in a somewhat ‘random’ manner since as stated; they can span all non-zero  $n$  bit binary numbers. In addition they can be used for noise generation, or scramblers. But, the most common use of LFSR is in cryptographic applications. Whether it is used for a pseudo-random number generator (PRNG) or in a stream cipher, LFSR are attractive due to their quick hardware implementations. They can be difficult to implement in software, but in hardware, they only need a simple shift and XOR to function. This allows for

execution of cryptographic protocols to be very fast – an extremely desirably quality.

the concept of encryption has lived and developed alongside the plain text writing. The idea of rendering text seemingly incomprehensible for purposes of guarding a secret has been central especially in military use and politics. The word cipher originates from the medieval times, from words such as the latin cifra and Arabic صفر(sifr), which means “zero”. There are numerous theories on why zero would have been used to describe encryption, including that the concept of zero was not part of the roman number system and seen as a mystery among numbers. One of the oldest and most widely known ciphers used in military context is Caesars cipher, also known as Caesars shift.

In order to minimize the size of the internal state, stream ciphers dedicated to low-cost hardware implementations may use a linear transition function. Among all such possibilities, linear feedback shift registers (LFSRs) offer several advantages including their performance, their implementation cost and many theoretical results on the statistical properties of the produced sequences.

Modern cryptography comes in two flavors: Private key, or classical, crypto uses complicated substitution and transposition techniques to obscure a message and relies on the receiver sharing a secret key with the sender. Public key cryptography, an essential tool in internet security, uses powerful mathematical ideas to allow secure communication between parties who do not have a shared key.

Courses in the mathematics of cryptography attract at least two different groups of students: mathematics majors, many with strong backgrounds in algebra or number theory, and engineering students, with strong backgrounds in computer science and computer engineering.

For public-key cryptography, an understanding of finite fields is essential, and mathematics majors are likely to have the necessary background in field theory and linear algebra.

Engineering students routinely learn about Linear Feedback Shift Registers (LFSR's), which are used in communications and in generating pseudo-random sequences; students may even know how to physically build them. LFSR's can also be used to create extremely efficient private-key cryptosystems, although in their straightforward implementation they are not cryptographically secure.

Symmetric cryptography is split into block ciphers and stream ciphers, which are

easy to distinguish. Figure 1.1 depicts the operational differences between stream

(Fig. 1.1a) and block (Fig. 1.1b) ciphers when we want to encrypt  $b$  bits at a time,

where  $b$  is the width of the block cipher.

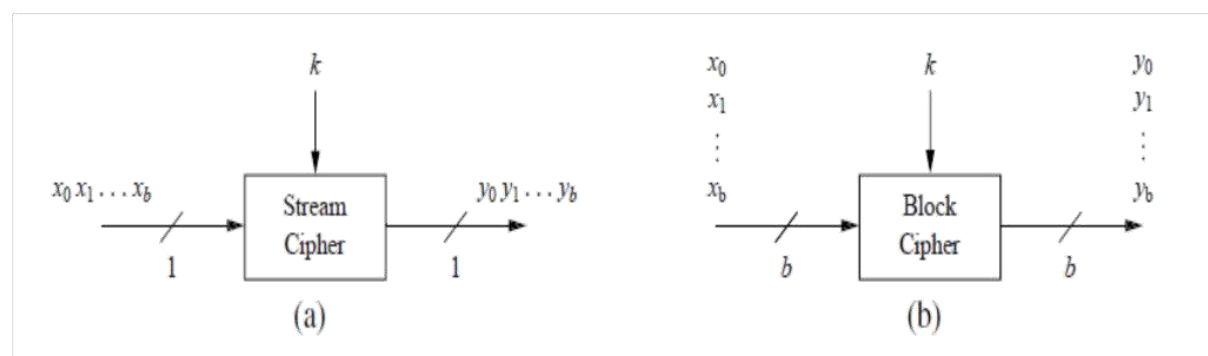


Figure 1. 1 Principles of encrypting  $b$  bits with (a) a stream and (b) a block cipher

A description of the principles of the two types of symmetric ciphers follows.

**Stream ciphers** encrypt bits individually. This is achieved by adding a bit from a key stream to a plaintext bit. There are synchronous stream ciphers where the key stream depends only on the key and asynchronous ones where the key stream also depends on the cipher text. If the dotted line in Fig. 1.2 is present, the stream cipher is an asynchronous one.

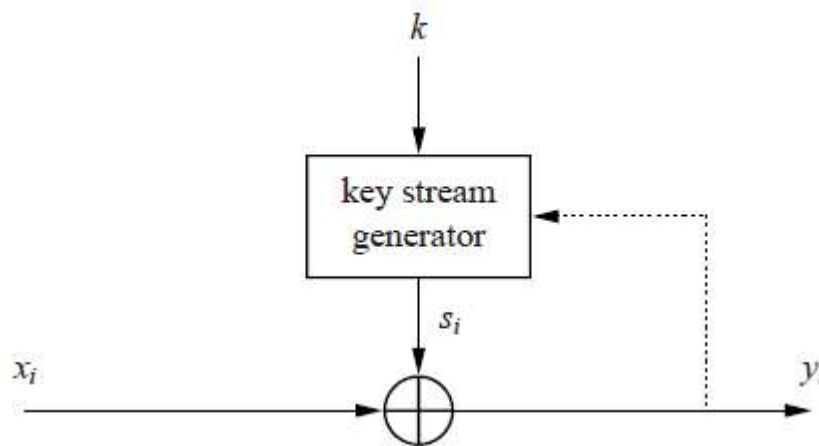


Figure 1. 2 Synchronous and asynchronous stream ciphers

Block ciphers encrypt an entire block of plaintext bits at a time with the same key. This means that the encryption of any plaintext bit in a given block depends on every other plaintext bit in the same block. In practice, the vast majority of block ciphers have either a block length of 128 bits (16 bytes) such as the advanced encryption standard (AES), or a block length of 64 bits (8 bytes) such as the data encryption standard (DES) or triple DES (3DES) algorithm.

Generally, High computational cost of such block ciphers is a major obstacle for real-time encryption. Encrypting online streams, of no fixed duration, imposes some restrictions on type of ciphers and/or encryption keys. Stream ciphers (e.g. LFSR's and chaotic map ciphers) - rather than block ciphers are, therefore, more appropriate for encrypting data streams and GSM signals.

## Chapter 2

### The main concept to Linear Feedback Shift Registers (LFSR)

A Linear Feedback Shift Register (LFSR) is a device that can generate a long seemingly random sequence of ones and zeroes; it is used in computer simulations of random processes, error-correcting codes, and other engineering applications. The ease with which shift registers can produce such sequences make them an attractive topic in an introductory course in the mathematics of cryptography.

A first course in cryptography inevitably explores the notion of the One-Time Pad. This cryptosystem, introduced by G. S. Vernam in 1917, is a "perfectly secure cryptosystem", that is, the cipher text does not leak any information

about the message [1] [2]. It relies on generating long random sequences of letters or numbers.

Suppose the message  $M$  consists of a sequence  $m_1m_2 \dots m_l$  of  $l$  letters taken from the usual 26-letter English alphabet. The venerable Caesar cipher works by shifting each letter of the alphabet some fixed amount; the venerable cipher shifts the letters by a different amount at each position in the message. To encrypt  $M$ , we generate a sequence  $k_1k_2 \dots k_l$  of  $l$  random letters of the alphabet, each letter chosen randomly and independently with uniform probability  $1/26$ . The cipher text is then the sequence  $c_1c_2 \dots c_l$  with  $c_i$  determined by adding  $m_i$  to  $k_i$ ,

Where we treat the letters as the integers from 0 to 25 mod 26.

Mod 26 arithmetic is somewhat inconvenient and mod 2 arithmetic is more natural in digital computers. Therefore, we assume that a message has been encoded in some standard way as a string  $m_1m_2 \dots m_l$  of "bits", i.e., zeroes and ones. The key is then a random binary string  $k_1k_2 \dots k_l$  and we compute the ciphertext by  $c_i = m_i \oplus k_i$ , where the operation  $\oplus$  is addition mod 2. To decrypt, we use the simple formula  $m_i = c_i \oplus k_i$ . To do this, of course, the recipient of the message must have the key string. Since this string is completely arbitrary, it is theoretically impossible to recover the message without the key, since every possible message of length  $l$  can be encrypted to any cipher text of length  $l$ .

There are some major practical difficulties with this scheme. First, the recipient must have previously received the key, which is as large as the message. Second, the key must be chosen completely randomly [3] [4].

To overcome these difficulties in practice, cryptographers try to come up with a device or algorithm for generating a long seemingly random binary string of bits using only a small random string  $S$  (called the "seed"). Then the sender and

receiver only need to agree on the seed, which they can exchange using public-key cryptography.

The Linear Feedback Shift Register consists of clocked storage elements (known as flip flop) and feedback paths, The LFSR is successively connected in a flip flop configuration with feedback from contents some flip flops output (taps) that XOR together and the result is feedback into a register input as shown in Figure 2.1.

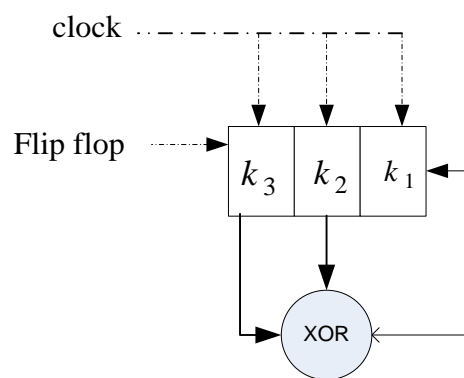


Figure 2. 1 LFSR of degree 3

The length of register and positions of taps depend on a so-called primitive polynomial. For instance, if the primitive polynomial was  $x^3 + x^2 + 1$ , then the register would be composition from 3 (the highest exponential of primitive polynomial) flip flops and the positions of taps would be 3 and 2 in register sequence as shown in figure above. Usually, there are  $(2^n - 1)$  possible binary states that are produced from LFSR until the start set (called the seed of LFSR) repeats, where n is the length of LFSR [5].

The following table lists maximal-length polynomials for shift-register lengths up to 24. More than one maximal-length polynomial may exist for any given shift-register length.

Bits (n)	Feedback polynomial	Period ( $2^n - 1$ )
2	$x^2 + x + 1$	3
3	$x^3 + x^2 + 1$	7
4	$x^4 + x^3 + 1$	15
5	$x^5 + x^3 + 1$	31
6	$x^6 + x^5 + 1$	63
7	$x^7 + x^6 + 1$	127
8	$x^8 + x^6 + x^5 + x^4 + 1$	255
9	$x^9 + x^5 + 1$	511
10	$x^{10} + x^7 + 1$	1,023
11	$x^{11} + x^9 + 1$	2,047
12	$x^{12} + x^{11} + x^{10} + x^4 + 1$	4,095
13	$x^{13} + x^{12} + x^{11} + x^8 + 1$	8,191
14	$x^{14} + x^{13} + x^{12} + x^2 + 1$	16,383
15	$x^{15} + x^{14} + 1$	32,767
16	$x^{16} + x^{15} + x^{13} + x^4 + 1$	65,535
17	$x^{17} + x^{14} + 1$	131,071
18	$x^{18} + x^{11} + 1$	262,143
19	$x^{19} + x^{18} + x^{17} + x^{14} + 1$	524,287
20	$x^{20} + x^{17} + 1$	1,048,575
21	$x^{21} + x^{19} + 1$	2,097,151
22	$x^{22} + x^{21} + 1$	4,194,303
23	$x^{23} + x^{18} + 1$	8,388,607
24	$x^{24} + x^{23} + x^{22} + x^{17} + 1$	16,777,215

Table lists maximal-length polynomials for shift-register lengths up to 24



In a stream cipher, the LFSR is seeded with a random binary seed is called as mentioned above, the secret key ( $k_i$ ) where  $i=1,2,\dots n$ . According to the above primitive polynomial, the  $k_3$  will XOR with  $k_2$  and the resulting output will be input to LFSR. Therefore, the right content of LFSR is shifted one bit to the left. Assume the secret key is  $k_3 = 0, k_2 = 1, k_1 = 0$ . The table 2.2 gives the sequence state of LFSR after clocking. [3]

Initial state	clock	$k_3$	$k_2$	$k_1$
Secret key	0	0	1	0
	1	1	0	1
	2	0	1	1
	3	1	1	1
	4	1	1	0
	5	1	0	0
	6	0	0	1
	7	0	1	0

Table 2.2 Sequence states of LFSR of degree

The main drawback of LFSR is its linearity weakness that the each bit in a LFSR sequence is linearly related to the initial state, (i.e. the initial state is easily deduced from some of the later bit in the LFSR bits sequence), and is thus vulnerable to algebraic and correlation attacks.

Since there are only  $2^n$  possible states for the LFSR, it is obvious that whatever initial state is specified, the LFSR must eventually repeat. It is not quite as obvious that it must return to its initial state, and if we did not assume  $c_n = 1$  this would not be true. For instance, the initial state  $(0, 0, \dots, 1)$  would drop into the zero state. We will soon see that if  $c_n = 1$ , the LFSR will always return to its

initial state. If the initial state is the zero vector, then the LFSR will remain in that state forever, so we exclude that from consideration. Consequently, the maximum number of steps before the LFSR returns to its initial state is  $2^n - 1$ . Given a seed  $s$ , the period of  $s$  is the number of steps it takes to return to  $s$ ; the period is the smallest positive  $r$  such that  $x(r) = s = x(0)$  [6].

In computing, a linear-feedback shift register (LFSR) is a shift register whose input bit is a linear function of its previous state. The most commonly used linear function of single bits is exclusive-or (XOR). Thus, an LFSR is most often a shift register whose input bit is driven by the XOR of some bits of the overall shift register value.

LSFRs are used in cryptography for pseudo-random number generation, pseudo-noise sequences and whitening sequences. They are also often used for digital counters because they are so fast.

LFSRs (linear feedback shift registers) provide a simple means for generating consequential lists of numbers quickly on microcontrollers. Generating the pseudo-random numbers only requires a right-shift operation and an XOR operation. Finally, LFSRs can be implemented in hardware, and this makes them useful in applications that require very fast generation of a pseudo-random sequence, such as direct-sequence spread spectrum radio. LFSRs have also been used for generating an approximation of white noise in various programmable sound generators.

## **2.1 The electronic structure of the LFSR**

The electronic structure of the LFSR circuit is shown as follows:

An LFSR is a shift register that, when clocked, advances the signal through the register from one bit to the next most-significant bit (see Figure 2.2). Some of the outputs are combined in exclusive-OR configuration to form a feedback mechanism [3]. A linear feedback shift register can be formed by performing

exclusive-OR on the outputs of two or more of the flip-flops together and feeding those outputs back into the input of one of the flip-flops as shown in Figure 2.3.

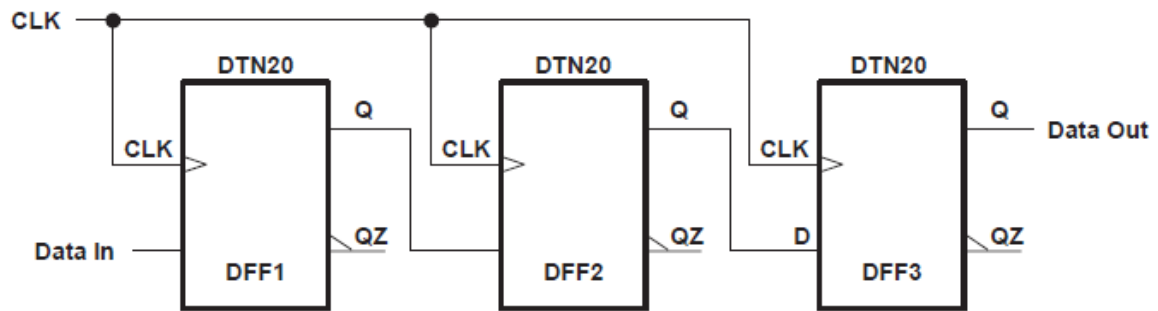


Figure 2. 2A 3-Bit Shift Register

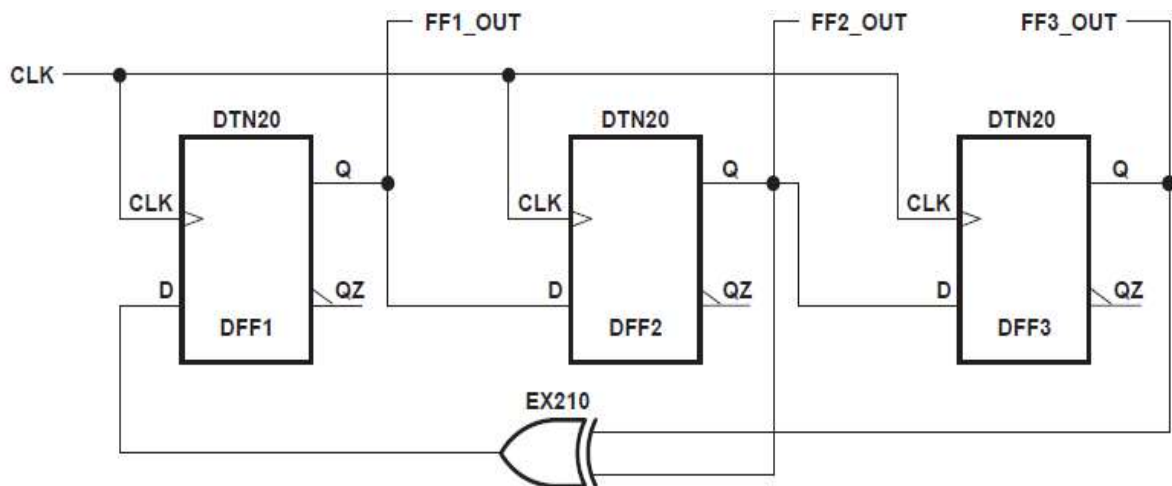


Figure 2. 3Linear Feedback Shift Register

Linear feedback shift registers make extremely good pseudorandom pattern generators. When the outputs of the flip-flops are loaded with a seed value

(anything except all 0s, which would cause the LFSR to produce all 0 patterns) and when the LFSR is clocked, it will generate a pseudorandom pattern of 1s and 0s. Note that the only signal necessary to generate the test patterns is the clock.

As discussed previously, a maximal-length LFSR produces the maximum number of PRPG patterns possible and has a pattern count equal to  $2^n - 1$ , where n is the number of register elements in the LFSR. It produces patterns that have an approximately equal number of 1s and 0s and have an equal number of runs of 1s and 0s. [7]

Because there is no way to predict mathematically if an LFSR will be maximal length, Peterson and Weldon[2] have compiled tables of maximal-length LFSRs to which designers may refer. Table 2.3 shows the patterns produced by the LFSR in Figure 2.3, assuming that a pattern of 111 used as a seed.

CLOCK PULSE	FF1_OUT	FF2_OUT	FF3_OUT	COMMENTS
1	1	1	1	Seed value
2	0	1	1	
3	0	0	1	
4	1	0	0	
5	0	1	0	
6	1	0	1	
7	1	1	0	
8	1	1	1	Starts repeat

Table 2.3 Pattern-Generator Seed Values

## Chapter 3

### Proposal to securer image transmission based LFSR

As mentioned earlier, the traditional block ciphers are less efficient/suitable than stream ciphers for image/video encryption in constrained environment. Therefore, in this approach the LFSR is used for ciphered image as stream ciphers.

#### 3.1 The encryption scheme

The main weakness of LFSR ciphers is their linearity, which leads to a relatively easy cryptanalysis. A common solution to this linearity weakness of LFSR is to destroy the linearity properties of LFSR. A5 is a stream cipher used in GSM to provide secure communication during conversation via mobile phones. A5 uses three LFSRs with different taps and length as shown in Figure 7.4. LFSR1 has length 19 bits with four taps: bit 13, 16, 17 and 18, while LFSR2 and LFSR3 have length 22, 23 bits with taps 21, 20 22 and 21, 20, 7 respectively. The middle bit from each LFSR represents the clocking bit, as shown in red colour in Figure 3.1. When the LFSRs are clocked, their taps will be XORed to produce next Least Significant Bit (LSB).

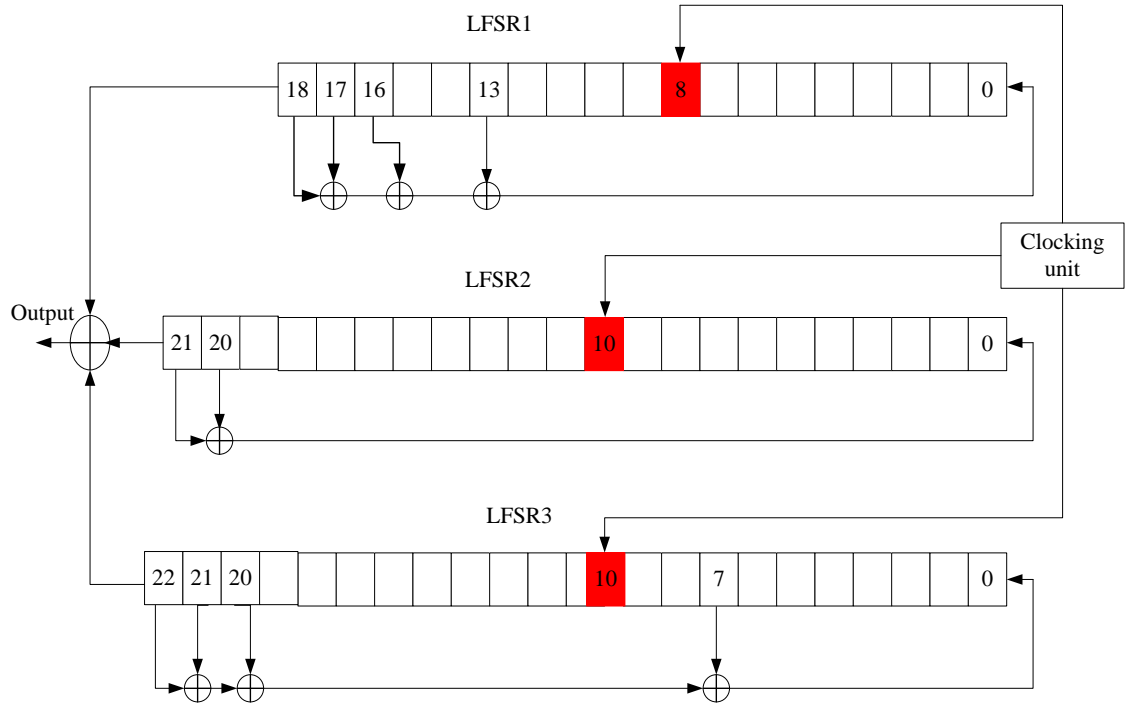


Figure 3. 1 illustrates the A5 structure

The A5 cipher solves the linearity weakness by applying irregular clocking of the LFSR to the cryptosystem.

Considering the linearity weakness of LFSR, here we follow the A5 stream cipher and use a number of LFSRs, with three secret keys applied in three rounds on the image. This combination will increase the security level of the used encryption method without significantly increasing processing time. This method is shown in Figure 3.2.

In the first round, the image is divided into blocks of 8x8. The resultant blocks are arranged in code book and then scrambled using a certain LFSR supported by a secret key (Key1). All scrambled blocks will be put back into their original places.

In the second round, the image that produce from first round is dividing it into 8x8 blocks. In this round all will be scrambled again using a second LFSR with secret key (Key2). For a second time, all scrambled blocks will be put back into their original places.

The final round will use a different block sub-division (16x16) with the initial LFSR set to a third secret key (Key3). As described in previous chapter in stream cipher, the pseudo random generated by LFSR depending on the initial secret key. Therefore, we used secret key 3 with LFSR1 to generate pseudo random different from numbers produced in round one. As a result, the security level will be increased against algebraic and correlation attacks.

This method will shuffle the significant information located in image in different forms and distribute it in the entire image. This makes re-shuffling the information of the image without knowing the secret key very time consuming, particularly in the case of video streaming.

