Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF ARDUINO AND IOT-BASED SMART HOME SAFETY SYSTEM

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Bachelor of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

2021

DEVELOPMENT OF ARDUINO AND IOT-BASED SMART HOME SAFETY SYSTEM

MANOTHE KUMAR A/L ANNAMALAI

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I declare that this project report entitled “Development of Arduino and IoT-Based Smart home Safety System” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Student Name : MANOTHE KUMAR A/L ANNAMALAI

Date : 2 January 2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

Signature : .....

Supervisor Name : TS. MOHD HANIF BIN CHE HASAN

Date : 7 February 2022

Signature : .....

Co-Supervisor Name (if any) : .....

Date : .....

DEDICATION

To my beloved mother, Danam, and father, Annamalai ,

and

To my dearest Siblings,

ABSTRACT

There are too many theft and accidents happens in the home itself. Cooking Gas leaking fire accidents, fire accidents then the accidents that causes by natural disaster like earth quake and flood. Then the robbery and theft cases were increasing, this kind of things will threaten the people living in the house and who away from the house. This Development of Arduino and IoT-Based Smart home Safety System is recommended do all class people because it is a compilation of fire detection system, theft detection system, LPG gas detection system, earthquake detection system and also flood detection system. All these systems are in the process of compiling in one system is integrated with IoT system. This system designed with several sensors that is useful to fulfil the criteria of the project. Those sensors are MQ2 sensor, Rain sensor, MPU-6050, PIR sensor, Flame sensor to integrate with Arduino Board and ESP32.

ABSTRAK

Kini terdapat terlalu banyak kecurian dan kemalangan yang berlaku di rumah. Kebocoran gas LPG, kemalangan kebakaran kemudian kemalangan yang disebabkan oleh bencana alam seperti gempa bumi dan banjir. Kemudian kes rompakan atau kecurian semakin meningkat, perkara seperti ini akan mengancam seorang yang tinggal di rumah dan orang yang jauh dari rumah. Pengembangan Sistem Keselamatan Rumah Pintar Berasaskan Arduino dan IoT ini disarankan untuk semua golongan kelas kerana ia adalah penyusunan sistem pengesanan kebakaran, sistem pengesanan pencurian, sistem pengesanan gas LPG, sistem pengesanan gempa bumi dan juga sistem pengesanan banjir. Semua sistem ini dalam proses penyusunan dalam satu sistem disatukan dengan sistem IoT. Sistem ini direka dengan beberapa sensor yang berguna untuk memenuhi kriteria projek. Penderia tersebut ialah penderia MQ2, Penderia hujan, MPU-6050, penderia PIR, Penderia api untuk disepadukan dengan Papan Arduino dan ESP32.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Mr. Ts. Mohd Hanif bin Che Hasan for his precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) and my faculty FTKEE for the financial support which enables me to accomplish the project. Not forgetting my fellow friends for the willingness of sharing their thoughts and ideas regarding to the project.

My highest appreciation goes to my parents and family members for their love and prayer during the period of my study. An honourable mention also goes to my supervisor Mr. Ts. Mohd Hanif bin Che Hasan for all the motivation and understanding.

Finally, I would like to thank all the staffs at the FTKEE , fellow friends and classmates, the Faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

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LIST OF SYMBOLS

°C	-	Celsius
Hz	-	Hertz
dB	-	Decibel
mol	-	Moles

LIST OF ABBREVIATIONS

V	-	Voltage
IoT	-	Internet of Things
PIR	-	Passive infrared
GSM	-	Global system for mobile communication
GPS	-	Global Positioning system
GPRS	-	General Packet Radio Service
IDE	-	Integrated development environment
Wi-Fi	-	Wireless Fidelity
IP	-	Internet Protocol

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this era there are too many theft and accidents happens in the home itself. Cooking Gas leaking fire accidents, fire accidents then the accidents that causes by natural disaster like earth quake and flood. Then the robbery and theft cases were increasing, this kind of things will threaten the people living in the house and who away from the house.

1.2 Background

There is a lot of smart home security system designs and patterns available in current markets. Those products are attractive and beneficial to the customers however, due to the evolution of technology previous designs and previous ideas needed some modification which is adaptable to the current technologies. The aim of this project is to provide an organized security system which able to notify to the owner and to the respective parties immediately without any interruption. To make this idea alive the project has to be integrated with internet of things. Internet of things is considered as an advance technology to receive an information from a sensor or any device.

1.3 Problem Statement

The problem statements are the important criteria to motivate a project approach. It indicates the future works of the previous related projects and the problem statements are:

- A lot fire accident cannot be detected in early stages.
- There is a lot of theft cases because of insufficient monitoring system.
- The house owner not able to find theft when they are not around the house so they cannot ask for the police help.
- The natural disasters like earthquake and flooding cannot be monitored.

1.4 Project Objective

The main aim of this project is to propose a systematic and effective methodology to detect the upcoming dangers and notify to the respective person , the objectives are as follows:

a) To design a smart home safety system using Arduino as microcontroller and Esp32 as Wi-Fi module.

b) To develop a safety alarm system that detects various kind of mishaps.

c) To fabricate a smart home safety system that allows user to monitor the house through smartphone.

1.5 Scope of Project

This section is to make sure the flows of projects in right way. The scope of this project are as follows:

a) Arduino is the Microcontroller to direct all the sensors.

b) The MQ-2 Gas sensor will detect the LPG gas

c) The MPU-6050 will be the Earth quake sensor

d) The rain sensor module will be the Flood detecting sensor.

e) The PIR sensor will be detecting the suspicious movement.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this era there are too many theft and accidents happens in the home itself. Cooking Gas leaking fire accidents, fire accidents then the accidents that causes by natural disaster like earth quake and flood. Then the robbery and theft cases were increasing, this kind of things will threaten the people living in the house and who away from the house. This is the most integral part to be carried out in a final year project assessment. This part consists of the studies of other researches and the way they approach their problem statements and solve it to achieve their objectives. Classifying the keyword and specification of our own project will lead us to the right journal papers.