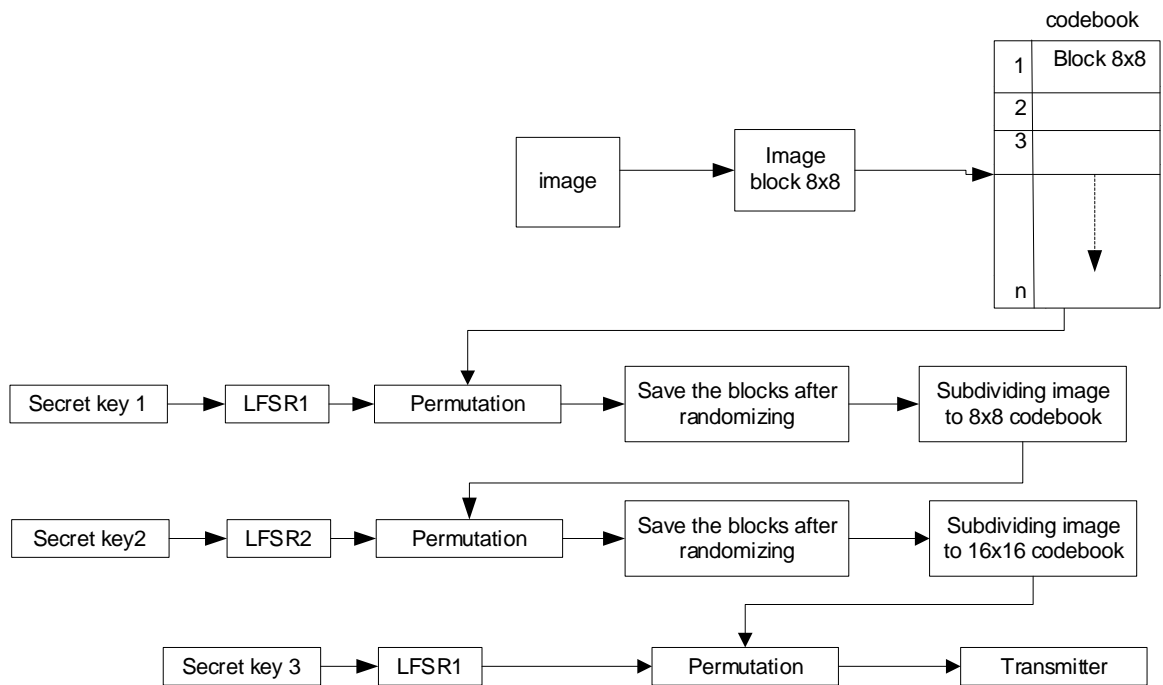


Figure 3. 2 Illustrates the Encryption scheme



## 3.2 Experimental and Analysis of Results

In this section, we shall evaluate the performance of the encryption scheme; the simulation of the proposed scheme is carried out using MATLAB V 9.4 (R2018a)

The proposed method applied on six different images of different nature, are shown in Figure 3.3. The image size is (256 x320) pixels. During our experiments, we converted all images to grayscale.

The encryption analysis was performed in three different ways; histogram analysis to assess the viability of any statistical attack; correlation analysis to assess the viability of frequency attacks, and the PSNR analysis to assess the availability of significant information left in the clear. These types of analysis have been used in [8], [9], and [10].

### 3.2.1 Histogram analysis

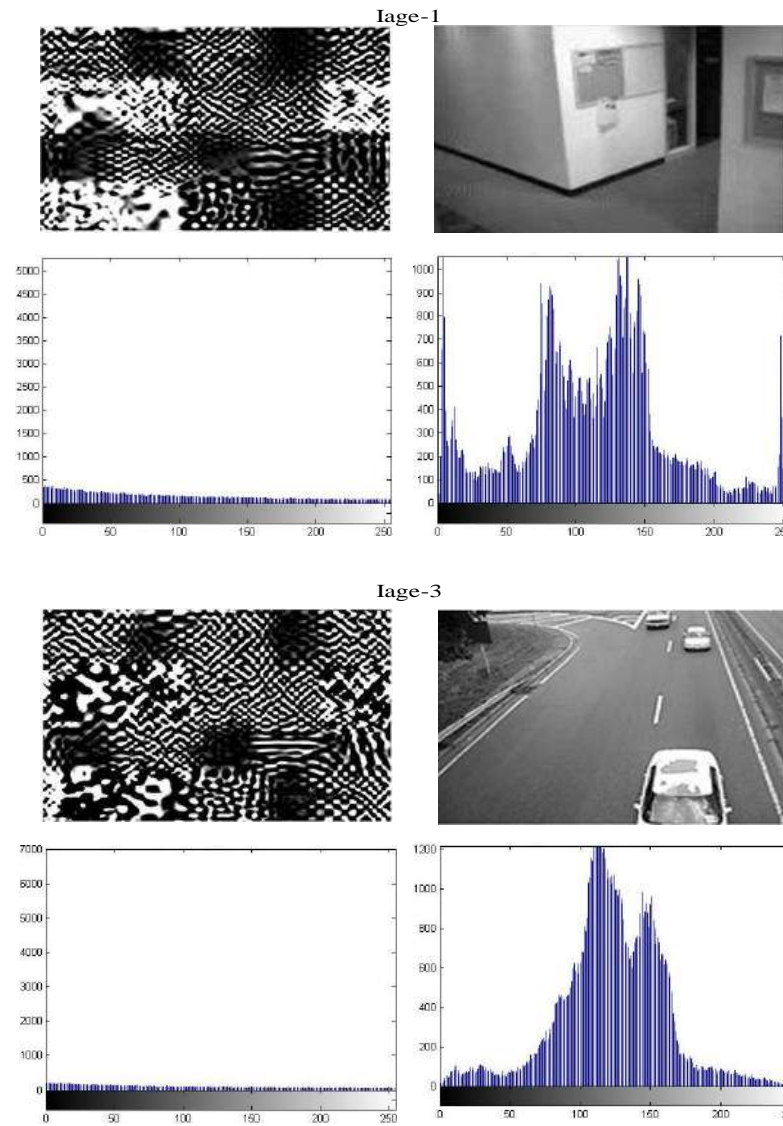
Figure 3.4 and Figure 3.5 shows images 1,3 and 6, the figure show the image after encryption and decryption and their corresponding histograms. In addition, we calculate the The Maximum Deviation Measuring Factor (MDMF) between the histogram of encrypted and unencrypted images.

The Maximum Deviation Measuring Factor (MDMF) is often used to estimate the quality of encryption scheme. The MDMF maximizes deviation between the histogram of original and that of the ciphered image. Generally, when the histogram of encrypted image is different from the histogram of the unencrypted image, the MDMF tend to increase. Therefore, when the MDMF is higher value, the ciphered image is deviated from the raw image and will

increase the complexity analysis of attacker to get significant information about original image.

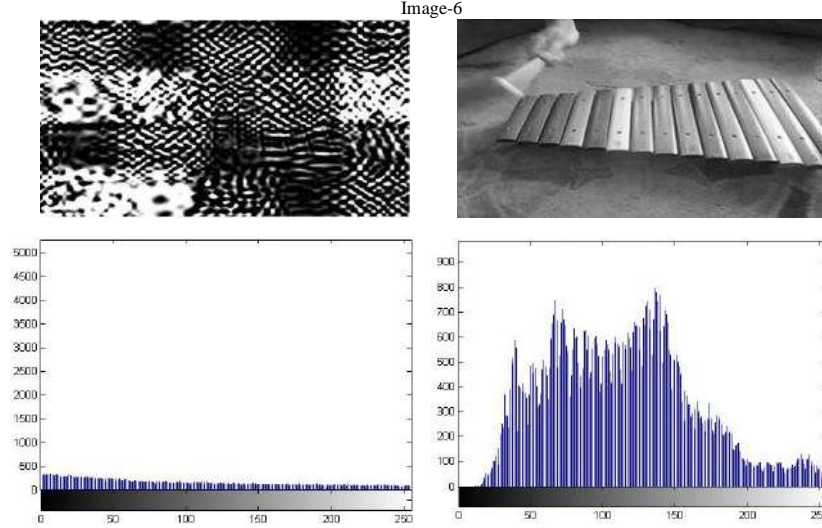


Figure 3. 3 shows images test



A1	A2
B1	B2
C1	C2
D1	D2

Figure 3. 4 (A1, C1) represents encrypted image, (B1, D1) represents histogram of encrypted image, (A2, C2) represents decrypted image, (B2, D2) represents histogram of decrypted image



A	B
C	D

Figure 3. 5 (A) represents encrypted image, (B) represents decrypted image (C) represents histogram of encrypted image, (D) represents histogram of decrypted image

The MDMF is measured and proved in [1] [11]. The MDMF is measure as follow;

1. Count the number of pixels of each gray scale value in the range 0 to 255 for both original and encrypted image (i.e. calculate the histogram distribution for original and ciphered image).
2. Calculate the absolute difference between the Histogram (HS) of original and ciphered image.
3. The MDMF is given in following equation;

$$MDMF = \frac{HS_0 + HS_{255}}{2} + \sum_{i=1}^{254} HS_i$$

Where,  $HS_i$  is absolute difference between the histogram of 'i' pixel in original and encrypted image,  $i=1, 2, \dots, 254$ . And  $HS_0, HS_{255}$  is the absolute difference between the histogram of zero and 255 in encrypted and raw image.

<i>image</i>	1	3	6
$HS_i$	42222	41656	43111
$HS_0$	30952	30524	29963
$HS_{255}$	13468	13749	14066
MDMF	64432	63793	65126

*Table 3. 1 the MDFM of some encrypted images*

The MDMF for this histogram shows in Table 3.1. The MDMF values showing that the ciphered images are different from the deciphered images. As result, the histogram of the encrypted image does not provide any information that can be used for any statistical attack.

### 3.3.1 Correlation analysis

Correlation ( $C_r$ ) is a measure of the relation between two variables. So, if the correlation between two variables is close to zero, then predicting their relationship becomes difficult. In order to evaluate the correlation between two adjacent pixels, in vertical and horizontal direction within the same image, 1000 pairs of horizontally and vertically adjacent pixels are selected randomly from the original and encrypted images. The correlation of the selected coefficients is then calculated by applying following formula.

$$C_r = \frac{N \sum_{j=1}^N (x_j \times y_j) - \sum_{j=1}^N x_j \times \sum_{j=1}^N y_j}{\sqrt{(N \sum_{j=1}^N x_j^2 - (\sum_{j=1}^N x_j)^2) \times (N \sum_{j=1}^N y_j^2 - (\sum_{j=1}^N y_j)^2)}}$$

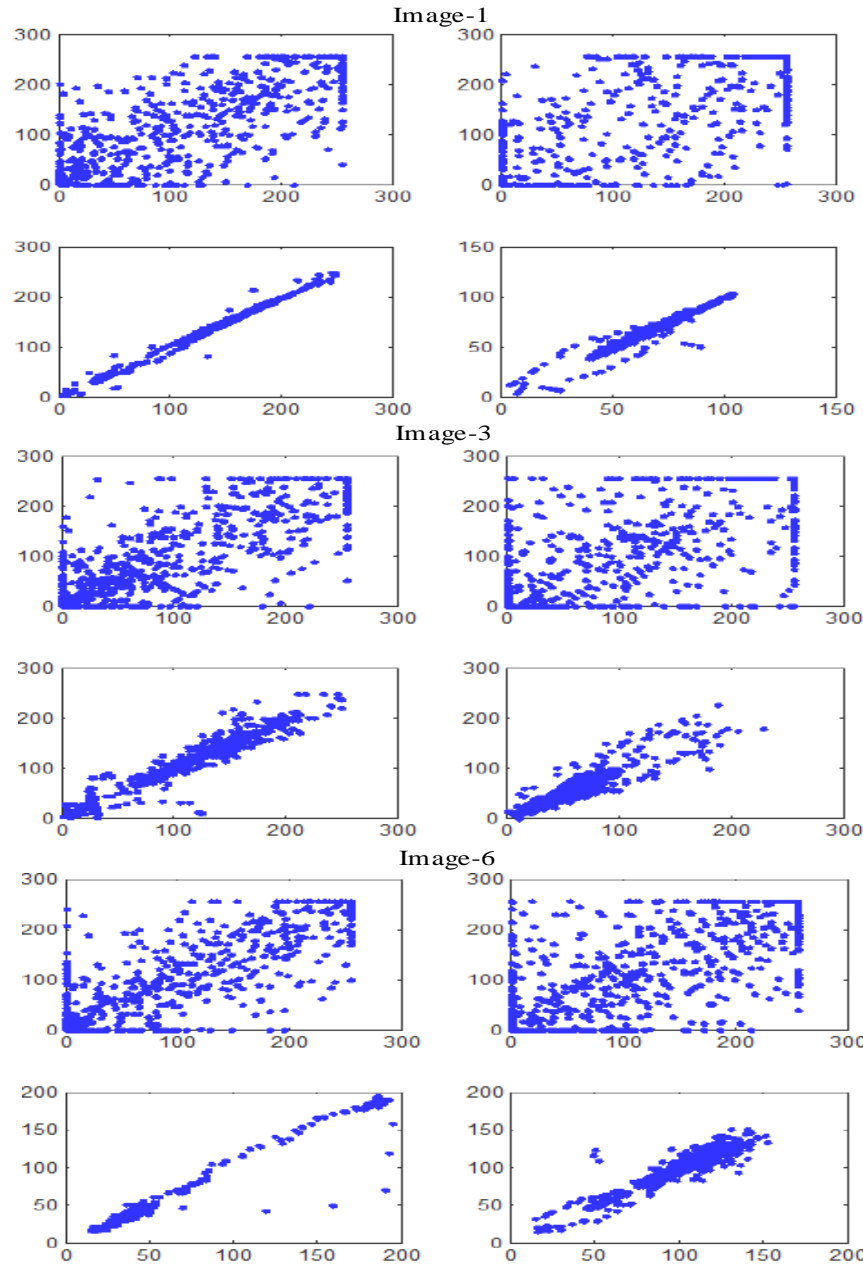
Where  $x$  and  $y$  are the value of two adjacent pixels,  $N$  is the total number of pixels in the image [12].

Table 3.2 shows that the correlation of the original image is 1 or close to 1. In contrast, the correlation of the encrypted image is close to 0.


Image	Encrypted image		Original image	
	Correlation coefficient		Correlation coefficient	
	Horizontal	Vertical	Horizontal	Vertical
1	-0.0014	- 0.018	-1	-1
2	-0.0059	- 0.0052	-1	-1
3	-0.005	- 0.0011	0.999	0.989
4	-0.0066	- 0.0012	-1	-1
5	-0.0061	- 0.00124	-1	-1
6	-0.0022	- 0.0012	0.998	1

*Table 3.2 the Correlation coefficient of adjacent pixels*

The scattered plots of the correlation of neighbouring pixels in the original and the encrypted images are shown in Figure 3.6. It can be seen that neighbouring pixels in the encrypted image are of low correlation. In contrast, the correlation of neighbouring pixels values in the original image was around 45° diagonal line, which indicates that two neighbouring pixels are highly correlated.



A1	A2
B1	B2
C1	C2
D1	D2
E1	E2

 Figure 3. 6 illustrates the correlation of two adjacent pixels in the encrypted and decrypted images, (A1, C1, E1) represent the correlation test in horizontal direction of the encrypted images in image 1,3 and 6 respectively, (A2, C2, E2) represents correlation test of encrypted image in vertical direction, (B1, D1, F1) and (B2, D2, F2) represents the correlation test for decrypted image in the horizontal and vertical direction respectively.

### 3.4.1 PSNR analysis

Peak signal to noise ratio is commonly used as the objective measure to assess intelligibility of reconstructed image. In order to evaluate the performance of encoding scheme in, the Peak Signal-to-Noise Ratio (PSNR) is used as quality criterion. PSNR is driven from the Mean Square Error (MSE) and defined as:

$$PSNR = 10 \log_{10} \frac{255^2}{MSE}$$

MSE between the two images X and Y is thus defined as:

$$MSE = \frac{1}{M \times N} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} (Y - X)^2$$

$M \times N$  is the image size.

Although the MSE is not a perfect criterion for the human vision system, it is still frequently used as a measure of the quality of recovered image.

Generally, when  $PSNR > 30\text{dB}$ , the quality of reconstruction is estimated as acceptable [8].



The mean and STD of PSNR for ciphered images are shown in Table 3.3. The low PSNR values reflect the difficulty in recovering the original image from the encrypted image, without knowing the secret key of encryption algorithm.

Images	STD	Mean
Image-1	0.4075	12.9150
Image -2	0.4338	14.7446
Image -3	1.2436	15.1161
Image -4	2.1767	13.1353
Image -5	0.3196	13.2366
Image -6	0.0569	13.2158

*Deviation (STD) of PSNR for encrypted images*

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### 3.5.1 Attack complexity analysis

In order to evaluate the encryption security level of our approach in terms of attack complexity, we computed the number of possible combinations of permutations and compared it with AES method with 256 bit keys  $\approx 10^{77}$ . The total number of possible combinations of block permutations constructed from image is  $3 \approx 10^{161}$  which is greater than the number of possible permutations of AES, thus making a brute force attack on the AES key more efficient than trying to reshuffle the scrambled blocks of our proposal encryption [13].

## Chapter 4

### Conclusion and Future Work

This section describes the conclusion of the research and some of achievements. In addition the possible futures work.

#### 4.1 Conclusion

A Linear Feedback Shift Register (LFSR) is a device that can generate a long seemingly random sequence of ones and zeroes, which is important in cryptography. In this research, the stream cipher proposed for image encryption. The encryption approach is based on pixels scrambling using two LFSRs . The raw image is divide into blocks 8x8 and code bock constructed. Then, the blocks are scrambling by LFSR 1. Next, the scrambled image is scrambling again by LFSR 2. Finally, the image is subdividing into blocks 16x 16 and scramble by LFSR1 with different secret key.

The encryption analysis includes histogram analysis, correlation analysis and PSNR. The security analysis shows that a cipher algorithm is secure from statistical analysis attack and frequency analysis attack.

## 4.2 Future Work

The future work will focus to improve the algorithms to image encryption based on selective encryption to reduce the computational time and implement Fibonacci LFSRs.

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**Dijlah University**  
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## **Protocol evaluation of video traffic over 4g network**

**A project submitted to the department of computer techniques engineering as a partial of the requirement to fulfillment the B.Sc. degree in the computer techniques engineering**

**By:**

**1-Anwar resan aoead**

**2-Ehab abd alrahman**

**3-Feras jafar tooma**

**4-Jafar huseen jafar**

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**Supervised**

**Dr. Sura khalil**

## **SUPERVISOR CERTIFICATION**

### **SUPERVISOR CERTIFICATION**

I certify that this Project entitled

**"Performance Evaluation of TCP,UDP and DCCP Traffic Over 4G Network"**

was prepared under my supervision at the Department of Computer Techniques Engineering, Dijlah University College - Baghdad, in partial fulfillment of the requirements for the degree of B. Eng. in Computer Techniques.

**Signature :**

**Name : Dr. Sura khalil**

**Date : 19/6/2021**

## **Abstract**

The fourth generation (English: 4G) is about the fourth generation in wireless communication technology, which was provided for the first time by the American company Sprint at the beginning of 2009 AD, and this technology has become available by most telecommunications companies in most regions of the United States American. The fourth generation technology is the newest technology than the third generation technology, and it is faster than it by up to 10 times, and the need for a faster technology has arisen due to the development of cellular and tablet devices and their need for fast communication technology, as these devices are now able to broadcast video and audio clips live. 4G is not available for all devices; It requires that the device used supports the ability to exchange data at a speed of 100 Mbps.

The aforementioned questions are crucial in the performance evaluation of the most famous protocols (particularly User Datagram Protocol (UDP), Transmission Control Protocol (TCP) and Datagram Congestion Control Protocol (DCCP)) within the 4G environment. Through the Network Simulation-3 (NS3), the performance of transporting video stream including throughput, delay, packet loss and packet delivery ratio are analyzed at the base station through UDP, TCP and DCCP protocols over 4G's Long Term Evaluation (LTE) technology. The results show that DCCP has better throughput and lesser delay, but at the same time it has more packet loss than UDP and TCP. Based on the results, DCCP is recommended as a transport protocol for real time video.

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# **Chapter one**

## **Introduction**

## 1.1 Introduction

The trend of 1G till 4G nowadays are the boiling connection over airwaves (Xue et al., 2014). The demand of the 4G has increased widely thought the most spread smart phone (Shukla and Khare, 2013), for example, I-phones and Samsung. Nevertheless, the performance of the multimedia stream will not completely fit the merit of end-user satisfaction. In the transport layer of the OSI model, User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) are the most recommended and widely used protocols (Abeta, 2010). However, both of them have a few performance shortcomings.

In UDP, the transmission is unreliable due to the lacking of acknowledgment for received data stream. In contrary, in TCP, the transmission is more reliable at the expense of the time cost. To achieve a kind of trade-off clogging control system with reasonable conveyance is needed. The existing transport protocols, e.g., UDP, TCP and DCCP (Datagram Congestion Control Protocol), do not propose a generic solution to the said dilemma. The functional drawbacks distributed among the above protocols is Lack of 4G performance, especially, when DCCP transport video such as MPEG-4 over transport layer (Varet and Larrieu, 2014). Therefore, in this study we will study the analysis and will compare the Internet protocols which are used for streaming video, such as MPEG-4 over LTE infrastructure technology to show the strength and weakness of DCCP, TCP and UDP by simulating it in the latest NS3- repository and gives the intensive results based on simulations each protocol spread.

The main scope of this research is to compare three important protocols - UDP, TPC and DCCP based on four metrics, i.e., Delay, Packet loss, Packet delivery ratio and throughput. After that we will design a separate three main scenarios for each protocol based on selected metrics with coverage. Then, we expect through our result to see that which protocol will perform better than other, especially, when there are payloads through MPEG-4 over slandered LTE station

## **1.2 Work Motivation**

This Project is significant because we can study the effectiveness of the 4G through video traffic stream, especially the delay and video transmission time. The performance of DCCP, TCP and UDP protocols will be studied, supporting to determine which one is better in 4G environment. In fact, the vast majority of people nowadays have used smart phone and they are defiantly looking for 4G supportive devices. Then, they will search the performance of the video payload. Therefore, our study will evaluate the video traffic and will reveal that which protocol will be more useful for the 4G Smart phones and their applications. However, the vast studies emphasis its performance separately

A payload video traffic would cause video latency, or even lost 4G signaling in some cases. Then, the advantages of MPEG4 are slightly reducing the traffic. But, what about the other holding protocols that MPEG4 went through 4G LTE. Therefore, we have evaluated UDP, TCP and DCCP protocols. Also we have provided a comparison study of all UDP, TCP and DCCP traffic over transport layer by sending MPEG4 video over 4G network.

# **Chapter Two**

## **Literature Review**

## 2.1 Literature Review

Japan had invented the cellular communication system in late 1970s and it was the main paradigm in that time (Bamidele Moses, 2014). While 4G is the name to port generation of wireless technologies. Moreover, the mobile devices that the user used to communicate with each other like telephone calls, emails, Internet access and GPS signals are using these networks. These technologies are faster and have more mobility than the old wired network technologies (Shukla *et al.*, 2014). However, in 1980s, a modern a faster analog telecommunication was brought for the wireless technologies at that time.

Then, with the modernization of cellular network generations starting from 0G to 4G, have distributed widely for new telecommunications world. Nevertheless, the para of mobile telephone services can be characterized as: Mobile Telephone Service, IMTS (Improved Mobile Telephone Service) AMTS (Advanced Mobile telephone System) (Rumney, 2013). While, in the range of 28Kbit/s to 56Kbit/s it would be the speed performance for the 1G. However, from 2.9KB/s to 5.6KB/s. 2G is the actual standard downloads speed (Shukla and Khare, 2013) technologies allow network operators to offer customers a wider variety of more cutting facilities for attaining better network, can be improved via spectral efficiency.

On the other hand, IEEE 802.11 (Wi-Fi and WLAN), 3G covers a wider area with high bit rate. The speed is up to 5.8Mbit/s in the uplink and 14.4Mbit/s in the downlink. UMTS (Universal Telecommunication CDMA 2000, W-CDMA (Wideband EDGE (Mobile Enhanced Data Rates for GSM Evolution) and WIMAX (Worldwide Interoperability for Microwave Access) are main standards in 3G 2000). However, 3.5G includes HSDPA (High 11(10): 1048-1057, 2015 1049 formance yload d . icate emails, . and paradigm ance 2013). 3G

cutting-edge where capacity System), Wideband-CDMA), GSM (Garg, . High-speed Downlink Packet Access) up to 8 downlink. 3.75G is HSUPA (High-speed Uplink Packet Access) up to 1.4Mbit/s in the uplink 2002). Nonetheless, in 2006 it came out with the emergence of 3G. Then, after four years pre had come out (Dzebo and Mutapcic, 2013) LTE has bright later three years (Long Term Evolution) and it has been more significant. Because of this the coverage of LTE is more friendly and established.

Fourth Generation blankets over billions of supporters overall or more than 80% of the worldwide versatile business sector (Dahlman However, the number of worldwide subscribers, in 2008, utilizing High-Speed Packet Access (HSPA) networks surpassed 70 million (Khan, 2009) HSPA is a 3G evolution of GSM that supports high speed data transmission by means of WCDMA technology. While the global use of HSPA technologies among clients and businesses have accelerated, representing continuous traffic growth for high mobile networks worldwide. Where are proceeding in the 3G Partnership Project (3GPP) to create a novel criterion for the development of GSM/HSPA technology towards a packet method known as LTE with the intention of meeting the continuous demands in the Internet traffic Jones, 2014).

The main purpose of the LTE standard is to design plans for a new radio-access technology that can suitably handle higher data rates and is beneficial for low latency and better spectral efficacy However, the spectral efficacy target for the LTE scheme is three to four times more than the existing HSPA scheme (Shukla and Khare, 2013) uncompromising spectral efficacy targets need to push the technology envelope by using advanced air interface mechanisms, for example, low orthogonal uplink multiple access based on the Multiple-Input Multiple Output (MIMO), Single Carrier Frequency Division Multiple Access (SC FDMA), inter-cell interference mitigation methods, multi-antenna technologies, low latency structure and Single-

Frequency Network (SFN) broadcast (Khan, 2009). For the wireless, broadband data speed transaction, Fig. 1 explained how the wireless data transfer grows from 384 kbps till LTE.

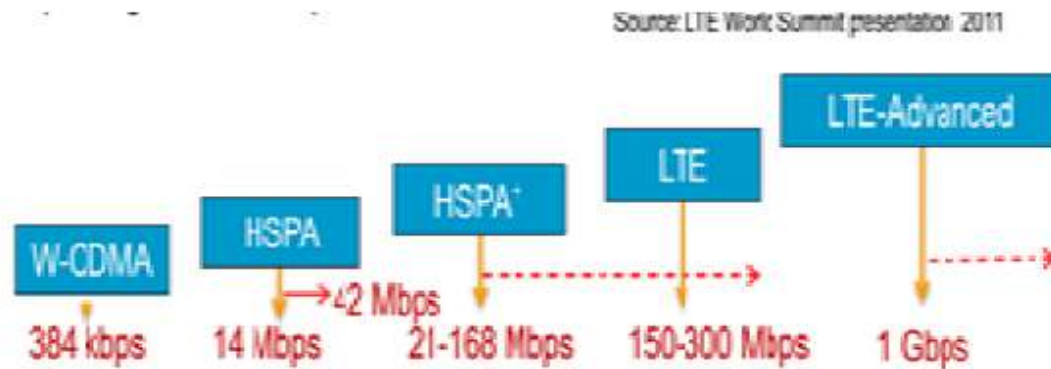


Fig. 1: The grown of the telecommunication

Table 1: Services and features provided by TCP, UDP and DCCP

Features and services	TCP	UDP	DCCP
Reliable	Yes	No	No
Connection-oriented	Yes	No	Yes
Congestion control	Yes	No	Yes
Sequence number	Yes	No	Yes
Message-oriented	No	Yes	Yes

testing, explaining the performances over previous survived data (Ramli *et al.*, 2014). transport layer are DHCP (Lemon et al., 2002), RIP (Hedrick, 1988) and VoIP (Goode, 2002) etc.



# **Chapter Three**

## **Methodology**

### **3. Methodology**

#### **3.1 Transport layer protocols for multimedia applications**

The services and features of some transport layer protocols, i.e., UDP, TCP and DCCP are shown in Table 1, all of them have their own features and relevance for particular application under specific environments.

#### **3.2 Transmission Control Protocol (TCP)**

TCP is another IPS core protocol that functions well when two end-systems at a higher level interact. However, the stream of bytes provides packet reliability through TCP (Verma and Dhawan, 2014). Whereas, this protocol also performs some management tasks, such as controlling rate and message during regulating traffic congestion and communication.

TCP acts as a transport layer that hides the underlying systems administration points of interest from correspondence provisions. One of the best cases of TCP applications is the web browser (Vetro *et al.*, 2011). Then, other common main applications include, web server, e-mail and file transfer.

#### **3.3 User Datagram Protocol (UDP)**

The UDP has structured by Postel (1980) and it considers the backbone for the Internet Protocol Suite (IPS) (Alferness *et al.*, 1997). However, the protocol does not have the ability for the handshaking mechanism to guarantee packet reliability, data integrity and packet ordering. UDP is a connection-less protocol working on transport layer (Zheng and Boyce, 2001).

The header size of UDP protocol is 8 bytes including the fields source port address, destination port address, Length and checksum. All fields are of 16 bits i.e., 2 bytes each. It is unreliable due to the lack of acknowledgement in the data transfer. Thus, an application program running

over UDP should deal precisely with the issues of end-to-end communication that a connection-oriented protocol would have managed.

These issues may be any of the re-transmission for consistent delivery, flow control, packetization and reassembly and congestion control etc. It is fast due to no connection establishment and tear down phase. So it is much suited for small applications which do not need reliable connection. The most common use of UDP is in DNS services. To get the IP address for a requested URL from DNS, UDP is used as a transport layer protocol. Other application layer protocols which use UDP as a carrier protocol on transport layer are DHCP (Lemon *et al.*, 2002), RIP (Hedrick, 1988) and VoIP (Goode, 2002) etc.

Nevertheless, Time-sensitive and Real-time applications, for example, video traffic and voice, are using UDP due to the dropping packets, which preferable to delayed ones. Owing to the stateless nature of UDP, network applications, such as Trivial File Transfer Protocol and online games, also use it as a transport protocol (Edelman *et al.*, 2007).

### **3.4 Datagram Congestion Control Protocol (DCCP)**

The DCCP is a convention of the transport layer with dependable association setup, blockage control and characteristic transaction competence (Kohler *et al.*, 2006). However, the primary configuration goal and broadening over the conventional UDP is the affirmation of blockage control for datagram streams. At that point, DCCP has a scheduled outline that divides the focal part purpose of the convention from the usage of the blockage control instrument.

DCCP is envisioned for multimedia functions, for example, streaming media which can be assisted from manipulation over the adjustments between delay and reliability in-order delivery. TCP may not be suitable for these applications because congestion control and reliability in-order delivery can result in arbitrarily long delays.

UDP can avoid long delays, but for congestion control the governing application will have to deal on its own. DCCP provides built-in congestion control, including ECN support, for unreliable datagram flows, avoiding the arbitrary delays related with TCP. A DCCP feature is a connection quality on whose value the two endpoints make agreement. Several advantages of a DCCP association are coordinated by characteristics, for example, congestion control mechanism in use on the two half-connections. The endpoints attain the arrangement in the course of option of exchange negotiations in DCCP headers.

The primary uses of DCCP protocol are round-trip time occasionally, such as in the initial values for the certain times. DCCP round-trip time measurements are performed by congestion control mechanisms. According to RFC793, DCCP implementations follow TCP's general principle of robustness, i.e. "Be conservative in what you do, while be liberal in what you accept from others". DCCP is a transport layer protocol that deploys unicast, bidirectional connections of congestion-controlled and unreliable datagrams.

### 3.5 Simulation Setup and Metrics

We have used Linux Ubuntu 12.04 as operating system, because the Network Simulation 3 (NS3).

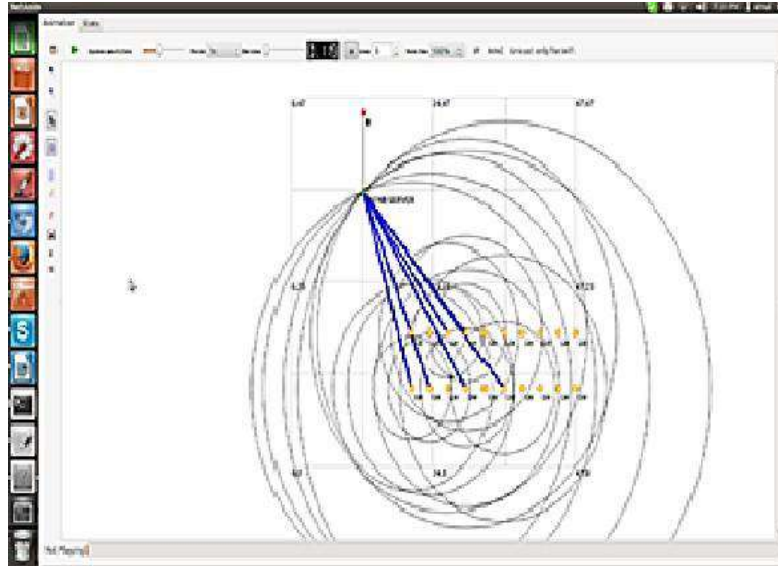


Fig. 2: Transmission between eNB server and ue nodes

(Henderson et al., 2006) works with high efficiency in Linux environment than other operating system. And the hardware computer CPU is core I5 with memory size 4 Gigabyte. Our scenario is connected to a number of nodes Ue with one base station eNB. Then the base station connect to server node as point to point. Just to read the network performance from server node.

Besides, we have implemented visualization graph for that scenario using NetAnim tool as shown in Fig. 2. The main traffic metric that is used for the LTE network by using UDP, TCP and DCCP protocols are:

### **3.5.1 Throughput**

Defines the rate of something can be processed; it means in the network, the amount of effective message delivery over a communication channel, perhaps the delivery over a physical or logical link (Chughtai et al., 2009). Throughput is usually measured either bits per second (bit/s or bps), or data packets per second (p/s or pps). It refers to the performance of network, as shown in the Eq. (1)

$$\text{Throughput} = \text{Number of received packets} / (\text{last packet sent time} - \text{first packet sent time})$$

(1)

### 3.5.2 Packet loss

For one reason or another, the packets are dropped from node. This causes unreliable delivery in the network. If a user has something which is less than the complete success in transmitting and receiving packets then packet loss is happened. It can require much slower download and upload speeds, reduced quality VoIP audio, pauses with streaming media. Packet loss is a metric where anything greater than 0% should cause concern. Moreover, packet loss happens in the wireless network more than the wired network because of sharing media among nodes 2009; Alubady et al., 2015) Eq. (2):

$$\text{Packetloss} = \Sigma \text{ packets send} - \Sigma \text{ packets received} \quad (2)$$

### 3.5.3 Packet delivery ratio

It is referred to the number of packets effectively delivered to an endpoint as compared to the amount of packets that has been sent out by the sender (Alubady et al., 2015) the total number of arrived packets is divided by the total number of sender packets. See Eq. (3):

$$\text{PDR} = \Sigma \text{ Total number of received packets} / \Sigma \text{ Total number of send packets} \quad (3)$$

### 3.5.4 Delay

This metric is also important to check network performance. Let explain how by instance, with a live audio stream, it is far imperative to send recent packets quickly than to assure that stale packets are finally sent. Some of the protocols give high priority delivery guaranty and do not care about the real time delivery. Such a network might use control protocol for congestion management, adding even more complexity, as a consequence give more

delay 2009). Delay is the time faced by a packet to move or travel across the network from one node to another. See the Eq. (4):

$$\text{Delay} = T_r - T_s \quad (4)$$

where, 'Ts' is the sending time of a particular packet and 'Tr' is receiving time of that packet. Mean delay average delay computed using the relation shown in Eq. (5):

$$\text{Mean Delay} = \text{Total delay} / N \quad (5)$$

where, 'N' is the total number of packets received during simulation time.

### **3.6 Experimental And Results With Discussion**

In this research, we show the results of TCP, UDP and DCCP protocol using NS3. NS-3 supports a graphical tool gnuplot. All the graphs are generated by gnuplot to show the results of NS-3 simulation for each protocol. We give the graphical analysis of the protocol performance metrics like delay, throughput, Packet Delivery Ratio and packet loss.

We have shown previously that the network topology consists of three parts. The mobile unit call (Ue) which is communicating directly with base station, the Base Transceiver Station (BTS) also calls Evolved Node B, (abbreviated as eNodeB or eNB) and the end terminal which is server in our scenario. This server receives the packets from mobile units. In order to measure network performance we have created three different scenarios 10 Ue, 20 Ue and 30Ue connect directly to one eNB and the eNB connected to server node.



### **3.6.1 Network performance measurement**

Most importantly, through our research, we have found that there are two research questions here. Why the number of nodes (Ue) 10, 20 and 30 Ue specifically. And what is the effect of the different distance between nodes (Ue) and base station (eNB). These are so important questions that the researcher must be concerned about them, especially when design the topology and write code. Therefore to be more fairly, we have implemented easy and dynamic C++ code that could help us to find the answers for those questions. So inside the code we have changed the number of nodes for several different numbers. We have taken (5 nodes, 8 nodes, 10 nodes 16 nodes... etcetera) as a different program running scenario in the end we have got different results. After that we have studied there are different results by analysis and compare. Then we have ignored all the similarity result from our research.

Therefore we have chosen the (10 20 and 30) nodes. We have implemented also different scenarios based on different distances. The second question regarding the impact of the distance on the network performance. The distance from Ue to eNB is (50, 100, 150 and 250 m). But we have discovered that different distance does not affect so much of the network performance. That is why we ignored.

### **3.6.2 Comparison analysis for throughput**

One of the main solutions to improve the performance of the new wireless communication systems is by improving the protocols used over these networks such as UDP, TCP and DCCP protocols. This section investigates the comparative performance of UDP, TCP and DCCP protocols over LTE systems by using the throughput metric. The throughput in the network refers to the rate of successful message delivery over a communication channel, perhaps the delivery over a physical or logical link. The measurement unit of

throughput is usually either bits per second (bit/s or bps), or data packets per second (p/s or pps).

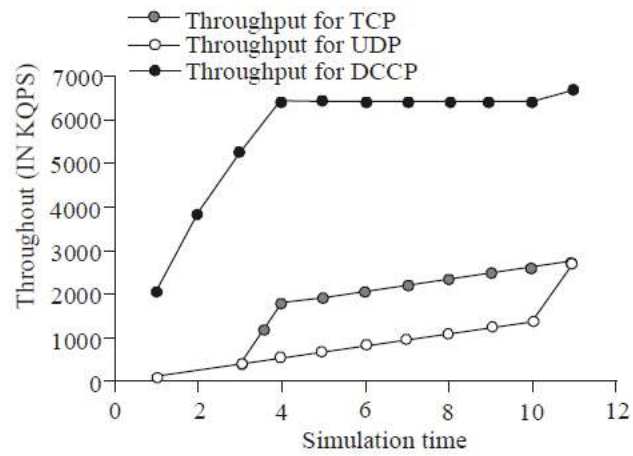


Fig. 3: Throughput of TCP/UDP/DCCP for 10 nodes

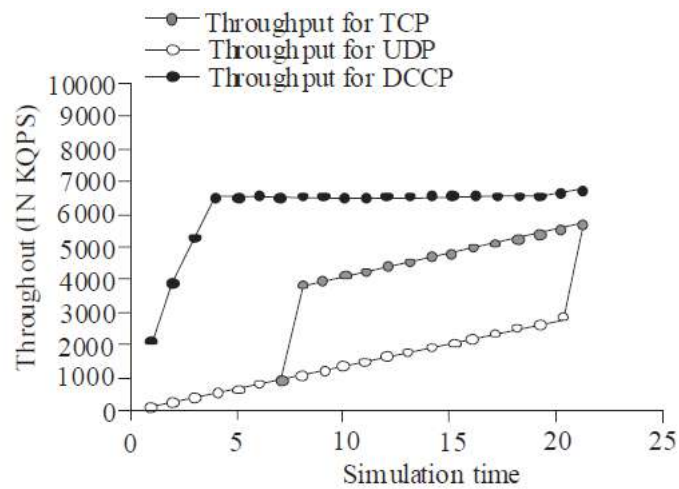


Figure 3 shows that the DCCP protocol has a good throughput in the environment of the LTE network of 10 nodes. The scenario here supposes all 10 nodes send file video at a same time to the server. If we increase the number of nodes in the LTE network, for instance, let suppose 20 nodes, then still the DCCP protocol is better than other protocols as the results showed in Fig. 4. All these results are taken from NS3 simulator, which is already valid and we have made the node number as 30 nodes. The result is shown in Fig. 5. Furthermore, here as the number of nodes increases the throughput of complete network will get improved.

The consistent growth of graph shows that the network is capable to handle all these nodes number. To get the peak performance, there is no bottleneck up to this limit of node numbers. The value of throughput is given in kbps. As the nodes increase the throughput grows too high. From the total throughput result, as the number of nodes increases the throughput gets double approximately from 2805.15 to 5593.25 Kbps. The DCCP protocol has good throughput because it uses congestion-controlled schemes with Explicit Congestion Notification. DCCP provides with two diverse congestion control techniques containing TCPLike and TCP friendly rate control. Also DCCP provides less delay. DCCP supports delay-sensitive streaming over UDP without TCP's delay inducing reliability. Moreover, the TCP protocol is suitable for wire connection not adaptive or designed to work in the wireless environment. Therefore the TCP's disadvantage protocol has been overcome by new protocol (DCCP) which is adaptive and design for wireless environment.

### **3.6.3 Comparison analysis of delay**

Delay is one of the important metrics to check network performance. Before we proceed further, let us explain how by instance, with a live voice stream, it is more vita to send recent packets faster than to assure that stale packets

are finally sent. Some of protocols give high priority for packet delivery guarantee. And do not care about the real time delivery, such as TCP protocol. In the end the congestion management, adding even more complexity, as a consequence gives more delay. So for that reason the TCP protocol has long delay time. As shown in the Fig. 6.

The DCCP protocol has best result because the delay time is less than the other protocols. This result is for 10 nodes. Again, all these are node sending file stream video at a same time to reach the server. The server must be behind the eNB. Figure 6 and 7 show the result for 10 nodes and 20 nodes, respectively. We see the result is a same except in the beginning of figures for UDP and TCP protocols. The small difference is that the TCP protocol needs at the beginning more time to establish the connection. Also, this establishment of connection affects the number of nodes. To be fair, the DCCP protocol also has good result with 20 node scenario.

Compared to all three scenarios for Average Delay time for TCP, UDP, DCCP, the UDP protocol shows consistently more delay due to connecting less flow of the data over the network. In TCP, first the delay is more during the connection establishment phase, but once the connection has been established, TCP increases its window size delay drops sharply in the data flow as shown in the diagram. And DCCP outperforms these both conventional connection-less and connection-oriented protocols in case of delay. Comparative Analysis of TCP/UCP/DCCP protocols for 30 node scenario shows that the DCCP protocol is the best protocol regarding to delay time. Figure 8 shows the results for the 30 node scenario. Because the number of nodes increases definitely the time delay also increase. This increase happens more in the wireless than wire because the layer two in the wireless needs acknowledgement (ACK) the RTS/CTS as well as layer three (ACK). Besides, wireless network uses media share not like wire.

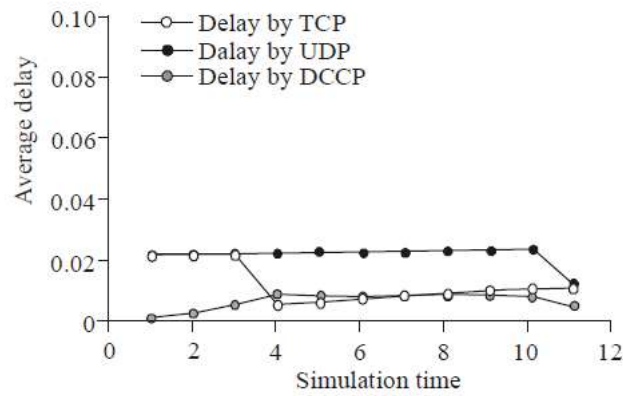


Fig. 6: Average delay of TCP/UDP/DCCP for 10 nodes

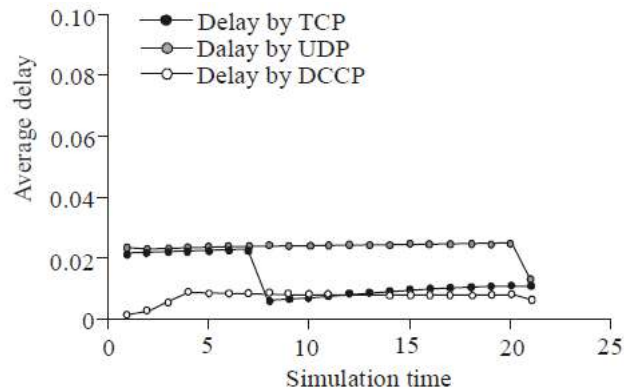


Fig. 7: Average delay of TCP/UDP/DCCP for 20 nodes

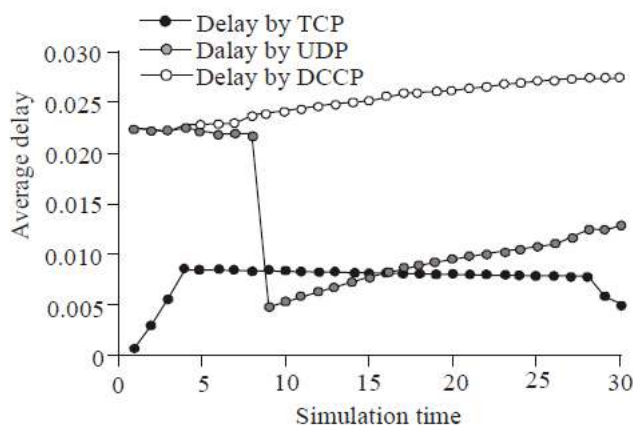


Fig. 8: Average delay of TCP/UDP/DCCP for 30 nodes

### 3.6.4 Comparative analysis of TCP, UDP and DCCP

DCCP offers a method to overcome network load by congestion control methods if the sender delivers more packets than the receiver can keep. It permits the flowbased semantics like in Transmission Control Protocol (TCP), but does not offer reliable in-order transmission.

Sequenced delivery within multiple streams as in the Stream Control Transmission Protocol (SCTP) cannot be offered by DCCP. DCCP is helpful for applications with timing restrictions on the transmission of data. Such applications consist of multiplayer online games, streaming media and Internet telephony. At present, such applications have regularly either settled for TCP or used User Datagram Protocol (UDP) and employed their own congestion control methods, or have no congestion control at all. DCCP has been developed to afford nominal functionality of unreliable data transport with congestion control and therefore attempts to deploy that only. It does not offer any flow control as offered by TCP. It also does not have support for multicasting.

There is no sequenced delivery like SCTP therefore streams are to be layered on top of DCCP. It offers the unreliable transport needed by modern day real-time applications and streaming media while running congestion control techniques. TCP utilizes a network congestion-avoidance algorithm. There are two variants proposed by TCP, i.e., Tahoe and Reno. Before we proceed further, let us know why the result in this section is different from the above section. Actually to measure the congestion we have to use a standard algorithm with the limitation of the buffer queue. The NS3 gives us facilities to make that in easy way. Figure 15 presents the NS3 script for transferring the video streaming file sized (128 MB). Our result shows that the DCCP protocol has a good throughput when the number of Ue becomes 10 & 20. But the UDP and TCP protocol have less throughput if compare with DCCP. The difference throughput between UDP and TCP is small difference even with this small difference the TCP is better than UDP protocol. The DCCP protocol has fewer throughputs when the number of Ue becomes 30. That's because the default maximum number in the LTE is 22 Ue.

We brock this exception to see what is the result. Also the result shows the TCP, then UDP protocol have less loss packets. Because the TCP protocol is connection oriented. Therefore DCCP uses to transfer video, voice due to real time transfer (Table 2). As we saw in the above scenario for Average Delay for all three protocols, in TCP, first the delay is more during connection establishment phase, but once the connection has been established and TCP increased its window size, delay drops sharply in the data flow. But The UDP protocol shows consistently more delay due to connection less flow of the data over the network. And DCCP outperforms these both conventional connection-less and connection-oriented protocols in case of delay.

Similarly more comparison graphs are given for TCP, UDP and DCCP for throughput, PDR and packet loss. In throughput also DCCP outperforms the TCP and UDP protocols. TCP outperforms in case of PDR due to its congestion control flexible window mechanism. Due to controlled window size TCP also gives the minimum packet loss as compared to DCCP and UDP. So seems TCP is better in maximum parameters.

Table 2: UDP/TCP/DCCP protocols based LTE environment with 10, 20, 30 nodes

Protocol	Throughput (in Kbps)			Packet loss		
	10Ue	20Ue	30Ue	10Ue	20Ue	30Ue
UDP	2762.19	5524.38	8286.56	3%	3%	3%
TCP	2805.16	5593.25	8397.78	1%	1%	1%
DCCP	6699.34	6715.28	6731.22	16%	17%	19%
Protocol	Packet delivery ratio			Delay		
	10Ue	20Ue	30Ue	10Ue	20Ue	30Ue
UDP	96%	96%	96%	0.01243390	0.01341040	0.01463610
TCP	98%	98%	98%	0.01139420	0.01246730	0.01106310
DCCP	83%	82%	80%	0.00522303	0.00511127	0.00500419



# **Chapter Four**

## **Conclusion & Future work**

## **4.1 Conclusion**

In this Project we analyzed the performance of transport layer protocols on LTE network. As the capabilities of network layer changes with high potential of network, our concludes the performance at transport layer by analyzed the TCP, UDP and DCCP protocols, on various performance metrics like delay, throughput, packet delivery ratio and packet loss. As our simulation results on network simulator, DCCP protocol outperformsthe other conventional connection-oriented and connection-less protocols in delay and throughput. While due to its connection oriented architecture, TCP give maximum packet delivery ratio and minimum packet loss count. So for the applications where we can't handle packet loss, we must go for TCP else DCCP is best suited for real time applications with good throughput.

## **4.2 Future work**

We have applied the scenarios to send traffic video stream with size 150 MB by using DCCP, TCP and UDP protocols. The performance metrics of bandwidth throughput, packet loss and delay will be used to set the benchmark of the 4G network performance. In future DCCP can also be improved to reduce the packet loss and also to be suited for the applications which are very critical to packet loss.

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# المخلص

الجيل الرابع (انجليزي: G4) عبارة عن الجيل الرابع في تقنية الاتصالات اللاسلكية والذي تم توفيره لأول مرة من قبل شركة Sprint الأمريكية في بداية عام ٢٠٠٩ م ، وأصبحت هذه التقنية متاحة من قبل معظم شركات الاتصالات في معظم المناطق من الولايات المتحدة الأمريكية. تقنية الجيل الرابع هي أحدث تقنية من تقنية الجيل الثالث ، وهي أسرع منها بما يصل إلى ١٠ مرات ، وقد نشأت الحاجة إلى تقنية أسرع بسبب تطور الأجهزة الخلوية والأجهزة اللوحية وحاجتها إلى سرعة الاتصال التكنولوجية ، حيث أصبحت هذه الأجهزة الآن قادرة على بث مقاطع الفيديو والصوت مباشرة. G4 غير متوفر لجميع الأجهزة ؛ يتطلب أن يدعم الجهاز المستخدم القدرة على تبادل البيانات بسرعة ١٠٠ ميجابت في الثانية.

الأسئلة المذكورة أعلاه ضرورية في تقييم أداء أشهر البروتوكولات (خاصة بروتوكول مخطط بيانات المستخدم (UDP) ، وبروتوكول التحكم في الإرسال (TCP) وبروتوكول التحكم في ازدحام مخطط البيانات (DCCP)) داخل بيئة G4. من خلال (NS3 Network Simulation-3) ، يتم تحليل أداء نقل دفق الفيديو بما في ذلك الإنتاجية والتأخير وفقدان الحزم ونسبة تسليم الحزم في المحطة الأساسية من خلال بروتوكولات UDP و TCP و DCCP عبر تقنية التقييم طويل الأمد (LTE). تظهر النتائج أن DCCP لديها إنتاجية أفضل وتأخير أقل ، ولكن في نفس الوقت لديها خسارة رزمة أكثر من UDP و TCP. بناءً على النتائج ، يوصى باستخدام DCCP كبروتوكول نقل للفيديو في الوقت الفعلي.



## تقييم بروتوكول حركة مرور الفيديو عبر شبكة 4G

مشروع مقدم لقسم هندسة تقنيات الحاسوب كجزء من شرط استيفاء شهادة  
البكالوريوس في هندسة تقنيات الحاسوب

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د. سري خليل



**Dijlah University**

# **Room and Body Temperature Monitoring System with Arduino and Bluetooth**

**By:**

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**Supervised by:**

**م. صبار نصيف جاسم**

الآية

# بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

“ يُؤْتِي الْحِكْمَةَ مَنْ يَشَاءُ ۚ وَمَنْ يُؤْتَ الْحِكْمَةَ فَقَدْ أُوتِيَ خَيْرًا كَثِيرًا ۚ وَمَا يَذَّكَّرُ إِلَّا أُولُوا الْأَلْبَابِ ”

صدق الله العظيم

(البقرة: 269)



## الاهداء

إلى من علّمني كيف أقف بكل ثبات فوق الأرض،

أبي المحترم.

إلى نبع المحبة والإيثار والكرم،

أمي الموقرة.

إلى روعي وقرة عيني ونبض فؤادي،

اخوتي و اخواتي.

إلى جميع من تلقّيتُ منهم النصح والدعم

أهديكم خلاصة جهدي العلمي

شكر وتقدير

نتوجه بفائق الشكر و التقدير الى استاذنا الفاضل الأستاذ (م.صبار نصيف جاسم) لما ابداه من توجيهات سديدة و سعة صدر طول مدة البحث فكان للمساته و توجيهاته العلمية الرصنة في اثناء و اغناء موضوع البحث. كذلك نتقدم بخالص الشكر و التقدير الى اساتذتنا الأفاضل الذين تتلمذنا على ايديهم خلال رحلتنا الدراسية.

كما نتقدم بخالص شكرنا و تقديرنا الى عمادة كلية الحسين و رئاسة قسم هندسة الأجهزة الطبية لما لمسته منهم عطا و علما و نسأل الله ان يوفقهم في مجال عملهم.

و نختم شكرنا و تقديرنا الى كل الناس الطيبين الذين كانوا معنا في متابعة مستمرة خلال فترة كتابة البحث لما قدموه من عون و نسأل الله تعالى ان يوفق الجميع و يجزيهم خير الجزاء.

## Abstract

This project discusses how to monitor the temperature of the patient and the room in real-time. Where the proposed approach consists of sensors that measure room and body temperature that are controlled by the microcontroller. Both the readings are displayed on the LCD monitor. Moreover, then a Bluetooth module is used to transfer the measured data to the smartphone. However, the recorded data are sent to the microcontroller and then transfer it to the receiver part. Finally, the data are displayed in the smartphone using an android app.

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# Chapter One

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## **Introduction**

## 1.1 Introduction

In today's world, the use of wireless technology is enhanced to meet the need of remote control and monitoring. Remote patient monitoring is a technology that helps us to monitor patient even when the patient is not in the clinic or hospital. It may increase access to health services and facilities while decreasing cost. Remote Patient Monitoring saves time of both patient and doctor, hence increasing efficiency and reliability of health services. [1,2]

Body temperature is a major sign that are routinely measured by physicians after the arrival of a patient. Heart rate refers to how many times a heart contracts and relaxes in a unit of time (usually per minute). [3,4]

Normal body temperature varies from person to person and changes throughout the day. The body temperature is lowest in the early morning and highest in the early evening. The normal body temperature is about 37° C or 98.6 ° F. However, it can be as low as 36.1° C (97°F) in the early morning and as high as 37.2° C (99° F) and still be considered normal. Thus, the normal range for body temperature is 97 to 100 degrees Fahrenheit or 36.1 to 37.8 degrees Celsius. Temperature can be measured by using different types of sensors. These sensors come in different forms such as thermocouples, thermistors, resistance temperature detectors (RTD), and integrated circuit (IC) sensors. The temperature sensor produces analog output voltage which is proportional to the temperature. The temperature sensor requires analog to digital (A/D) converter so that the analog output voltage can be converted to digital form. The output of the temperature sensor is connected to the microcontroller. The microcontroller processes this data and displays it in LCD and send it via Bluetooth to the receiving end. [5,6,7]



## **1.2 Aim of The Study**

Is to build a low-cost remote doctor monitoring system which measures room and body temperature of a patient and sends the data to a remote end via Bluetooth where the data will be displayed and physician or doctor will be able to examine him/her.

## Chapter Two

---

# **Review of Literature**

## **2.1 Body temperature monitoring**

Human body temperature varies. It depends on sex, age, time of day, exertion level, health status (such as illness and menstruation), what part of the body the measurement is taken at, state of consciousness (waking, sleeping, sedated), and emotions. Body temperature is kept in normal range by thermoregulation, in which adjustment of temperature is triggered by the central nervous system.

In humans, the average internal temperature is 37.0 °C (98.6 °F), though it varies around this point by 0.5 to 1 C. [8] However, no person always has exactly the same temperature at every moment of the day. Temperatures cycle regularly up and down through the day, as controlled by the person's circadian rhythm. The lowest temperature occurs about two hours before the person normally wakes up. Additionally, temperatures change according to activities and external factors.[9]

In addition to varying throughout the day, normal body temperature may also differ as much as 0.5 °C (0.9 °F) from one day to the next, so that the highest or lowest temperatures on one day will not always exactly match the highest or lowest temperatures on the next day.

Normal human body temperature varies slightly from person to person and by the time of day. Consequently, each type of measurement has a range of normal temperatures. The range for normal human body temperatures, taken orally, is  $36.8 \pm 0.5$  °C ( $98.2 \pm 0.9$  °F).[10] This means that any oral temperature between 36.3 and 37.3 °C (97.3 and 99.1 °F) is likely to be normal.

The normal human body temperature is often stated as 36.5–37.5 °C (97.7–99.5 °F).[8] In adults a review of the literature has found a wider range of 33.2–38.2 °C (91.8–100.8 °F) for normal temperatures, depending on the gender and location measured.[11]

### **2.1.1 Significance of Temperature Control**

Temperature control is part of a homeostatic mechanism that keeps the organism at optimum operating temperature, as the temperature affects the rate of chemical reactions.

### **2.2.2 Measuring Body Temperature**

Different methods used for measuring temperature produce different results. The temperature reading depends on which part of the body is being measured. The typical daytime temperatures among healthy adults are as follows:

1. Temperature in the anus (rectum/rectal), vagina, or in the ear (tympanic) is about 37.5 °C (99.5 °F) [12]
2. Temperature in the mouth (oral) is about 36.8 °C (98.2 °F) [10]
3. Temperature under the arm (axillary) is about 36.5 °C (97.7 °F) [12]

Generally, oral, rectal, gut, and core body temperatures, although slightly different, are well-correlated.

Oral temperatures are influenced by drinking, chewing, smoking, and breathing with the mouth open. Mouth breathing, cold drinks or food reduce

oral temperatures; hot drinks, hot food, chewing, and smoking raise oral temperatures.[8]

### **2.1.3 Types of Temperature Sensors**

A temperature sensor is a device that detects and measures hotness and coolness and converts it into an electrical signal.

Types of temperature sensors include:

1. Negative and Positive Thermal Coefficient Thermistor
2. Infrared Temperature Sensors
3. Digital Temperature Sensors

#### **2.1.3.1 Negative and Positive Thermal Coefficient Thermistor**

NTC and PTC thermistors are a common type of temperature sensor to measure surface temperature. The sensor is a two-wire connection and uses the resistance properties of ceramic/metal composites to measure temperature. Common applications for this type of temperature sensor include adult rectal, pediatric rectal, and skin probes. Certain designs are capable of withstanding 134°C.

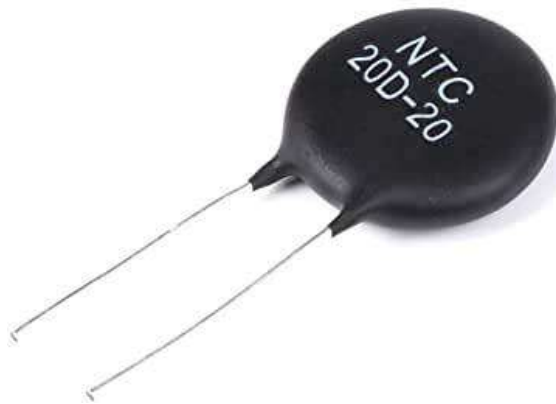


Fig (2-1): Negative thermal coefficient resistor

### 2.1.3.2 Infrared Temperature Sensors

Infrared (IR) temperature sensors enable accurate non-contact temperature measurement in medical applications. The most common applications for this type of temperature sensor is measuring ear temperature, forehead temperature, or skin temperature. The sensing element is composed of multiple thermocouples on a silicon chip to measure an object's infrared energy.



Fig (2-2): Contactless temperature sensor

### **2.1.3.3 Digital Temperature Sensors**

Digital temperature sensors are embedded into home healthcare and personal tracking devices. These sensors provide accurate measurements of temperature with a digital output signal and small circuit board package.



Fig (2-3): Digital temperature sensor

For example, digital temperature sensors can be designed into medical devices to monitor the temperature of air in respiratory devices to create greater comfort for patients as air enters the airway.

## **2.2 Room Temperature**

Room temperature is the range of air temperatures that most people prefer for indoor settings, which feel comfortable when wearing typical indoor clothing. Human comfort can extend beyond this range depending on humidity, air circulation and other factors. In certain fields, like science and engineering, and within a particular context, room temperature can mean different agreed-on ranges. In contrast, ambient temperature is the actual temperature of the air (or other medium and surroundings) in any particular place, as measured by a thermometer. It may be very different from usual room temperature, for example an unheated room in winter.

The American Heritage Dictionary of the English Language identifies room temperature as around 20–22 °C (68–72 °F), while the Oxford English Dictionary states that it is "conventionally taken as about 20 °C (68 °F)".

Owing to variations in humidity and likely clothing, recommendations for summer and winter may vary; a suggested typical range for summer is 23–25.5 °C (73–78 °F), with that for winter being 20–23.5 °C (68–74 °F),[3]

Some studies have suggested that thermal comfort preferences of men and women may differ significantly, with women on average preferring higher ambient temperatures.

## **2.3 Wireless Communication**

Wireless Communication is the fastest growing and most vibrant technological areas in the communication field. Wireless Communication is a method of transmitting information from one point to other, without using any connection like wires, cables or any physical medium.



Generally, in a communication system, information is transmitted from transmitter to receiver that are placed over a limited distance. With the help of Wireless Communication.

The primary and important benefit of wireless communication is mobility, apart from mobility, wireless communication also offers flexibility and ease of use, which makes it increasingly popular day – by – day. Wireless Communication like mobile telephony can be made anywhere and anytime with a considerably high throughput performance.

Another important point is infrastructure. The setup and installation of infrastructure for wired communication systems is an expensive and time-consuming job. The infrastructure for wireless communication can be installed easily and low cost.

In emergency situations and remote locations, where the setup of wired communication is difficult, wireless communication is a viable option.

### **2.3.1 Advantages of Wireless Communication**

There are numerous advantages of Wireless Communication Technology, Wireless Networking and Wireless Systems over Wired Communication like Cost, Mobility, Ease of Installation, and Reliability etc.

### **2.3.2 Types of Wireless Communication Systems**

Wireless Communication Systems provide different services like video conferencing, cellular telephone, paging, TV, Radio etc. Due to the need for variety of communication services, different types of Wireless Communication

Systems are developed. Some of the important Wireless Communication Systems available today are:

Television and Radio Broadcasting

Satellite Communication

Radar

Mobile Telephone System (Cellular Communication)

Global Positioning System (GPS)

Infrared Communication

WLAN (Wi-Fi)

Bluetooth

Paging

Cordless Phones

Radio Frequency Identification (RFID)

### **2.3.3 Bluetooth**

Bluetooth is another important low range wireless communication system. It provides data, voice and audio transmission with a transmission range of 10 meters. Almost all mobile phones, tablets and laptops are equipped with Bluetooth devices. They can be connected to wireless Bluetooth receivers, audio equipment, cameras etc.

## Chapter Three

---

# **Materials and Methods**

## **3.1 Materials**

This Heartbeat and body temperature system consists of six main parts which are:

1. The power Supply
2. Microcontroller unit
3. Room Temperature sensor
4. Body Temperature sensor
5. display
6. Wireless module

All these components are encased in a plastic box with the following dimensions:

1. Length = 11 cm
2. Width = 11 cm
3. Height = 6 cm

The total volume for the box =  $726 \text{ cm}^3$

### **3.1.1 The power Supply**

The power supply unit of this device is rechargeable and consists of:

1. Li-ion battery
2. Battery management system circuit
3. Step up converter
4. Charger
5. On/Off switch with LED indicator

### 3.1.1.1 Li-ion Battery

We used one li-ion battery with 3.7 volts and a capacity of 3800 mAh.



Fig (3-1):3.7v Li-Ion Battery

### 3.1.1.2 Battery Management System (BMS)

Is any electronic system that manages a rechargeable battery (cell or battery pack), such as by protecting the battery from operating outside its safe operating area, monitoring its state, calculating secondary data, reporting that data, controlling its environment, authenticating it and balancing it.



Fig (3-2): Battery management circuit

### 3.1.1.3 Step-up Converter

The BMS circuit has a built-in step up that converts the 3.7 volts that the battery supplies to 5 volts in order to supply the microcontroller Unit (Arduino Nano) which works on 5 volts.

### 3.1.1.4 Charger

A battery charger, or recharger, is a device used to put energy into a secondary cell or rechargeable battery by forcing an electric current through it.

The charger used is 5 volts 1 ampere charger with USB micro jack.



Fig (3-3): Battery charger

### 3.1.1.5 On / Off Switch with LED indicator

Five ampere on/off switch that controls the power of the device

The system also equipped with 5mm LED which lights when the system is powered on.



Fig (3-4): On/Off switch



Fig (3-5): Light emitting diode (LED)

### 3.1.2 Microcontroller Unit

For controlling the input and output data we used Arduino Nano which is based on ATMEGA328 Microcontroller

#### **Arduino Nano**

is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a mini USB cable.

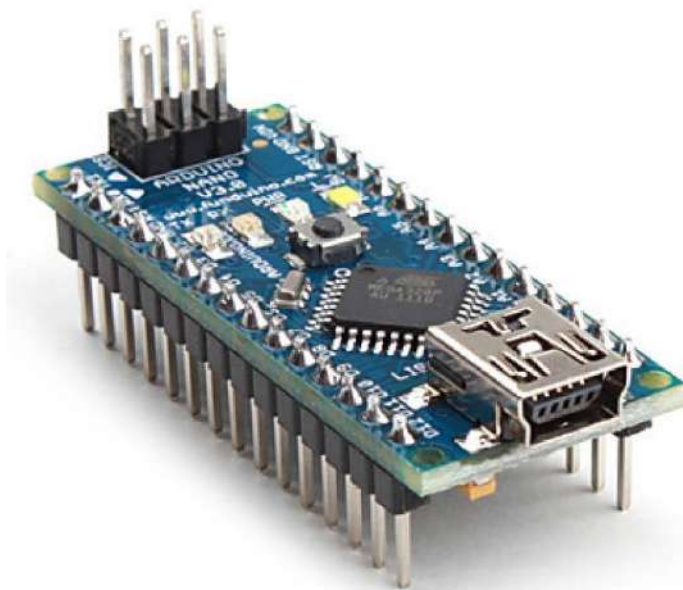


Fig (3-6): Arduino Nano



### 3.1.3 Room Temperature Sensor

The temperature sensor in this device is the digital sensor LM35.

LM35 is a temperature measuring device having an analog output voltage proportional to the temperature.

It provides output voltage in Centigrade (Celsius). It does not require any external calibration circuitry.



Fig (3-7): LM35 temperature sensor

The sensitivity of LM35 is 10 mV/degree Celsius. As temperature increases, output voltage also increases.

It is a 3-terminal sensor used to measure surrounding temperature ranging from -55 °C to 150 °C.

LM35 gives temperature output which is more precise than thermistor output.

### 3.1.3.1 Body Temperature Sensor

We used the same sensor used for measuring room temperature which is the LM35 temperature sensor.

### 3.1.4 Display

16 x 2 LCD blue backlight display is used to view heart rate and body temperature.



Fig (3-8): LCD display 16x2

An LCD (Liquid Crystal Display) screen is an electronic display module that has a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols.

### 3.1.5 Wireless module

For sending the data to the receiving end, HC-05 Bluetooth module is used.

HC-05 is a Bluetooth module which is designed for wireless communication.

This module can be used in a master or slave configuration.

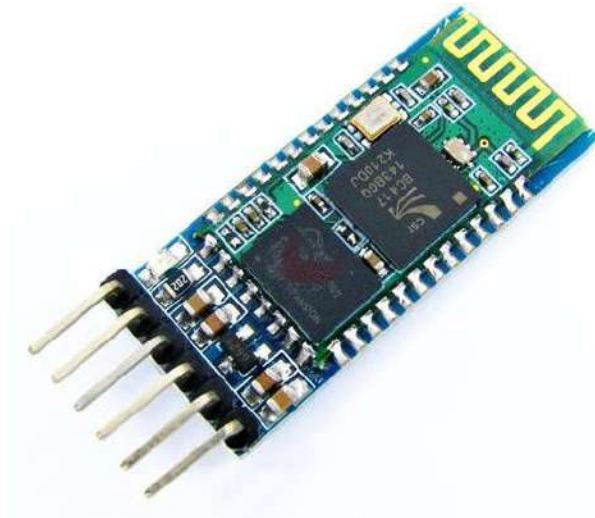


Fig (3-9): HC-05 Bluetooth module

## 3.2 Working Principle

The aim of this proposed approach is to design an automatic wireless temperature monitoring system. The objective is to monitor the temperature of the room and patient's body which should be displayed to the doctor using Bluetooth technology. In hospitals, the monitoring of the patients' health is done by the staff members of the hospital. The temperature of the patient's body is checked constantly and a record of it is kept. The required components used in this system include a power supply, ATmega328 microcontroller, a temperature sensor, a Bluetooth module and an LCD display. The ATmega328 microcontroller is used as a CPU for monitoring the temperature of the patient's body. The working of this proposed health monitoring system can be explained with the help of a block diagram.

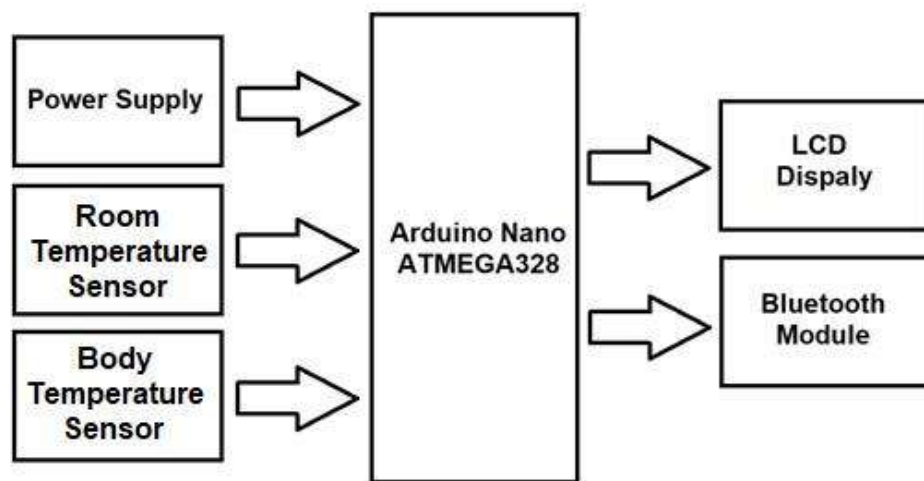


Fig (3-10): Device block diagram

This block diagram includes a power supply block that supply power to the whole circuit, and two temperature sensors are used to sense the temperature of a patient's body and the temperature of the room, then the data which are sensed by the sensor is sent to ATmega328.

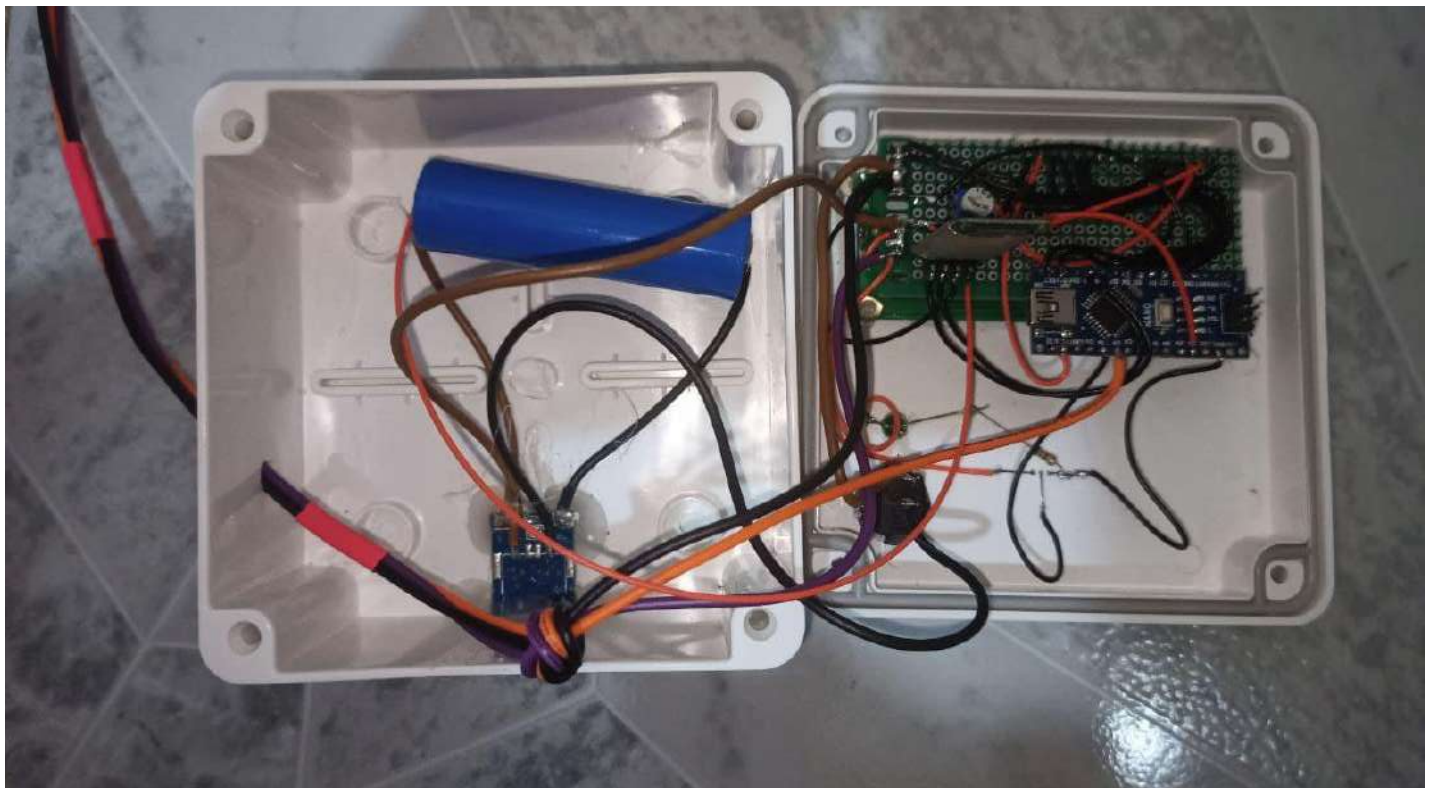


Fig (3-11): Internal components of the device

The transmitted information can be encoded into serial data over the air through Bluetooth module to a smartphone and the temperature of the patient's body values is displayed on the LCD display.



Fig (3-12): External components of the device

## Chapter Four

---

# **Results and Conclusion**

## 4.1 Results

### 4.1.1 Body Temperature Measurement

When the power is turned on, the green LED on the box starts glowing, indicating that circuit is working properly. Here there is a use of the temperature sensor (LM 35) which gives us the temperature in °C. That temperature is displayed on the LCD.



Fig (4-1): Final view of the device

### 4.1.2 Room Temperature Measurement

The room temperature also measured using LM35 Temperature sensor.





Fig (4-2): The system during operation



Fig (4-2): The Mobile application

## **4.2 Conclusion**

In this project has been analyzed the wireless patient health monitoring system of body and room temperature using Bluetooth. The temperature was measured by using precision integrated temperature sensor LM35. Both the data were processed in the Arduino uno and sent to the remote end wirelessly by using Bluetooth module. The wireless communication was preferred because it gives greater mobility to the sensor equipment and reduces the cost wherein there are multi-transmitting sections.

### **4.3 Future Applications and Developments**

1. The device can be connected to PC by using serial output so that measured heartbeat and temperature can be sent to PC for further online or offline analysis.
2. Warning for abnormalities of health condition can be displayed.
3. Sound warnings can be made more interactive.
4. The output can be sent to mobile phones by using GSM module or Bluetooth module for further analysis.
5. More parameters (like blood pressure) can be added to the device.
6. The system can also be provided with GSM module, which makes the system able to send warning messages to the healthcare provider.
7. According to availability of sensors or development in biomedical trend more parameter can be sense and monitor which will drastically improve the efficiency of the monitoring system in biomedical field.

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**Republic of Iraq**

**Ministry of Higher Education and Scientific Research**

**Dijlah University College**

**Department of Computer Techniques Engineering**

## **Smart Home Appliance**

**A Graduation Project Submitted to the**

**Department of Computer Techniques Engineering**

**Dijlah University College**

**as a Partial Fulfilment of the Requirement**

**of the BSc. Degree in Computer Techniques Engineering**

**By**

**Abbas Fadel**

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**Ali Mohammed**

**Abdullah Ahmed**

**Supervised**

**Dr. Mustafa Musa**

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ  
﴿ وَمَا أَرْسَلْنَا مِنْ قَبْلِكَ إِلَّا رِجَالًا نُوحِي إِلَيْهِمْ فَاسْأَلُوا أَهْلَ الذِّكْرِ إِنْ كُنْتُمْ لَا تَعْلَمُونَ ﴾  
صدق الله العلي العظيم



## **Supervisor's Certification**

I certify that the preparation of this graduation research project titled  
**"Smart Home"**/ Department of  
Computer Techniques Engineering / Dijlah University College in partial fulfillment  
of the  
requirements for the degree of BSc. In Computer Techniques Engineering

Signature:



Name: Mustafa Musa Jaber

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Affiliation: Dijlah University College / Department of Computer  
Techniques Engineering

Date: 25/ 06 / 2021

## **Abstract**

There is no doubt that the objective of this study has been achieved. Internet of things (IoT) is the main aspect towards 4<sup>th</sup> Industrial Revelation. The main objective of this project is to develop a lock door system that has many advantages, everyone can easily get and use this product, besides smoke sensor along with alarm system which sends a SMS to the house owner using GSM shield. In addition to developing smart lighting this creating fewer channels. And the development of a fire alarm device with an innovative technology to avoid danger. This project has been approved by IoT experts.

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## **Chapter one**

### **Introduction**

#### **1.1 Introduction**

A smart home refers to a convenient home setup where appliances and devices can be automatically controlled remotely from anywhere with an internet connection using a mobile or other networked device. Devices in a smart home are interconnected through the internet, allowing the user to control functions such as security access to the home, temperature, lighting and a home theater remotely.

#### **Key Takeaways**

A smart home allows homeowners to control appliances, thermostats, lights, and other devices remotely using a smartphone or tablet through an internet connection. Smart homes can be set up through wireless or hardwired systems. Smart home technology provides homeowners with convenience and cost savings. Security risks and bugs continue to plague makers and users of smart home technology.

## 1.2 What Arduino Uno

Arduino is an open source electronics platform based on easy to use hardware and software. Arduino boards are able to read inputs - light on a sensor finger on a button or a Twitter message and turn it into an output activating a motor, turning on an LED publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language based on Wiring and the Arduino Software IDE based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. community students hobbyists, artists, programmers, and professionals has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming.

As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

## 1.3 Why Arduino

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, all of these tools take the messy details of microcontroller programming and wrap it up in an easy to use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

Inexpensive Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than \$50 Cross-platform - The Arduino Software IDE runs on Windows, Macintosh OSX and Linux operating systems.

Most microcontroller systems are limited Windows. Simple, clear programming environment - The Arduino Software IDE is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works. Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers.

The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to. Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it.

## **1.4 Research Background**

This project aims to develop a secret door lock system. The user will set up the knockout pattern. Which will help open the door. In this system, any user can use any type of pattern to lock and unlock the door of the house. After opening the door, the door closes automatically after a few seconds.

It also aims to develop an alarm system using SMS chip by sending a notification to the user that a fire has occurred, and finally aims at how to create smart lighting by clapping through Arduino programming

## **1.5 Research problems**

There are problems with many people when a fire occurs and he does not know. This system informs the owner of the house that there is a fire or a gas leak in order to inform the people close to the house or shop to take the necessary measures before the fire breaks out, or if the owner of the house or shop is close to the scene of the accident. It takes the required measures to prevent the fire from occurring. It is notified through the mobile sms chip, and the rest of the system parts are to facilitate the person's life, for example, turning on the light while sitting by clapping or opening the door easily by knocking



## 1.6 Project Overview

Smart Lock Door is a keyless mechanical and electronic door lock system used for offices, homes and exit doors. It is a hardware based system used to lock the main door of any home. In this generation the easy way. Smoke sensor Primary smoke alarm system is an important system for industrial as well as domestic use When it detects a fire or smoke, it immediately alerts the user about the fire through the sms chip to display the system status whether smoke and excessive heat are detected or the first two do not interact with the SMS chip so that it receives The user has an alert message to notify the user that the fire has been detected. This system is really useful when the user is not at home, in industry or indoors.

When a fire occurs, the system automatically senses and alerts the user by sending an alert to an application installed on the user's Android phone. Smart lighting Arguably the easiest way to improve lighting is to use smart bulbs. These smart lights allow you to control your phone or through Alexa or Google Assistant. But we will use the technique of clapping with the Olean board. Plus, you can schedule it at any time and have it built as desired

## **1.7 Objective**

- 1- No need for any metal cabinet key.
- 2- The door can easily be opened.
- 3- Open the door using engraving methods.
- 4- Send a message to the user when a fire occurs
- 5- This security system represents a major improvement in home
- 6- Smart lighting enables households and users to remotely control

## **Chapter Two**

### **Literature Review**

#### **2.1. Beginning Arduino**

Beginning of Arduino is about the popular Arduino microcontroller by working your way through an amazing set of many projects And progress from a complete beginner regarding Arduino programming and electronics knowledge to intermediate skills and the confidence to create your own amazing Arduino projects. Absolutely no experience in programming or electronics required Rather than requiring you to wade through pages of theory before you start making things. Each project is designed to build upon the knowledge learned in earlier projects and to further your knowledge in programming as well as skills with electronics.

#### **2.2 Introduction to Arduino**

give you a taste of the wide variety of different types of sensors that you can hook up to. For this chapter will deliver details for the current studies that has been discussed in the literature review.

## **2.3 The Working Principle Of An Arduino**

analyze the working principle of an arduino. These days many people try to use the arduinobecause it makes things easier due to the simplified version of C++ and the already made Arduino microcontrollerthat can programme, erase and reprogramme at any given time. In this paper we will discuss the hardware components used in the arduino board, the software used to programme it Arduino board with the guide on how to write and construct your own projects, and a couple of examples of an arduino project, This will give you the overall view of an arduino uno

## **2.4 The Making of Arduino**

Arduino uno owner of the Italian cofounder of the electronics project that he named in honor of the place. Arduino is a low cost microcontroller board that lets even a novice do really amazing things.

## **2.5 Working Principle Of Arduino and Sing It**

the working principle and applications of an Arduino board. This also explores on how it can be used as a tool for study and research w. Arduino board can provide a quick tool in development of VLSI test bench especially of sensors. Main advantages are fast processing and easy interface. Today, with increasing number of people using open source software and hardware devices day after day, technology is forming a new dimension by making complicated things look easier and interesting. These open sources provide free or virtually low costs, highly reliable and affordable technology. This paper provides a glimpse of type of Arduino boards, working principles, software implementation and their applications

## **2.6 Arduino as a learning tool**

shall take a brief look at the Arduino microcontroller and some of its applications and how it can be used in learning. Arduino is an open-source microcontroller used in electronic prototyping. Arduino hardware and its components shall be looked at. Software and the Environment that Arduino runs on are both looked at too. Some applications will be taken as examples that can help make learning Arduino more interesting. This can be used as a major way to encourage students and others to learn more about electronics and programming.

## **2.7 Inside The Smart Home**

fascinating insight into potentially one of the most exciting developments that affects each and every one of us as we move forward into Century. This book indicates the direction industry must take if we are to achieve the dream of living in a Smart Home Steve Hearnden Mobile Telecommunications Consultant UK A timely and much needed compliment to more technology led explorations of the Smart Home. It draws attention to the complexity, diversity and conceptual richness of domestic life and critically reflects on the adoption and use of technologies. In the home to date. Geraldine Fitzpatrick Sapient Ltd uk If the predictions of leading electronics and consumer companies are to be believed in the future you may never again have to worry about forgetting to switch the lights off, or locking the front door when you leave your home Even mundane chores such as visiting your local supermarket to stock up your fridge will become a thing of the past, as the Smart Homes of the future will be able to decide what is needed and order them for us. Inside the Smart Home looks at the designs and

technologies behind these new innovations, along with their time-saving, environmental and security benefits, amongst others. Despite these clear advantages however, Smart Homes have so far failed to reach the levels of success originally anticipated, thereby forcing designers to further examine the roles and practicalities of these new technologies. Through the use of detailed case studies from such international giants as Orange Ariston Philips Electronics and Electrolux,

## **2.8 Principles Of Smart Home Control**

Seeking to be sensitive to users smart home researchers have focused on the concept of control. They attempt to allow users to gain control over their lives by framing the problem as one of end-user programming. But families are not users as we typically conceive them, and a large body of ethnographic research shows how their activities and routines do not map well to programming tasks. End-user programming ultimately provides control of devices. But families want more control of their lives. , this disconnect. Using grounded contextual fieldwork with dual-income families, we describe the control that families want, and suggest seven design principles that will help end-user programming systems deliver that control

## **2.9 Smart Home Automation**

Home automation is becoming popular due to its numerous benefits. Home automation refers to the control of home appliances and domestic features by local networking or by remote control. Artificial Intelligence provides us the framework to go real-time decision and automation for Internet of Things (IoT). The work deals with discussion about different intelligent home automation systems and technologies from a various features standpoint. The work focuses on the concept of home automation where the monitoring and control operations are facilitating through smart devices installed in residential buildings. Heterogeneous home automation systems and technologies considered in review with central controller based, web based, email based, Bluetooth-based, mobile-based, SMS based, ZigBee based, Dual Tone Multi Frequency-based, cloud-based and the Internet with performance

## **2.10 Smart GSM Based Home Automation System**

the potential of Full Home Control which is the aim of the Home Automation Systems in near future. The analysis and implementation of the home automation technology using Global System for Mobile Communication (GSM) modem to control home appliances such as light, conditional system, and security system via Short Message Service (SMS) text messages is presented in this paper. The proposed research work is focused on functionality of the GSM protocol, which allows the user to control the target system away from residential using the frequency bandwidths. The concept of serial communication and AT-commands has been applied towards development of the smart GSM-based home automation system. Home owners will be able to receive feedback status of any home appliances under control whether switched on or off remotely from their mobile phones. microcontroller with the integration of GSM provides the smart automated house system with the desired baud rate of 9600 bps. The proposed prototype of GSM based home automation system was implemented and tested with maximum of four loads and shows the accuracy



## **2.11 Smart Home Automation System Using Bluetooth Technology**

a low cost and user friendly remote controlled home automation system is presented using Arduino board, Bluetooth module, smartphone, ultrasonic sensor and moisture sensor. A smartphone application is used in the suggested system which allows the users to control up to 18 devices including home appliances and sensors using Bluetooth technology. Nowadays, most of conventional home automation systems are designed for special purposes while proposed system is a general purpose home automation system. Which can easily be implement in existing home. The suggested system has more features than conventional home automation systems such as an ultrasonic sensor is used for water level detection and soil moisture sensor is use for automatic plant irrigation system. This paper also describes the hardware and software architecture of system, future work and scope. The proposed prototype of home automation system is implemented and tested on hardware and it gave the exact and expected results

## **Chapter Three**

### **The Important System**

#### **3.1 Methodology**

basically the design and development of this project consists of one main part which are software details in the software development, the whole complete prototype was operated via android studio

#### **The Important System Requirement**

the implemented system would be run at the following requirements

## **3.2 Smart Lighting**

### **Hard ware Components Required**

#### **3.2.1 Equipment**

##### **1- Sound Sensor**

A sound sensor is defined as a module that detects sound waves through its intensity and converting it to electrical signals



Figure 3.2.1 Sound Sensor

##### **2- Arduino**

##### **3- A breadboard**

##### **4- Connecting wires**

##### **5- Light**

### 3.3 Smart Lock Door

#### Hard ware components required

##### 3.3.1 Equipments

###### 1- Lock Door

This electronic door lock uses a solenoid to move an armature in or out. When no power is applied, the metal slug points out, but when 9V to 12V is applied to the coil, the slug pulls in and the whatever has been locked is opened. Even though this door lock will work with 9V, it is best to power it with 12V



Figure 3.3.1 Lock Door

## 2- Relay 5v

It is frequently used in an automatic control circuit. To put it simply, it is an automatic switch to control a highcurrent circuit with a low- current signal. 5V relay signal input voltage range



Figure 3.3.1 Relay 5v

## 3- Sound sensor

## 4- Arduino

## 5- Connecting wires

## 3.4 Smoke Detection

### Hard ware components required

#### 3.4.1 Equipments

##### 1- Smoke Sensor

MQ2 S is one of the commonly used gas And Somke sensors in MQ sensor series. It Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple concentrations of gas can be detected

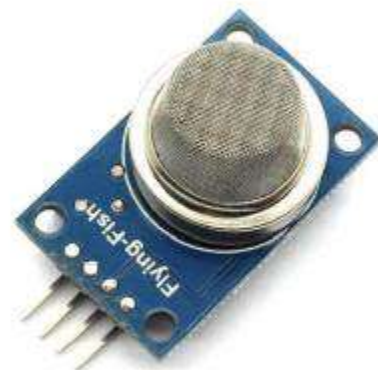


Figure 3.4.1 Smoke Sensor

##### 2- Arduino Uno

It is an electronic development board consisting an opensource electronic circuit with a computer programmed microcontroller, designed to facilitate the use of interactive electronic multidisciplinary projects. The Arduino is mainly



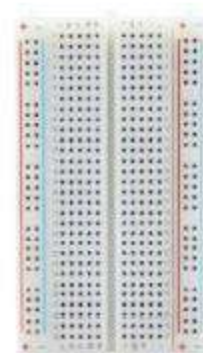
Figure 3.4.1 Arduino Uno

used in the design of interactive electronic projects or projects that target building different environmental sensors such as temperature, wind, light, pressure, etc. The Arduino can be connected to various programs on the personal computer, and it depends in its programming on the open source programming language Processing, and the programming codes are distinguished.

The Arduino language is similar to the C language and is considered one of the easiest programming languages to use in writing microcontroller programs. Some studies have shown that the Arduino chips are an important entrance through which to facilitate knowledge of principles of computer science, electrical engineering and mechanic

### **3- A breadboard**

is a flat board that is used as a base for connecting electronic components to build electronic circuits. And prototyping of electronic devices. It requires no soldering and is reusable, which makes it easy to use for creating temporary prototypes and circuit design



**Figure 3.4.1 A breadboard**

## 4- Connecting wires

Connecting wires provide a medium to an electrical current so that they can travel from one point on a circuit to another. Basic circuit, the wire comes from one terminal of a power source then connects to a switch that determines whether the circuit



Figure 3.4.1 Connecting wires

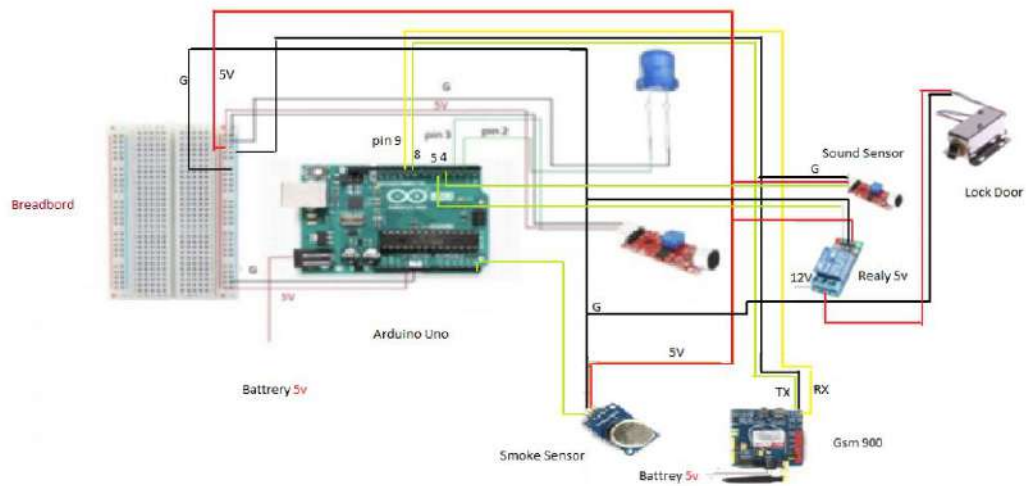
## 5- GSM

A GSM modem or GSM module is a device that uses GSM mobile technology to provide a data link to a remote network that, from a mobile phone point of view, is an ordinary mobile phone, including the need for a SIM card to identify the mselves with the network



Figure 3.4.1 Gsm 900





**Smart Home Circuit**

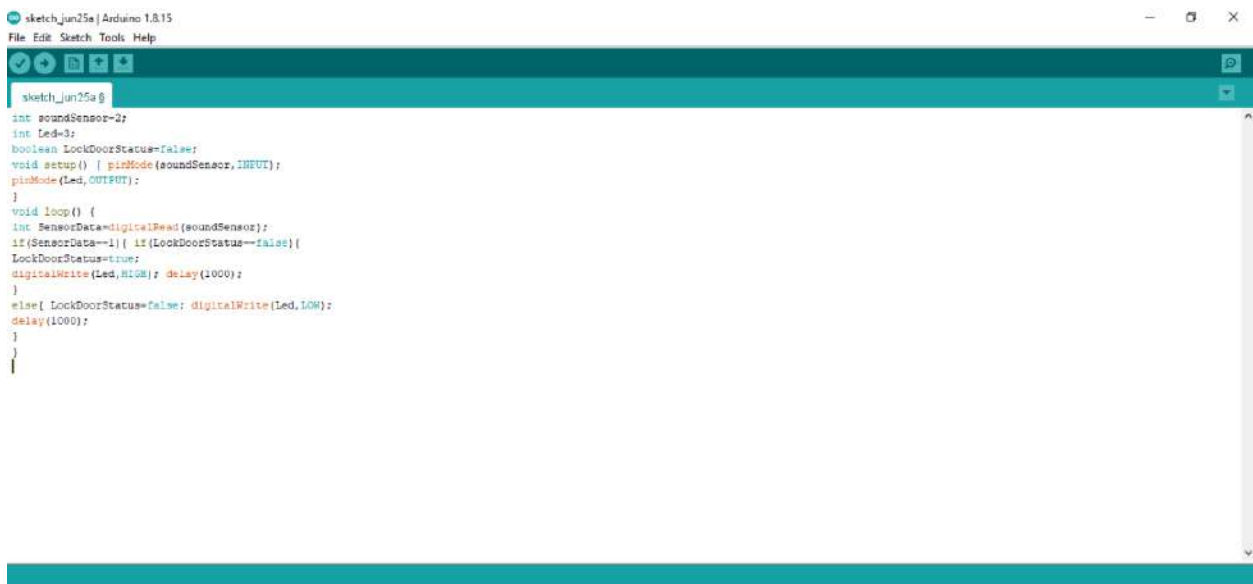
**Figure 3.5 Smart Hone Circuit**

## Chapter Four

### Programming And Result

#### 4.1 Smart Light

##### 4.1.1 programming



```
sketch_jun25a 0
int soundSensor=2;
int Led=3;
boolean LockDoorStatus=false;
void setup() { pinMode(soundSensor,INPUT);
pinMode(Led,OUTPUT);
}
void loop() {
int SensorData=digitalRead(soundSensor);
if(SensorData==1){ if(LockDoorStatus==false){
LockDoorStatus=true;
digitalWrite(Led,HIGH); delay(1000);
}
else{ LockDoorStatus=false; digitalWrite(Led,LOW);
delay(1000);
}
}
```

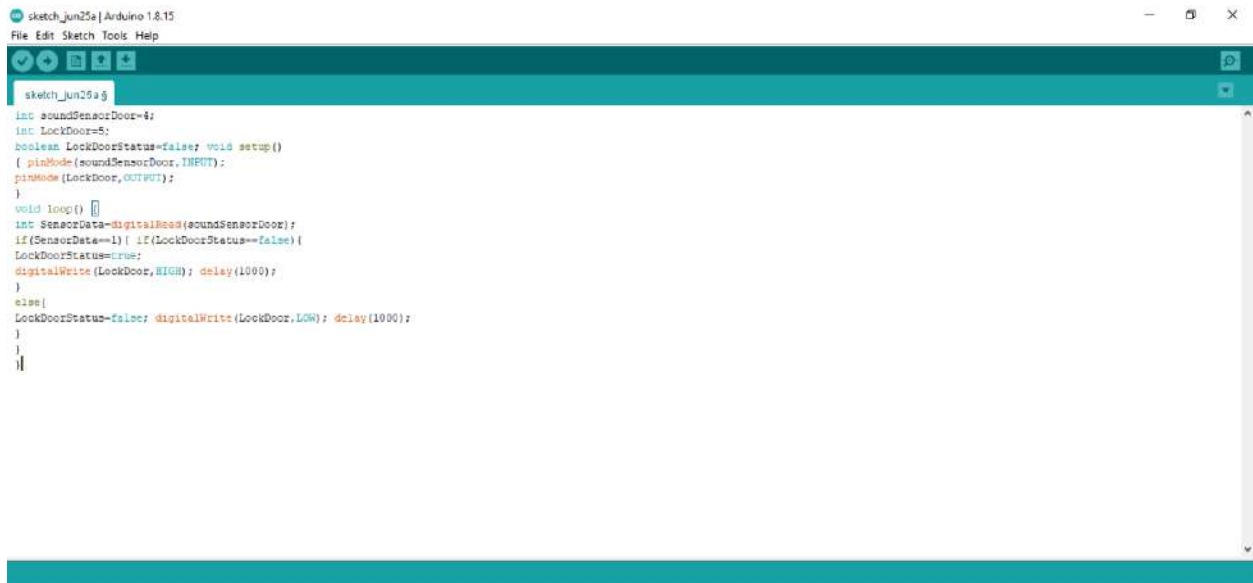
Figure 4.1.1 programming Smart Lighting

### **4.1.2 Result**

This model works by linking the sound sensor to the Arduino when the signal port of the sound sensor is connected to the Arduino digital port No. 2, and the positive port to the audio sensor we connect to the VCC 5 V, and the negative port to the audio sensor we connect to the negative port of the Arduino and the light we connect the positive port to the Arduino digital port No. 3 and the negative port to the light Connects with the negative port of the Arduino this work the connection to the device by setting a specific Clap to turn on or off the light by programming it in the Arduino.

## 4.2 Smart Lock Door

### 4.2.1 Programming



```
sketch_jun25a | Arduino 1.8.15
File Edit Sketch Tools Help

sketch_jun25a.g
int soundSensorDoor=4;
int LockDoor=5;
boolean LockDoorStatus=false; void setup()
{ pinMode(soundSensorDoor,INPUT);
  pinMode(LockDoor,OUTPUT);
}

void loop() {
  int SensorData=digitalRead(soundSensorDoor);
  if(SensorData==1) { if(LockDoorStatus==false){
    LockDoorStatus=true;
    digitalWrite(LockDoor,HIGH); delay(1000);
  }
  else{
    LockDoorStatus=false; digitalWrite(LockDoor,LOW); delay(1000);
  }
}
```

Figure 4.2.1 programing Smart Lock Door

### 4.2.2 Result

That's all about the secret door locker to detect clicks with sound sensor. Arduino is used in this project to control a file The entire system is monitored by sensors. When the sensors feel The voice then sends the command audio to a file Arduino, and also sends it the instruction IC of the transistor after that, it Little moldy servo motor. The comparison here is a file Interface between sensor arrangement and Arduino Connection method The audio sensor port is connected in digital mode with the Arduino through the signal port outside the audio port located in the S-shaped sensor, which means the signal and we connect it to the digital Arduino port No. 4 and the signal port outside the door lock to the Arduino port No. 5 by RELAY

### 4.3.1 Programming

```
sketch_jun25a | Arduino 1.8.15
File Edit Sketch Tools Help

sketch_jun25a.g

#include <SoftwareSerial.h>
SoftwareSerial SIM900(8, 9); // you module connected here
//using rx=pinD8;
int enable = 10; // enable / gas sensor connected with analog
pin 31 of the module / smps. ioo data = 0;
void setup() {
  randomSeed(analogRead(A0));
  Serial.begin(9600);
  SIM900.begin(9600); // for SIM900D 19200, while enter 9600 for
  SIM900A
  pinMode(enable, OUTPUT);
  while loop() {
    data = analogRead(enable); Serial.print("Data: ");
    Serial.println(data);
    if (data > 800) {}
    rx=pinD8 = "blat. There is a leak in the gas or a fire";
    sendSMS(rx=pinD8); Serial.println(rx=pinD8);
    Serial.println("message sent.");
    delay(3000); while();
  }
}
void sendSMS(String message) {
  SIM900.println("AT+CMGF=1");
  delay(1000);
  // AT command to send SMS message
  SIM900.println("AT+CMGQ=1,\"MSG\",\"999972813731\"");//1. //
  recipient's mobile number, in international format
  delay(1000); SIM900.println(message); delay(1000);
  SIM900.println(char(26)); delay(1000); SIM900.println();
  delay(100);
  // SIM900power();
  // message has send
  // End AT command with a ^Z ASCII code 26
  // give module time to send SMS // turn off module
}
```

### Figure 4.3.1 programing Fire Detection

### 4.3.2 Result

This is all about smoke sensor with gsm with fire alarm sensor. arduino is used in this project to control the whole system by monitoring the sensors. when the sensors detect the presence of gas or fire and then send the command to the arduino, the gsm instructions also send it after the user receives a message on the phone that there is a fire or a gas leak command linked by software serial with arduino and select rx that is receiver and tx which is a transmitter and connect to the digital ports of the arduino no. 8 tx number 9 rx

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## الملخص

الهدف من هذه الدراسة

تحقيق الهدف الرئيسي من هذا المشروع هو تطوير طريق  
نظام الباب الذي يتمتع بالعديد من المزايا ، يمكن للجميع الحصول عليه بسهولة  
واستخدام هذا المنتج بالإضافة إلى تطوير الإضاءة الذكية ،  
وبالتالي إنشاء عدد أقل من القنوات  
و جهاز انذار بتقنية مبتكرة لتلافي الخطر





جمهورية العراق  
وزارة التعليم العالي والبحث العلمي  
كلية دجلة الجامعة  
قسم هندسة تقنيات الحاسوب

المنزل الذكي  
القفل الذكي , الضوء الذكي, كاشف الغاز  
هذا المشروع مقدم الى قسم هندسة تقنيات الحاسوب  
كلية دجلة الجامعة  
كجز من متطلبات الحصول على درجة البكالوريوس في هندسة تقنيات  
الحاسوب

إعداد

عباس فاضل حسين

عائشة محمود حسين

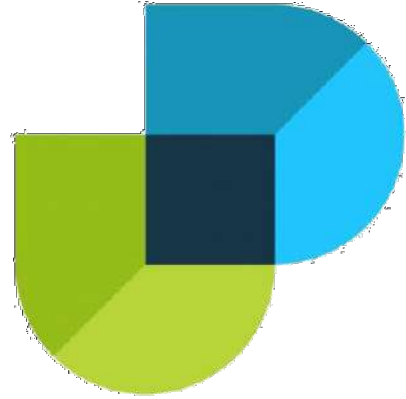
علي محمد جاسم

عبد الله احمد جاسم

إشراف

د. مصطفى موسى

**Dijlah University College**  
**Department of Computer**  
**technical Engineering**



# **Tetrahedron Engine Drone for Photography Purpose**

**A Project Submitted to the Department of Computer Techniques  
Engineering / Dijlah University College In partial Fulfillment of  
the Requirement for the Degree of B. Eng. In Computer  
Techniques.**

**By:**

**Mohammed Fouad Abd-Alrahman Hussen Yasser Zora Obed  
Mustafa Areby Rashed Fawaz Raed Fawzi**

**Supervised by:**

**Mohammed Wajeih Hussein**

**2021**

## **SUPERVISOR CERTIFICATION**

**I certify that this Project entitled (Tetrahedron Engine Drone for Photography Purpose) under my supervision at Dijlah university college, Department of Computer technical engineering in partial fulfillment of the requirements for the degree of bachelor in computer technical Engineering.**

**The Supervisor**

**Mohammed Wajeih Hussien**

**Signature**

**Dijlah University College**

**Department of Computer technical Engineering**

**Date:**

الآية

بسم الله الرحمن الرحيم

{يُزْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَ الَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ}

{المجادلة: 11}

# **Dedication**

**To the creative source of mercy and  
presence.... Allah...**

**To the basis of my humanity and its  
guide.... The prophet.**

**To my family**

**Who always stands beside me and  
encourage me**

**To all friends with love**

**To everyone who seeks for knowledge and  
learn .....**

## شكر وتقدير

نتوجه بفائق الشكر و التقدير الى استاذنا الفاضل الأستاذ (محمد وجيه) لما ابداه من توجيهات سديدة و سعة صدر طول مدة البحث فكان للمساته و توجيهاته العلمية الرصنة في اثراء و اغناء موضوع البحث .  
كذلك نتقدم بخالص الشكر و التقدير الى اساتذتنا الأفاضل الذين تتلمذنا على ايديهم خال رحلتنا الدراسية .  
كما نتقدم بخالص شكرنا و تقديرنا الى عمادة كلية ادجلة و رئاسة قسم هندسة تقنيات الحاسوب لما لمسته منهم عطا و علما و نسأل هلا ان يوفقهم في مجال عملهم .  
نختم شكرنا و تقديرنا الى كل الناس الطيبين الذين كانوا معنا في متابعة و مستمرة خال فترة كتابة البحث لما قدموه من عون و نسأل هلا تعالى ان يوفق الجميع و يجزيهم خير الجزاء .

## **Abstract**

Quadcopter is an unmanned aerial vehicle, which can be implemented in different applications. In project it will be represented a development of a quadcopter system and potential application in which it can be implemented. Quadcopter structure model, basic components with block diagram, hovering stability, dimensions, and description of basic movements will be represented and discussed. Control algorithms with steps in empirical methodology will also be presented. Current civil and military application will be examined, and future applications will be suggested.

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# Chapter One

## Introduction

### 1.1 Introduction

In the last few years, we have witnessed significant climate change in both the region and all over the world. Climate change is a lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions or in the distribution of weather around the average conditions (i.e., more or fewer extreme weather events) [1]. Many factors have been identified as significant for climate changes such as: plate tectonics, variations in solar radiation received by Earth and human activities, which has caused global warming increasing greenhouse gas levels. Analyzing climate change occurring around the world, it was determined that these changes, have more negative impact on both the people and the economy. Some of the disasters that have happened in the last few months on the territory of Serbia and region, which are caused by climate change, are: floods in Serbia (June 2013, April/May/Jun/July 2014) and region, the team snow drifts in Vojvodina (February 2014), fires caused by thunderstorms and wildfires (Serbia, Croatia, Greece, Russia, etc.. These data clearly indicate that it is necessary to develop a system for defining evacuation in safe way in case of natural disasters and accidents. The system described in this project consists of quadcopter equipped with cameras to capture different terrain (land or water), and a processing unit for processing the recorded state, which is placed on the vehicle / vessel or used as a handheld device. This system can be used in different kind of applications for example in: advertisements when taking pictures of sightseeing (tourism), buildings, etc., scenes in movies, performances and air shows with lights, fireworks, aerobatics, etc., industrial

applications for lifting tools and materials, diagnostics (observation of inaccessible places), finding missing persons, etc.

## **1.2 Objectives**

1. Building a quad drone that is capable of self-balancing and stabilization.
2. The drone is equipped with camera for capturing video for the flight
3. The drone may be used for taking pictures for the landmarks of the earth.

# Chapter Two

## Theoretical Background

### 2.1 Design of Quad-Copter

Quadcopter is a kind of unmanned aerial vehicle (UAV). UAV can generally be defined as a device used or intended to be used for flight in the air that has no on-board pilot [2]. These devices are sometimes referred to as drones, which are programmed for autonomous flight, and remotely piloted vehicles (RPVs), which are flown remotely by a ground control operator [3]. This fact in many cases can result in high maintenance and deployment costs particularly speaking in the industrial domain applications. Some applications implement an autonomous flight mode, however the autonomy here is intended as a simple path planning through several given points. Quadcopter can be used in applications such as aerial recognition, search-and-rescue, industrial monitoring missions among others. For instance, the Predator and Reaper, two drones built by General Atomics, which were used by the United States Air Force to recognition and combat over several countries [4]. A more pacific application of UAVs is monitoring agriculture as done by the company AGX Technologies that developed several configurations of aerial vehicle to map different varieties of plantations [5]. Dimensions of quadcopters can vary from the size of an insect to a size of a professional aerial vehicle. Dimensions differ according to the type of application in which this UAV are going to be implemented and the equipment they are taking. For example, in application where there is a need for detecting toxic substances in the air, quadcopter needs to be equipped with sensors (in most cases they are light) so the quadcopter can be small. In military applications, where the quadcopter needs to be equipped with camera, sensors, and sometimes weapons, quadcopter needs to be much

larger. Camera and adequate software can be used to provide imaging-based automatic inspection and analysis for such applications as automatic inspection, process control, and robot guidance in industry [6]. A quadcopter is a multirotor UAV that is lifted and propelled by four rotors. Quadcopters are classified as rotorcraft, as opposed to fixed-wing aircraft, because their lift is generated by a set of rotors (vertically oriented propellers). One of applications is in Amazon.com Inc., the world's largest online retailer. They announced their Prime Air service which is a new shipment system where a multi-rotor delivers packages to customers [7]. A quadcopter uses four propellers for thrust and has them configured in either a cross or plus format. The quadcopter robot can take off and land vertically which is a big advantage as it lowers the requirements for a landing platform. Also, it allows the quadcopter to hover in place with considerable stability. Hover stability prevents the quadcopter from crashing in the event of strong wind or due to its weight. Fig. 1 shows the six degrees of freedom of the quadcopter. In Fig. 1(a) (birds eye view),  $x$  and  $y$  represents the translational motion along the  $x$ - and  $y$ -axes respectively and  $\psi$  represents yaw, the rotational motion about the  $z$ -axis, while in Fig. 1(b) (frontal view),  $\theta$  represents roll, the rotational motion about the  $x$ -axis represents pitch, the rotational motion about the  $y$ -axis and  $z$  represents the translational motion in the direction perpendicular to ground. The label '1' signifies the front propeller

8. With a hover control unit, the quadcopter can hover at a constant height  $z$  with its roll and pitch angles stabilized by the gyroscope. The person at the command base will only need to control the quadcopter's motion along the  $x$ - and  $y$ -axes and also its rotation about the  $z$ -axis (to turn corners), reducing the degree of complexity from six to only three.

## **2.2 Quadcopter Model**

Quadcopters use 2 sets of identical fixed pitched propellers; 2 clockwise (CW) and 2 counter-clockwise (CCW). These use variation of RPM to control lift and torque. Control of vehicle motion is achieved by altering the rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics. The front and the rear propellers rotate counter-clockwise, while the left and the right ones turn clockwise. This configuration of opposite pairs directions re-moves the need for a tail rotor (needed instead in the standard helicopter structure). Fig. 2 shows the structure model in hovering condition, where all the propellers have the same speed [9]

## **2.3 Quadcopter Control Algorithm**

The PID (Proportional-Integral-Derivative) control algorithm has been considered and implemented in literature to control the hover altitude of the quadcopter [10], [11]. PID control is a type of linear control that is widely used in the robotics and automation industry [12]. The PID algorithm is popularly used mainly because [13]:

- It has a simple structure
- It provides good performance
- It can be tuned even if the specific model of the controlled plant or system is not available

A PID controller functions by calculating the error, or difference between a measured output and a desired setpoint and adjusts the system control inputs such that the calculated error is minimized. The PID algorithm consists mainly of three control parameters, P – Proportional, I –



Integral and D – Derivative. The mathematical expression of the discrete-time PID algorithm is given in (1). P determines the reaction to the current error; I determine the reaction based on a sum of recent errors while D responds to the rate at which the error has been changing. Calculation of the control input by control algorithms such as PID control may return a control input gain which may be too high for the quadcopter system. This results in a large control input magnitude which may be out of the limits recognizable by the system. To solve this problem, the linear quadratic regulation (LQR) method can be employed. LQR is a form of linear optimal control regulation which aims to reduce the magnitude of the control input without affecting the performance of the control algorithm [14]. The LQR algorithm is used to obtain the parameter settings that will minimize the undesired deviations (in this research, altitude) while at the same time limiting the energy expended by the control action by using a mathematical algorithm that minimizes a cost function or performance index with weighting factors. The cost function or performance index refers to the sum of deviations of measured values from its desired values [14].

## **2.4 Application of Quadcopter**

Quadcopters have been used, are being used or are actively being considered for different applications all over the world. They have range of potential environmental or commercial applications (emergency response, pollution detection, crop spraying, etc.). Also, they can be deployed in surveillance applications against civilians, such as applications in policing and border surveillance. Some police departments in Europe and North America have been using quadcopters since 2006. At least five police forces in the UK (Essex,

Merseyside, Staffordshire, Derbyshire and the British Transport police) have purchased or used micro-quadcopters. The range of potential applications is clear to police forces, where, for example, the South Coast Partnership between Kent Police and five other police forces in the UK is seeking to introduce drones (quadcopters) ‘into the routine work of the police, border authorities and other government agencies’ across the UK [15]. Police forces use quadcopters to monitor large crowds, prevent or detect crime and assist in incident responses. UK police have used quadcopters to monitor festivals, to monitor protests and to monitor the Olympic ceremony. In 2007, quadcopters were reported over political rallies in New York and Washington, DC. The CannaChopper has been deployed in the Netherlands and Switzerland against cannabis smokers, football fans at the European football championship in 2008 and “troublemakers” at the NATO summit in 2009. India has also recently begun using quadcopters to help secure sensitive sites and events [16]. A North Carolina county is using quadcopters with infrared cameras to monitor gatherings of motorcycle riders and to detect marijuana fields. In this deployment, the quadcopters fly a few hundred feet in the air, which is close enough to identify faces. Six police departments in Canada are using quadcopters in populated areas to record crime scenes and Canadian police are responsible for the first photographs taken by a quadcopter being admitted as evidence in court after the local police force used a quadcopter to photograph a homicide scene in 2007 [17]. Quadcopters may also be used to assist police in incident response. Merseyside police are credited with the first UK arrest using a quadcopter, where a car thief was tracked through undergrowth by the quadcopter’s thermal imaging camera. Once the teenage suspect’s location was detected by the Air Robot flying at 150 feet (45.7 m), the information was relayed to ground forces who arrested the youth. In Los Angeles, a sheriff’s department deployed their SkySeer drone to seek missing persons in rural areas, monitor accident or crime scenes and assist police in pursuits [18]. Quadcopters have been used in border surveillance operations in the USA since 2002. The US

is one of the most well documented users of UASs in this capacity along the US/Mexico border and the US/Canada border. In 2002, a US Marine operated Pioneer quadcopter intercepted people who were attempting to smuggle 45 kg of marijuana from Canada into the US [19]. In 2005, Predator quadcopter along Arizona's border with Mexico were integrated into a surveillance system that included seismic sensors, infrared cameras and laser illuminators. If the seismic sensor is triggered by drug smugglers, the Predator can investigate and, upon finding drug smugglers, tag them with its laser illuminator. With the GPS coordinates and the infrared illuminator, agents have no difficulty intercepting the smugglers [15].

# Chapter Three

## Materials and Methods

### 3.1 Materials

This Quad drone system consists of six main parts which are:

1. The Framework
2. Remote controller
3. Battery
4. Receiver
5. Flight Controller
6. ESC
7. Brushless Motors
8. Propellers
9. Wireless Camera

#### 3.1.1 The Framework

It was used F450 drone frame with landing frame



Fig (3-1): F450 Framework

### Features:

1. Built from quality glass fiber and polyamide nylon.
2. Integrated PCB connections for direct soldering of your ESCs.
3. Pre-threaded brass sleeves for all of the frame bolts.
4. Colored arms for orientation to keep you flying in the right direction.
5. Large mounting tabs on main frame bottom plate for easy camera mounting.
6. Easy assembly.

### Specification:

1. Width: 450mm
2. Height: 55mm
3. Weight: 280g (w/out electronics)
4. Motor Mount Bolt Holes: 16/19mm
5. Gross Weight: 395g
6. Wheelbase: 17.7in/450mm
7. Net weight: 272g

### 3.1.2 Remote controller

The remote controller is used to control the movement of the drone. It was used FS-I4 Remote controller from Fly Sky Co.



Fig (3-2): FS-I4 remote controller

Features:

1. Reliable, interference free 2.4GHz AFHDS 2A signal operation.
2. 4CH operation.
3. Use only 4 \* AA batteries for transmitter.
4. Quick and extremely stable in performance.
5. Simple binding procedure.

### Transmitter Specifications:

1. Channels: 4
2. Model type: fixed-wing/glider/helicopter
3. RF range: 2.405-2.475GHz
4. Bandwidth: 500KHz
5. Band: 142
6. RF power: less than 20dBm
7. 2.4G system: AFHDS 2A and AFHDS
8. Code type: GFSK
9. Sensitivity: 1024
10. Low voltage warning: less than 4.2V
11. DSC port: PS2; output: PPM
12. Charger port: no
13. ANT length: 26mm \* 2(dual antenna)
14. Power: 6V 1.5AA \* 4
15. Display mode: LED indicator
16. Size: 174 \* 89 \* 190mm
17. Weight: 335g

### 3.1.3 Battery

The battery used to power the drone is 11,1 volts and 5200 mAh Li\_PO4 rechargeable battery.

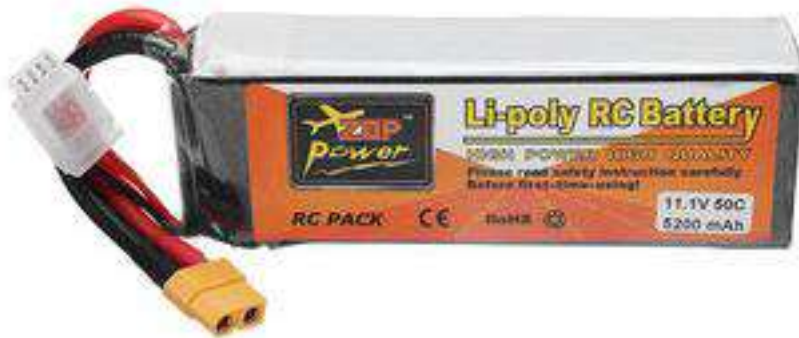


Fig (3-3): Drone battery

### 3.1.4 Receiver

The receiver gets the commands from the transmitter remote controller and sent it to the flight controller. The receiver used here is FS-6A from fly sky co.



Fig (3-4): FS-6A Receiver



#### Features:

1. 2.4GHz AFHDS 2A system
2. 2.4G modes: Automatic frequency second generation digital systems
3. Encoding: GFSK
4. I-BUS Port: No
5. Data Acquisition Port: No
6. Usage: Suitable for RC Airplane / glider / helicopter
7. Compatible Transmitter: For i4 i6 i10 GT2E GT2F GT2G

#### Specifications:

1. Channels:6
2. Model Type: Fixed-Wing/Glider/ Helicopter
3. RF Range:2.4055-2.475GHz
4. RF Channel:140
5. RF Receiver Sensitivity: -105dBm
6. Bandwidth:500KHz
7. Modulation Type: GFSK
8. Power:4.0-6.5V DC
9. Antenna Length:26mm
10. Color: Grey (Transparent)
11. Size:45\*22\*13mm (not including cable length)
12. Cable length:180mm

### **3.1.5 Flight Controller**

The flight controller is the brain of a drone. A small box filled with intelligent electronics and software, which monitors and controls everything the drone does. And just like the brains of different organisms, flight controllers also vary in sizes and complexity.

Functions of flight controller:

#### **1. Perception (sensing)**

The flight controller is connected to a set of sensors. These sensors give the flight controller information about like its height, orientation, and speed. Common sensors include an Inertial Measurement Unit (IMU) for determining the angular speed and acceleration, a barometer for the height, and distance sensors for detecting obstacles. Just like how we perceive as humans, the drone filters a lot of this information and fuses some to get more efficient and precise information. Advanced flight controllers can sense more precisely and detect differences more quickly.

#### **2. Controlling**

Aside from sensing what's going on, a flight controller... unsurprisingly controls the motion of the drone. The drone can rotate and accelerate by creating speed differences between each of its four motors. The flight controller uses the data gathered by the sensors to calculate the desired speed for each of the four motors. The flight controller sends this desired speed to the Electronic Speed Controllers (ESC's), which translates this desired speed into a signal that the motors can understand. Calculating the movements, fusing and filtering the sensory information, and estimating the safety and durability of a flight is all done by an algorithm. A fancy word that is used a lot nowadays which in essence nothing more than a set of strict rules that every microchip on the board has

to apply to. The most commonly used flight control algorithm is called PID control: Proportional Integral Derivative control. Within this area, there is a lot of research going on, which resulted in INDI: Incremental Nonlinear Dynamic Inversion. This algorithm reads out and reacts to incoming information way faster, therefore making the drone flight more stable.

### 3. Communicating

A key part of a flight controller is communication. A part of the sensor's job is to give out information that needs to be translated clearly for a pilot to read, which means efficiently. An obvious thing to communicate is its battery level, which can decide if a pilot wants to fly further or return to the charge.

But communication goes further than from flight controller to human pilot; with the entrance of auto-pilot programs in the drone industry, flight controllers need to communicate with other computer systems about its flight destination and how to get there. Communication is mostly done with wi-fi and radio frequencies right now, but cellular solutions are also already in use. The flight controller used there is: QQ Super Thunder Flight controller.



Fig (3-5): QQ super Thunder flight controller

### 3.1.6 ESC

It was used four 30A standard electronic speed controllers to control the four brushless motors

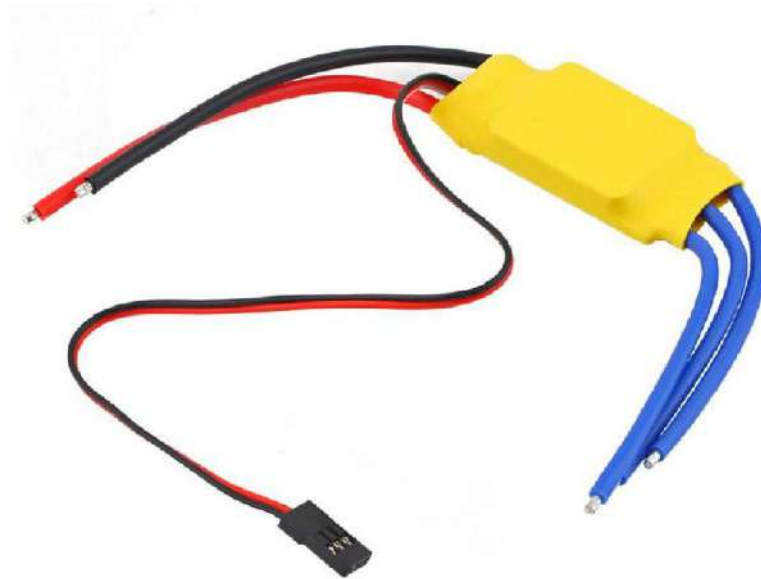


Fig (3-6): 30A ESC flight controller

#### SPECIFICATIONS:

1. MODEL: STANDARD 30A BLDC ESC ELECTRONIC SPEED CONTROLLER
2. WEIGHT & DIMENSIONS: 23g & 45.0\*24.0\*9.0mm
3. MATERIAL & COLOUR: NA & Yellow
4. CURRENT (A): 30A
5. BEC: 3A
6. PWM: N/A
7. LI-POLY: 2-3
8. NI-MH/NI-CD: 4-10 Ni-Mh
9. CONSTANT CURRENT: 30A Max 40A<10s
10. LI-POLY 2-3 CELLS; NI-MH 4-10 CELLS AUTO DETECT  
BREAK ON/OFF

### 3.1.7 Brushless Motors

In order to bear the weight of the drone and its components It was used four brushless motors with power of 180 watt each (980 KV). Two of the motors spin in clockwise direction and the other two spin counter clockwise.



Fig (3-7): 980KV brushless motors

### 3.1.8 Propellers

It was used four 1045 model propellers with the following specifications:

1. Material: carbon nylon
2. Size: 1 x 4.5". Diameter of Shaft: 6.mm
3. Thickness of center: 9.7mm
4. Recommended wheelbase: 550mm - 700mm
5. Recommended motor: 800KV - 1100KV



Fig (3-8): Propellers

### 3.1.9 Wireless camera

It was used an FVP wireless camera with the following features:

1. Support touch switch select channel frequency group.
2. Support NTSC / PAL switch, support vertical inverted image switch.
3. Support VTX power switchable
4. Wide lens angle.
5. Omni directional clover antenna
6. Miniature and light design.

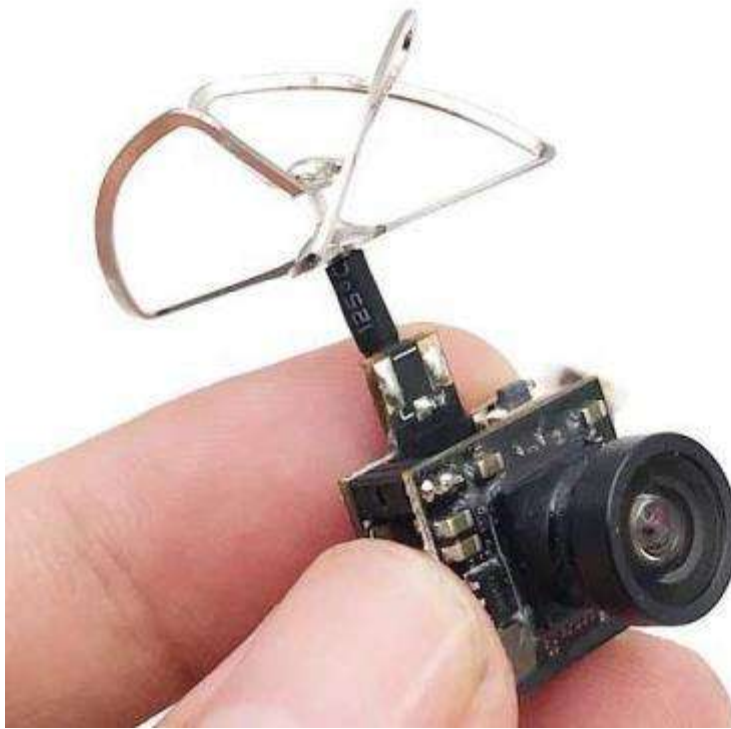


Fig (3-9): Wireless camera

Camera Specifications:

1. Model: HC48DS AIO FPV VTX Camera
2. Output power: 25 mw / 100 mw switchable
3. Camera resolution: 600TVL
4. Frequency Band: 5362-5945 MHz
5. Channel customers: 48

6. Modulation type: FM
7. Channel SEL: touch switch
8. Channel Show: CH1 – CH8 channel show with 8 LEDS and A-F bands
9. Frequency control: PLL
10. ALL harmonics: Max-50dBm
11. Frequency Stability: +/- 100 KHz (Type)
12. Frequency precision: +/- 200 KHz (type)
13. Channel carrier error: 1dB
14. Antenna Port: 50
15. Input format: NTSC
16. Sensor: NTSC: 640×480 1/4 CMOS
17. Objective angel: H: 120 degrees / V: 100 degrees
18. Base band interface: (P1.27 \* 2)
19. Supply voltage: 3.3-5.5V
20. Operating temperature: -10 degrees + 60 degrees
21. Weight: 4.1g

### **5.8GHz UVC Receiver**

In the mobile phone can be put into the double screen, glasses, experience from the perspective of the first-person flight. This is the newest version, add auto sweep and match frequency, Graphical interface, Snow screen 0.1s Delay. Sail model of affection and dedication, support any flight control, 150 frequency points + automatic sweep frequency + spectrum instrument graphical interface + snow display +..... more simple and beautiful appearance. Original 150-point full frequency band scan 1500 times to calculate the intensity of RSSI, locking the most accurate frequency. We increase the channel to 150, the accuracy is 2m, 2m is also the highest, and 2m basic can lock ninety-five percent signal points, which is the highest



accuracy of the chip. With a high accuracy, then the abstract radio, this thing is the mobile spectrum instrument, you can detect the quality of the antenna, the transmitter to do horizontal comparison, the factories electromagnetic environment testing, aircraft, etc.



Fig (3-10): Camera Video receiver

### Specifications:

1. Suit for android support UVC
2. Use environment: open, without shelter, without interference
3. Frequency range: 5645MHz~5945MHz
4. Resolution: 64030 480•fps
5. Operating current: USB 5V
6. Suitable temperature range: -10~65 DEG C

## 3.2 Working Principle

It is the propeller direction along with the drone's motor rotation and speed, which make its flight and maneuverability possible.

The quadcopter's flight controller sends information to the motors via their electronic speed control circuits (ESC) information on thrust, RPM, (Revolutions Per Minute) and direction. The flight controller will also combine IMU, Gyro and GPS data before signaling to the quadcopter motors on thrust and rotor speed.

While the drone and quadcopter technology of today is all modern, they still use the old principles of aircraft flight, gravity, action and reaction pairs.

In the manufacture of quadcopters, propellers and motor design, the 4 forces which affect all flight (weight, lift, thrust and drag) are also important considerations.

Mathematics is also used to calculate quadcopter motor thrust while aircraft aerodynamics is used for propeller design and the movement of air above, below and around the quadcopter.

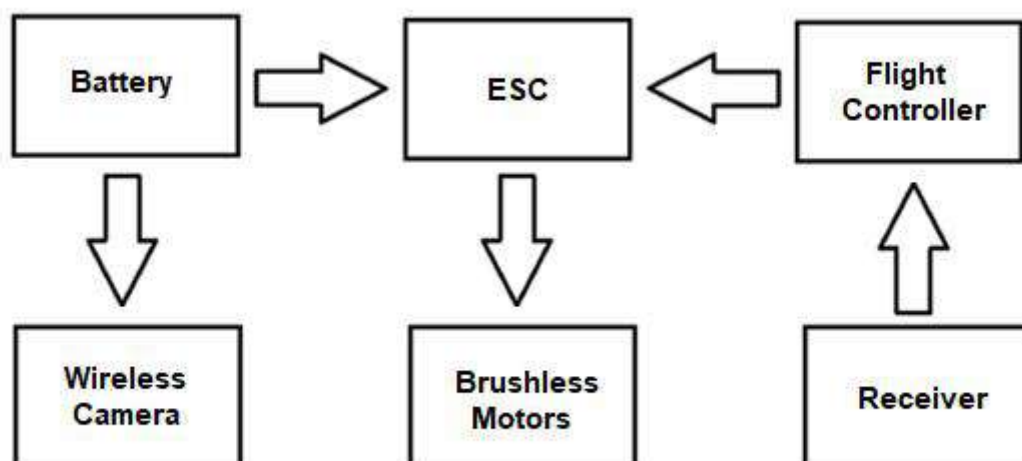


Fig (3-11): Device block diagram

Basically, the movement on the remote-control sticks, sends signals to the central flight controller. This central flight controller sends this information to the Electronic Speed Controllers (ESCs) of each motor, which in turn directs its motors to increase or decrease speed.

Now the central flight controller also takes information from IMU, Gyroscope, GPS modules and obstacle detection sensors if on the quadcopter. It makes computation calculations using programmed flight parameters and algorithms, then sends this data to the electronic speed controllers.

In fact, most flight controllers encompass the IMU, GPS, Gyroscope and plenty more features to control the quadcopter flight and stability.

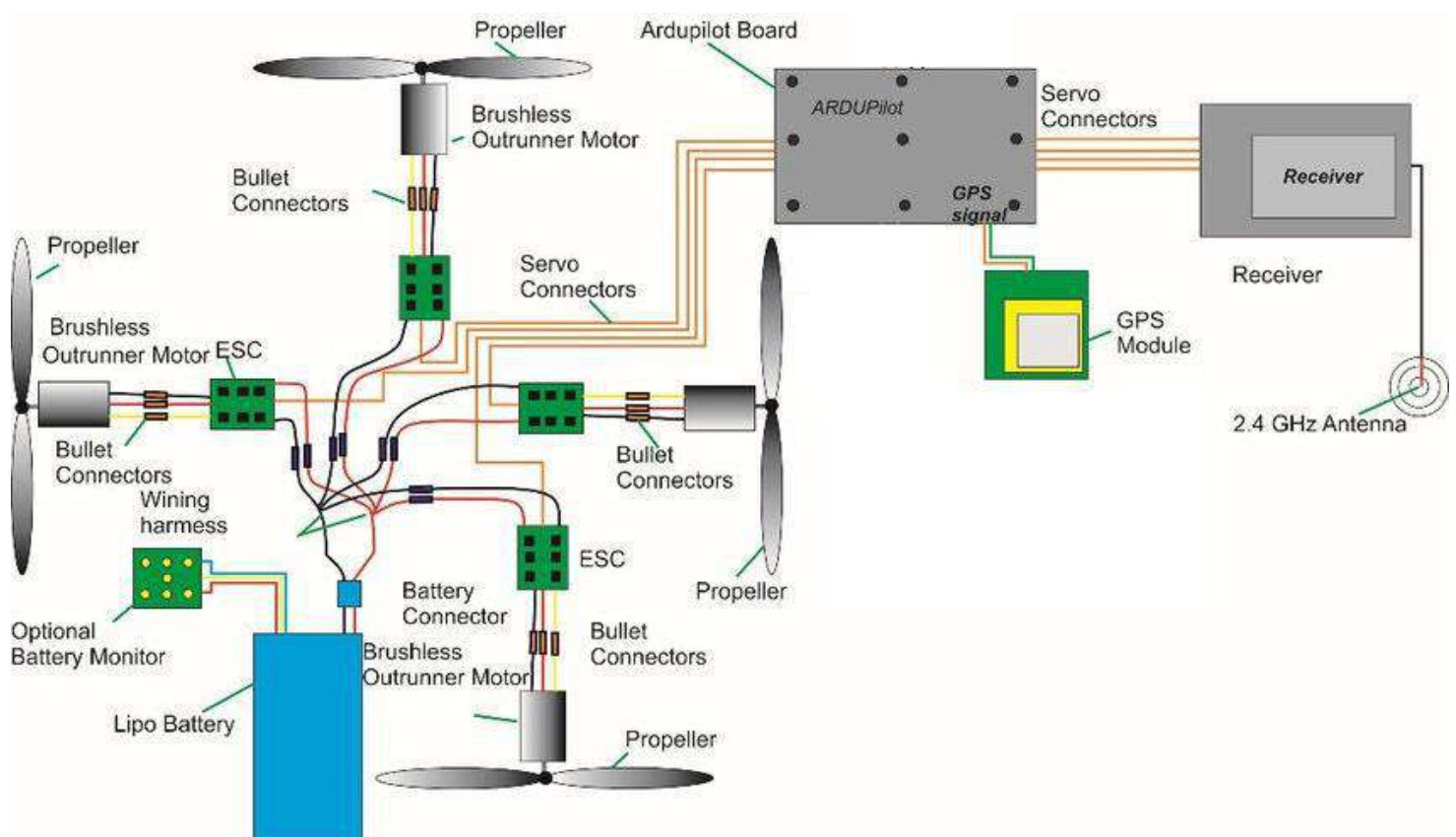


Fig (3-12): Wiring diagram

## Chapter Four

# Results and Discussion

### 4.1 Results

After connecting the different parts of the drone all together, we got our drone ready to calibrate and work



Fig (4-1): The final view for the drone

Then we did the calibration for the flight controller and the ESCs and the drone is tested for a while and video was captured for the flight.



Fig (4-2): The Drone while working



## **4.2 Discussion**

The theoretical analysis and motion study for a quadcopter system is completed. The various motion and motor coefficients are formulated. Based upon the requirements for our quadcopter design such as load capacity, camera weight and the thrust required, the final specifications for the motor are confirmed. The transmitter used in this project is FS-4a and the receiver is FS-6i both from fly sky co., the flight controller board that it was used in the research project is QQ Super Thunder connected with four standard 30A ESCs that it was used to drive our four 980 KV brushless motors, all the components are mounted on F450 frame with landing plastic framework. Then, the final assembly of the quadcopter was done and the assembled system was flown at high altitude.

## Chapter Five

# Conclusion and Future Work

### 5.1 Conclusion

Quadcopter is a special kind of vehicle, which can be implemented in different applications. In this project basic principles of quadcopter design as well as current applications are represented. In the future applications, quadcopter could be used for a variety of new policing functions. Quadcopter could be used for safety inspections, perimeter patrols around prisons and thermal imaging to check for cannabis being grown in roof lofts and other not easy to access locations. The police could use them to capture number plates of speeding drivers, for detecting theft from cash machines, railway monitoring, combat fly-posting, fly-tipping, abandoned vehicles, waste management. Future research will be in field of search and rescue. In future an effort will be directed to development of a system for defining evacuation/safe path in case of natural disasters and accidents. The system will consist of quadcopter which is equipped with a camera to capture different terrain (land or water) and a processing unit for processing the recorded condition which is placed on the vehicle/vessel or in form of handheld device. In addition to the situations of natural disasters and accidents it is possible to use this system in cases of climatic changes that affect the safety and health of the population, or in cases where it is endangering the functionality of different economic systems.

## **5.2 Future work**

The principal work to be done next is to ensure the drone's smoothness and stability. Besides, the feasibility of using the image processing has been investigated. The idea is to enable the drone to avoid obstacles and recognize people's faces in order to identify missing people, civilians, and criminals. Thus, working on this will enable us to eliminate criminal activities; especially, that there is a massive increase in crime rate in the world.

In addition, this can be used in favor of many institutes to record attendance by detecting faces without wasting time or effort. This is only one of many other applications that this general-purpose drone could be used to accomplish, which could have a huge impact on societies.

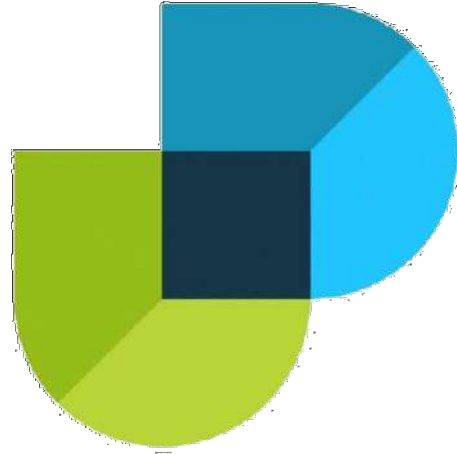


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كلية دجلة الجامعة  
قسم هندسة تقنيات  
الحاسوب



## طائرة بدون طيار ذات محرك رباعي السطوح لغرض التصوير

بحث مقدم الى كلية دجلة الجامعة – قسم هندسة تقنيات الحاسوب  
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3/26/2021

## **El-Gamal cryptosystem**

### **Encryption and Decryption**

**A Project Submitted to the Department of Computer  
Techniques Engineering  
Dijlah University College**

**In partial Fulfillment of the Requirement for the  
Degree of B. Eng. In Computer Techniques.**

**By:**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

وَقُلْ رَبِّ ادْخِلْنِي مُدْخَلَ

صِدْقٍ وَأَخْرِجْنِي مُخْرَجَ

صِدْقٍ وَاجْعَلْ لِي مِنْ لَدُنْكَ

سُلْطَانًا نَصِيرًا

صدق الله العظيم

سورة الاسراء (٨٠)

## **SUPERVISOR CERTIFICATION**

**I certify that this Project entitled El-Gamal  
cryptosystem Encryption and Decryption  
was prepared under my supervision at the Department  
of Computer Techniques Engineering, Dijlah University  
College - Baghdad, in partial fulfillment of the  
requirements for the degree of B. Eng. in Computer  
Techniques.**

**Signature:**

**Name: Dr. Ali Mohammed**

**Date:     /     / 201**

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**Abstract:**

Security is an essential requirement in the industrial world. Information leakage to competitors can cause financial problems for a company. Moreover, the wide use of the Internet as an environment for doing business and shopping calls for secure electronic transactions. Confidentiality of the information is through the use of encryption schemes. This paper proposes a new three-party extension of ElGamal encryption scheme and a multi-receiver extension of ElGamal encryption scheme. For both of the two proposed schemes, security and performance are analyzed. Finally, the application of El-Gamal encryption scheme in internet voting is studied for its importance nowadays.



# CHAPTER

# ONE

Introduction

1

## **1.1 Introduction:**

The vast expansion and rigorous treatment of cryptography is one of the major achievements in the security. Indeed, modern cryptography is strongly linked to complexity theory (in contrast to “classical” cryptography which is strongly related to information theory).

Modern cryptography is concerned with the construction of information systems that are robust against malicious attempts to make these systems deviate from their prescribed functionality. Indeed, the scope of modern cryptography is very broad, and it stands in contrast to “classical” cryptography (which has focused on the single problem of enabling secret communication over insecure communication media).

The design of cryptographic systems is a very difficult task. One cannot rely on intuitions regarding the “typical” state of the environment in which the system operates. For sure, the adversary attacking the system will try to manipulate the environment into “untypical” states.

Nor can one be content with counter-measures designed to withstand specific attacks, since the adversary (which acts after the design of the system is completed) will try to attack the schemes in ways that are different from the ones the designer had envisioned. The validity of the above assertions seems self-evident, but still some people hope that in practice ignoring these tautologies will not result in actual damage. (Goldreich,2005)

In cryptography, the encryption process is the process of transforming data using an algorithm or a mathematical function to make it unreadable to anyone except the intended receiver who knows the private key. The

ElGamal cryptosystem is a public key cryptosystem technique, whose security is based on the difficulty solving the discrete logarithm problem (Haraty , 2006).

This cryptosystem was invented in 1985 by the Egyptian cryptologist TaherElGamal. However this cryptosystem works over the finite cyclic group  $Z_p^*$  of the finite field (Schnorr, 2000), it's also used over a primitive root of a large prime number.

The cryptography in digital computing has been applied to different types of digital file formats such as text, images video etc.Indeed, because the need of information security, image encryption and decryption has been an important research area and it has wide application prospects. Therefore, this project focuses on applying one of the most public key cryptosystems ,which is the ElGamal cryptosystem over a primitive root of a large prime number.

## **1.2 The problem of Study:**

Public key cryptosystems generally have an elegant mathematical simplicity, and many textbooks describe them in these terms. However it is often the case that a simple implementation is not secure. In particular, (Allen,2008) describe several attacks on ElGamal and RSA which work well when the encrypted message is short and has not been preprocessed. The attacks on ElGamal also depend on the parameters used when creating the cryptosystem. The required parameters, while not commonly discussed in textbooks, are commonly used in practical implementations.

## **1.3 The Aim of Study**

The aim of this study is increasing the security of encryption. This process is using when we want to encrypt any message by ElGamal Cryptosystem. To apply this security, we use one of the statistical methods. This method is called the estimation. So, instead of considering the private key ( $a$ ) as  $2 \leq a \leq p-2$ , we will estimate it as the parameter of the statistical distribution. Furthermore, the distribution which is the data follow it (After doing the goodness of fit). These data represent the message after convert it to numerical values. Consequently, the main aim of this study is to develop the algorithm of ElGamal Cryptosystem by using the statistical methods.

# CHAPTER TWO

**Public-key Cryptosystem**

## 2.1 Public-key Cryptosystem:

### Public-key Cryptosystem

In a public-key cryptosystem, or asymmetric system, each user or application has a pair of permanent or long-term keys—a public key and a private key. The public key can be freely distributed or stored in a public directory, but the private key must be known only to the user or the user's cryptographic chip. Because the public and private keys must be mathematically related, the private key cannot be derived from the public key.

The advantage of public-key systems is that allow the transmission of secret messages without the need to exchange a secret key. To send a message, the sender obtains receiver's public key and uses it to encrypt the message. The receiver then decrypts the message using its private key as show in figure 1.1.

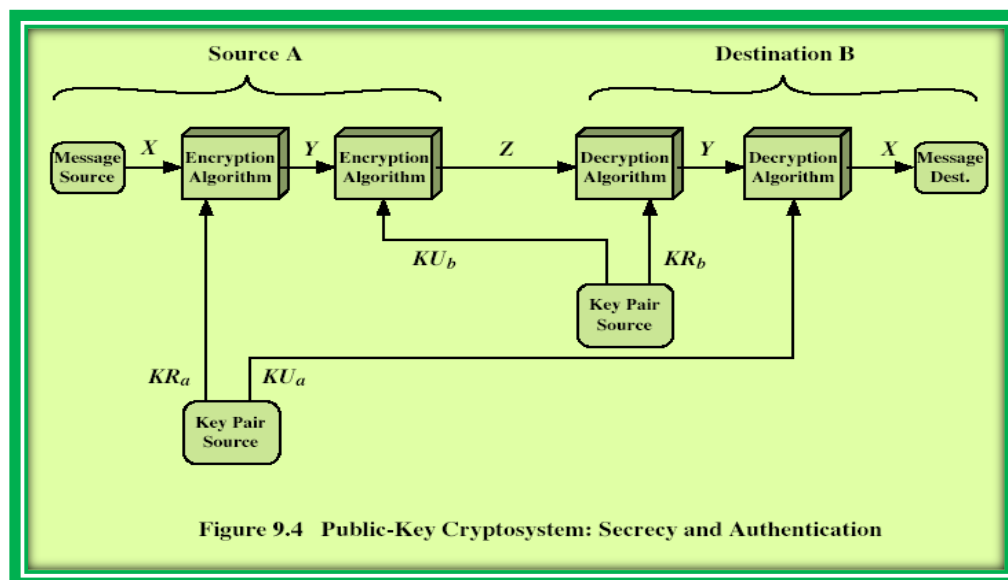


Figure 0.1public key cryptosystem

The sender's keys are not used (they would be used in a reply) [2]. Public-key cryptosystem can provide secrecy but not authenticity. This is true because a third party, with access to the receiver's public encryption key,

can inject bogus ciphertext that decrypts into meaningful plaintext. To get authenticity, it is necessary to combine a public-key cryptosystem with a public-key signature system.

## **2.2 RSA (cryptosystem):**

**RSA (Rivest–Shamir–Adleman)** is a public-key cryptosystem that is widely used for secure data transmission. It is also one of the oldest. The acronym **RSA** comes from the surnames of Ron Rivest, Adi Shamir and Leonard Adleman, who publicly described the algorithm in 1977. An equivalent system was developed secretly, in 1973 at GCHQ (the British signals intelligence agency), by the English mathematician Clifford Cocks. That system was declassified in 1997.<sup>[1]</sup>

In a public-key cryptosystem, the encryption key is public and distinct from the decryption key, which is kept secret (private). An RSA user creates and publishes a public key based on two large prime numbers, along with an auxiliary value. The prime numbers are kept secret. Messages can be encrypted by anyone, via the public key, but can only be decoded by someone who knows the prime numbers.<sup>[2]</sup>

The security of RSA relies on the practical difficulty of factoring the product of two large prime numbers, the "factoring problem". Breaking RSA encryption is known as the RSA problem. Whether it is as difficult as the factoring problem is an open question.<sup>[3]</sup> There are no published methods to defeat the system if a large enough key is used.

RSA is a relatively slow algorithm. Because of this, it is not commonly used to directly encrypt user data. More often, RSA is used to transmit shared keys for symmetric key cryptography, which are then used for bulk encryption-decryption.

## **2.3 ElGamal Cryptosystem**

Along with RSA, there are other public-key cryptosystems proposed. Many of them are based on different versions of the Discrete Logarithm Problem.

ElGamal cryptosystem, called Elliptic Curve Variant, is based on the Discrete Logarithm Problem. It derives the strength from the assumption

that the discrete logarithms cannot be found in practical time frame for a given number, while the inverse operation of the power can be computed efficiently.

Let us go through a simple version of ElGamal that works with numbers modulo  $p$ . In the case of elliptic curve variants, it is based on quite different number systems.

## 2.4 Generation of ElGamal Key Pair

Each user of ElGamal cryptosystem generates the key pair through as follows –

- **Choosing a large prime  $p$ .** Generally a prime number of 1024 to 2048 bits length is chosen.
- **Choosing a generator element  $g$ .**
  - This number must be between 1 and  $p - 1$ , but cannot be any number.
  - It is a generator of the multiplicative group of integers modulo  $p$ . This means for every integer  $m$  co-prime to  $p$ , there is an integer  $k$  such that  $g^k = a \pmod{p}$ .

For example, 3 is generator of group 5 ( $Z_5 = \{1, 2, 3, 4\}$ ).

**$N \quad 3^n \quad 3^n \pmod{5}$**

1 3 3

2 9 4

3 27 2

4 81 1

- **Choosing the private key.** The private key  $x$  is any number bigger than 1 and smaller than  $p-1$ .
- **Computing part of the public key.** The value  $y$  is computed from the parameters  $p$ ,  $g$  and the private key  $x$  as follows –

$$y = g^x \pmod{p}$$

- **Obtaining Public key.** The ElGamal public key consists of the three parameters  $(p, g, y)$ .



For example, suppose that  $p = 17$  and that  $g = 6$  (It can be confirmed that 6 is a generator of group  $Z_{17}$ ). The private key  $x$  can be any number bigger than 1 and smaller than 16, so we choose  $x = 5$ . The value  $y$  is then computed as follows –

$$y = 6^5 \bmod 17 = 7$$

- Thus the private key is 5 and the public key is (17, 6, 7).

## 2.5 Encryption

Suppose sender wishes to send a plaintext to someone whose ElGamal public key is  $(p, g, y)$ , then –

- Sender represents the plaintext as a series of numbers modulo  $p$ .
- To encrypt the first plaintext  $P$ , which is represented as a number modulo  $p$ . The encryption process to obtain the ciphertext  $C$  is as follows –
  - Randomly generate a number  $k$ ;
  - Compute two values  $C1$  and  $C2$ , where –

$$C1 = g^k \bmod p$$
$$C2 = (P * y^k) \bmod p$$

- Send the ciphertext  $C$ , consisting of the two separate values  $(C1, C2)$ , sent together.
- Referring to our ElGamal key generation example given above, the plaintext  $P = 13$  is encrypted as follows –
  - Randomly generate a number, say  $k = 10$
  - Compute the two values  $C1$  and  $C2$ , where –

$$C1 = 6^{10} \bmod 17$$
$$C2 = (13 * 7^{10}) \bmod 17 = 9$$

- Send the ciphertext  $C = (C1, C2) = (15, 9)$ .

## 2.6 Decryption :

- To decrypt the ciphertext (C1, C2) using private key x, the following two steps are taken –
  - Compute the modular inverse of  $(C1)^x$  modulo p, which is  $(C1)^{-x}$ , generally referred to as decryption factor.
  - Obtain the plaintext by using the following formula –

$$C2 \times (C1)^{-x} \bmod p = \text{Plaintext}$$

- In our example, to decrypt the ciphertext  $C = (C1, C2) = (15, 9)$  using private key  $x = 5$ , the decryption factor is

$$15^{-5} \bmod 17 = 9$$

- Extract plaintext  $P = (9 \times 9) \bmod 17 = 13$ .

## 2.7 Practical use ElGamal:

Like most public key systems, the ElGamal cryptosystem is usually used as part of a hybrid cryptosystem where the message itself is encrypted using a symmetric cryptosystem and ElGamal is then used to encrypt only the symmetric key. This is because asymmetric cryptosystems like ElGamal are usually slower than symmetric ones for the same level of security, so it is faster to encrypt the message, which can be arbitrarily large, with a symmetric cipher, and then use ElGamal only to encrypt the symmetric key, which usually is quite small compared to the size of the message.

## 2.8 Security ElGamal :

The security of the ElGamal scheme depends on the properties of the underlying group as well as any padding scheme used on the messages.

If the computational Diffie–Hellman assumption (CDH) holds in the underlying cyclic group  $G$ , then the encryption function is one-way.

If the decisional Diffie–Hellman assumption (DDH) holds in  $G$ , then ElGamal achieves semantic security;. Semantic security is not implied by the computational Diffie–Hellman assumption alone. See decisional Diffie–Hellman assumption for a discussion of groups where the assumption is believed to hold.

ElGamal encryption is unconditionally malleable, and therefore is not secure under chosen ciphertext attack. For example, given an encryption of some (possibly unknown) message  $m$ , one can easily construct a valid encryption of the message  $2m$ .

To achieve chosen-ciphertext security, the scheme must be further modified, or an appropriate padding scheme must be used. Depending on the modification, the DDH assumption may or may not be necessary.

Other schemes related to ElGamal which achieve security against chosen ciphertext attacks have also been proposed. The Cramer–Shoup cryptosystem is secure under chosen ciphertext attack assuming DDH holds for  $G$ . Its proof does not use the random oracle model. Another proposed scheme is DHAES, whose proof requires an assumption that is weaker than the DDH assumption.

# CHAPTER THREE

Implementation Of ElGamal cryptosystem

**ElGama**l is a public key method that is used in both encryption and digital signing. It is used in many applications and uses discrete logarithms. At the root is the generation of P which is a **prime number** and G (which is a value between 1 and P-1) [[Theory](#)].

Try example (P=71, G=33, x=62, M=15 and y=31)

Generate P, G, x (random), k (random) and Message

First Bob generates a prime number (p) and a number (g) which is between 1 and (p-1):

P: 4457

G: 2666

Bob select a random number (x) which will be his private key:

Bob selects a random number(x) 192

He then calculates Y:

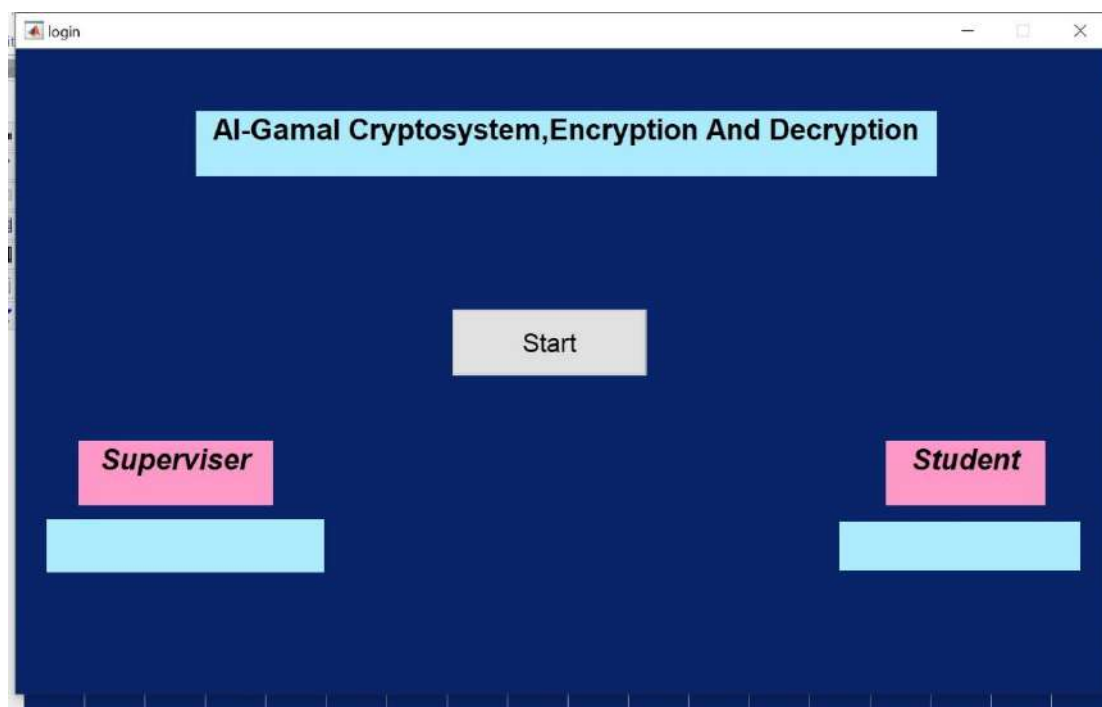
Y: 1380  $Y = G^x \text{mod } P$   $Y = G^x \text{mod } P$

Bob public key is now [P,G,Y] and sends g, p and Y to Alice. The private key is x Alice then creates a message:

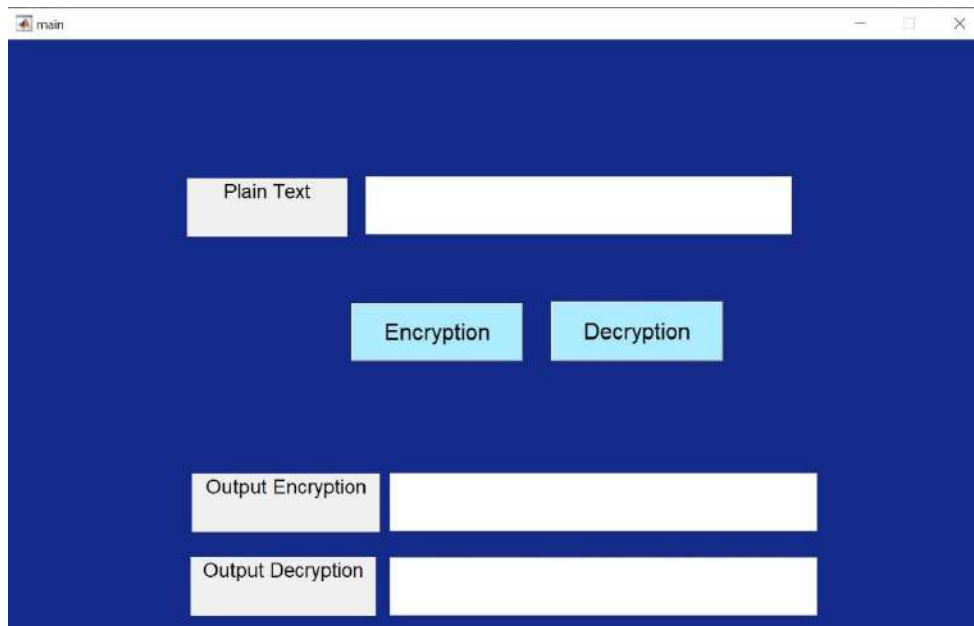
Message (to send) 15

### 3.1 - Design and implementation of the project:

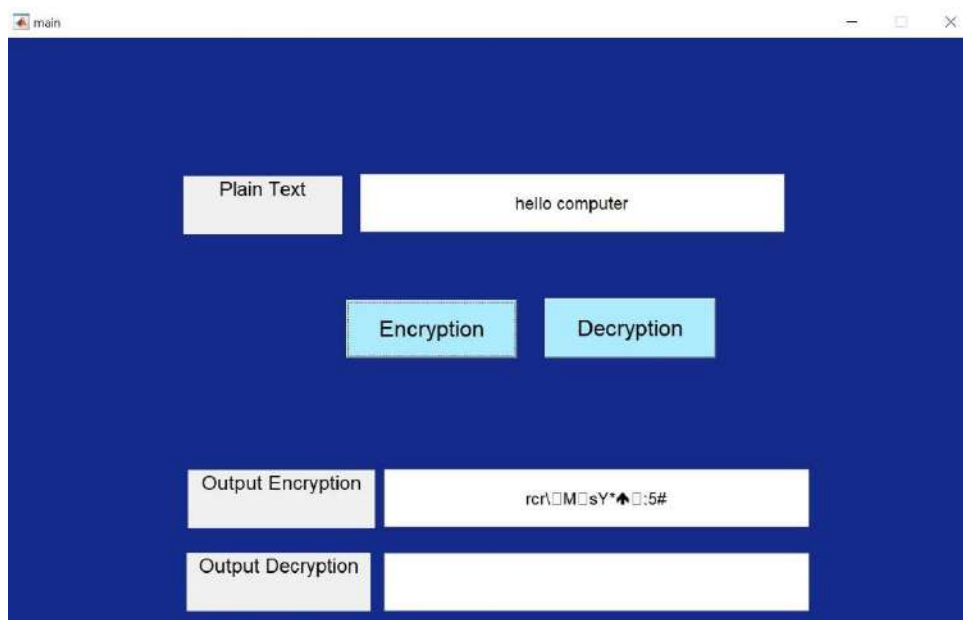
1-3 at the start of the implementation of the project in the program Matlab shows the next window through which we can enter the project:



2-3 – After pressing Enter, the main encryption window appears and the encryption is opened as shown in the following image:



3-3 When you enter the plain text and the text to be encrypted and choose the Encrypt button, the following result appears:



3-4 After the text has been encrypted within the text, it is possible to open the encryption by clicking on the Open Encryption command to show the following result:

main

Plain Text	hello computer
Encryption	Decryption
Output Encryption	rcr\ M sY* 5#
Output Decryption	hello computer



# CHAPTER FOUR

Conclusion and Future work

## **4.1 Conclusions**

The security of the ELGamal Cryptosystem algorithm is based on the difficulty of prime numbers . The text encryption and decryption algorithm is deliberated and realized to afford privacy and protection. This project shows successful implementation of text encryption and decryption. In this study, we showed using of the statistical methods in ELGamal Cryptosystem make it more efficient and increase the security. Especially, when we used the software, MATLAB language. The proposed methodology is applied for ensuring the personal privacy in messages.

## **4.2. Future Work**

The topics explored and results obtained in this project could potentially be the starting points for research in a number of different directions.

1. The application of this algorithm to other methods of statistical over variable.
2. Merge more than a way statistical algorithm beauty even more than from a security encryption.

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## APPENDIX

### Code all function in main GUI Matlab :

```
function varargout = main(varargin)

% function varargout = main(varargin)
% MAIN MATLAB code for main.fig
%     MAIN, by itself, creates a new MAIN or
%     raises the existing
%     singleton*.
%
%     H = MAIN returns the handle to a new
%     MAIN or the handle to
%     the existing singleton*.
%
%
% MAIN('CALLBACK',hObject,eventData,handles,...
%) calls the local
%     function named CALLBACK in MAIN.M with
%     the given input arguments.
%
%     MAIN('Property','Value',...) creates a
%     new MAIN or raises the
%     existing singleton*. Starting from
%     the left, property value pairs are
%     applied to the GUI before
%     main_OpeningFcn gets called. An
%     unrecognized property name or invalid
%     value makes property application
%     stop. All inputs are passed to
%     main_OpeningFcn via varargin.
%
%     *See GUI Options on GUIDE's Tools
%     menu. Choose "GUI allows only one
%     instance to run (singleton)".
```

```

%
% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response
to help main

% Last Modified by GUIDE v2.5 24-Mar-2021
08:42:01

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name',
    mfilename, ...
    'gui_Singleton',
    gui_Singleton, ...
    'gui_OpeningFcn',
    @main_OpeningFcn, ...
    'gui_OutputFcn',
    @main_OutputFcn, ...
    'gui_LayoutFcn', [], ...
    'gui_Callback', []);
if nargin && ischar(varargin{1})
    gui_State.gui_Callback =
str2func(varargin{1});
end

if nargout
    [varargout{1:nargout}] =
gui_mainfcn(gui_State, varargin{:});
else
    gui_mainfcn(gui_State, varargin{:});
end
% End initialization code - DO NOT EDIT

% --- Executes just before main is made
visible.
function main_OpeningFcn(hObject, eventdata,
handles, varargin)
% This function has no output args, see
OutputFcn.
% hObject    handle to figure

```

```

% eventdata reserved - to be defined in a
future version of MATLAB
% handles structure with handles and user
data (see GUIDATA)
% varargin command line arguments to main
(see VARARGIN)

% Choose default command line output for main
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% UIWAIT makes main wait for user response
(see UIRESUME)
% uiwait(handles.figure1);

% --- Outputs from this function are returned
to the command line.
function varargout = main_OutputFcn(hObject,
eventdata, handles)
% varargout cell array for returning output
args (see VARARGOUT);
% hObject handle to figure
% eventdata reserved - to be defined in a
future version of MATLAB
% handles structure with handles and user
data (see GUIDATA)

% Get default command line output from
handles structure
varargout{1} = handles.output;

function edit1_Callback(hObject, eventdata,
handles)
% hObject handle to edit1 (see GCBO)
% eventdata reserved - to be defined in a
future version of MATLAB

```

```

% handles      structure with handles and user
data (see GUIDATA)

% Hints: get(hObject,'String') returns
contents of edit1 as text
%          str2double(get(hObject,'String'))
returns contents of edit1 as a double

% --- Executes during object creation, after
setting all properties.
function edit1_CreateFcn(hObject, eventdata,
handles)
% hObject      handle to edit1 (see GCBO)
% eventdata    reserved - to be defined in a
future version of MATLAB
% handles      empty - handles not created
until after all CreateFcns called

% Hint: edit controls usually have a white
background on Windows.
%          See ISPC and COMPUTER.
if ispc &&
isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end

function edit2_Callback(hObject, eventdata,
handles)
% hObject      handle to edit2 (see GCBO)
% eventdata    reserved - to be defined in a
future version of MATLAB
% handles      structure with handles and user
data (see GUIDATA)

% Hints: get(hObject,'String') returns
contents of edit2 as text
%          str2double(get(hObject,'String'))
returns contents of edit2 as a double

```



```

% --- Executes during object creation, after
setting all properties.
function edit2_CreateFcn(hObject, eventdata,
handles)
% hObject      handle to edit2 (see GCBO)
% eventdata    reserved - to be defined in a
future version of MATLAB
% handles      empty - handles not created
until after all CreateFcns called

% Hint: edit controls usually have a white
background on Windows.
%           See ISPC and COMPUTER.
if ispc &&
isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end

% --- Executes on button press in
pushbutton1.
function pushbutton1_Callback(hObject,
eventdata, handles)
% hObject      handle to pushbutton1 (see GCBO)
% eventdata    reserved - to be defined in a
future version of MATLAB
% handles      structure with handles and user
data (see GUIDATA)
clc

text=get(handles.edit1, 'string');

global m
m= 15;
global q
q= 2^m;
%%

```

```

% Find a primitive polynomial and group
generator. Set the random number
% generator seed to produce a repeatable
result.

poly = primpoly(m, 'nodisplay');

primeFactors = unique(factor(2^m-1));
rng(123456);
while 1
    g = gf(randi([1, q-1]), m, poly);
    isPrimitive = true;
    for i = 1:length(primeFactors)
        if g^((q-1)/primeFactors(i)) == gf(1,
m, poly)
            isPrimitive = false;
            break;
        end
    end
    if isPrimitive
        break;
    end
end
%%
% Construct private and public keys.

global privateKey ;
privateKey = 7;
global publicKey ;
publicKey = {g, g^privateKey, poly};
global decrypt1
%% Encryption
% Create and display the original message.

%%
% Convert the message to binary and group
them every m bits.

binMsg = de2bi(int8(text), 7, 'left-msb');
numPaddedBits = m - mod(numel(binMsg), m);
if numPaddedBits == m

```

```

        numPaddedBits = 0;
    end
    binMsg = [binMsg(:); zeros(numPaddedBits,
    1)];
    textToEncrypt = bi2de(reshape(binMsg, [], m),
    'left-msb');
    %%
    % Encrypt the original message.

    cipherText =
    gf(zeros(length(textToEncrypt),2), m, poly);
    decrypt1=cipherText;
    for i = 1:length(textToEncrypt)
        k = randi([1 2^m-2]);
        cipherText(i,:) = [publicKey{1}^k, ...

    gf(textToEncrypt(i),m,poly)*publicKey{2}^k];
    end
    %%
    % Display the encrypted message.

    tmp = cipherText.x;
    encrypt=(de2char(tmp(:,2), m))
    set(handles.edit3, 'String', encrypt);

    %set(handles.edit3, 'String', cipher);
    % disp(strcat('Hidden text= ',c));

    % --- Executes on button press in
    pushbutton2.

    function pushbutton2_Callback(hObject,
    eventdata, handles)
    % hObject      handle to pushbutton2 (see GCBO)
    % eventdata    reserved - to be defined in a
    future version of MATLAB
    % handles      structure with handles and user
    data (see GUIDATA)
    clc
    global m

```

```

global q
global privateKey ;

global publicKey ;
global decrypt1;
poly = primpoly(m, 'nodisplay');

primeFactors = unique(factor(2^m-1));
rng(123456);
while 1
    g = gf(randi([1, q-1]), m, poly);
    isPrimitive = true;
    for i = 1:length(primeFactors)
        if g^((q-1)/primeFactors(i)) == gf(1,
m, poly)
            isPrimitive = false;
            break;
        end
    end
    if isPrimitive
        break;
    end
end
cipherText=get(handles.edit1 , 'string');
% Decrypt the encrypted original message.
decrypt1=cipherText;
decipherText = gf(zeros(size(cipherText,
1),1), m, poly);

for i = 1:size(cipherText, 1)

end
%%
% Display the decrypted message.

disp(de2char(decipherText.x, m))

set(handles.edit4, 'String', decrypt1);

```

```
function edit3_Callback(hObject, eventdata,  
handles)  
% hObject      handle to edit3 (see GCBO)  
% eventdata    reserved - to be defined in a  
future version of MATLAB  
% handles      structure with handles and user  
data (see GUIDATA)
```

```
% Hints: get(hObject,'String') returns  
contents of edit3 as text  
%           str2double(get(hObject,'String'))  
returns contents of edit3 as a double
```

```
% --- Executes during object creation, after  
setting all properties.
```

```
function edit3_CreateFcn(hObject, eventdata,  
handles)
```

```
% hObject      handle to edit3 (see GCBO)  
% eventdata    reserved - to be defined in a  
future version of MATLAB  
% handles      empty - handles not created  
until after all CreateFcns called
```

```
% Hint: edit controls usually have a white  
background on Windows.
```

```
%           See ISPC and COMPUTER.
```

```
if ispc &&  
isequal(get(hObject,'BackgroundColor'),  
get(0,'defaultUiControlBackgroundColor'))  
    set(hObject,'BackgroundColor','white');  
end
```

```
function edit4_Callback(hObject, eventdata,  
handles)
```

```
% hObject      handle to edit4 (see GCBO)  
% eventdata    reserved - to be defined in a  
future version of MATLAB  
% handles      structure with handles and user  
data (see GUIDATA)
```

```
% Hints: get(hObject,'String') returns
contents of edit4 as text
%         str2double(get(hObject,'String'))
returns contents of edit4 as a double

% --- Executes during object creation, after
setting all properties.
function edit4_CreateFcn(hObject, eventdata,
handles)
% hObject      handle to edit4 (see GCBO)
% eventdata    reserved - to be defined in a
future version of MATLAB
% handles      empty - handles not created
until after all CreateFcns called

% Hint: edit controls usually have a white
background on Windows.
%         See ISPC and COMPUTER.
if ispc &&
isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end
```



3/26/2021

## نظام تشفير الجمل

### التشفير وفك التشفير

بحث مقدم الى جامعة دجلة – قسم هندسة تقنيات الحاسوب  
كجزء من متطلبات منح درجة بكالوريوس هندسة في تقنيات الحاسوب

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## المخلص:

الأمن مطلب أساسي في العالم الصناعي. يمكن أن يتسبب تسرب المعلومات للمنافسين في مشاكل مالية للشركة. علاوة على ذلك ، فإن الاستخدام الواسع للإنترنت كبيئة لممارسة الأعمال التجارية والتسوق يستدعي إجراء معاملات إلكترونية آمنة. سرية المعلومات من خلال استخدام أنظمة التشفير. تقترح هذه الورقة توسعاً جديداً ثلاثي الأطراف لمخطط تشفير الجمل وامتداداً متعدد المستقبلات لنظام تشفير الجمل. لكل من المخططين المقترحين ، يتم تحليل الأمان والأداء. أخيراً ، تمت دراسة تطبيق نظام تشفير الجمل في التصويت عبر الإنترنت لأهميته في الوقت الحاضر.