First of all according to my project I have to find a proper and optimistic controller to control and grab information from various sensors. That controller also should perform some automation functions. From my expectation it should be a good controller in a lot of aspect. Especially the particular controller should be able to receive alert signals from various sensors and send the information to the Wi-fi module. Important tasks that should be carry out by the controller are, should be compatible to a LPG gas sensor, Motion Sensor, Earth Quake sensor, Water sensor, Fire sensor.

It also should be able to connect and compatible with a Wi-fi module. The researches on those sensors are also will be a good contribution for further project

development because every sensors characteristics should be align with the process and workflow.

This section will be a presentation of previous smart home security system researches and to discuss about the way they approach their research. Following are the contribution of them for the upcoming development on this field:

2.2 Microcontroller

Salha M. Alzahrani et al[3] proposed a study based on sensing for the Internet of things and it's application in the year of 2017. The basic idea of this study is to understand the capability of internet of things. In this research paper we can understand about the importance of IoT because it states that its a demonstration of internet of things implementation in larger scale application which includes liquid management, building alarm system, smart home control system and so on. Embedded system is a microcontroller based system which is attached to the machines are not same as computers. This is because the microcontroller-based system's complexity are hidden from the normal users or consumers. Embedded system output can be a light (LED), or a buzzer. Meanwhile this system can control devices using actuator end relays. Then the display unit will be LCD or any graphical display. Even though embedded system has a lot of advantages it's still have lot of limitations when we compare to the embedded system which is connected to the IoT system.

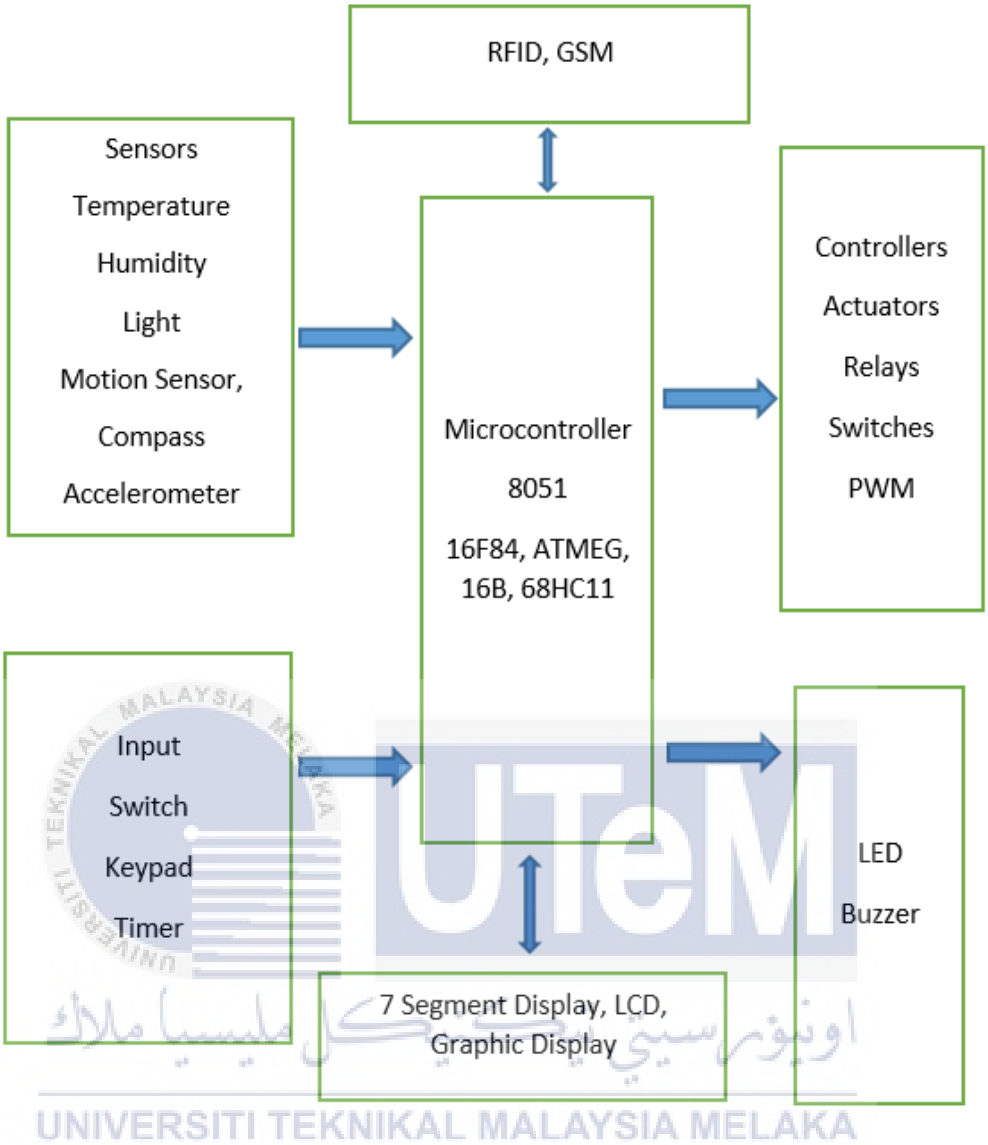


Figure 2.1 Embedded System

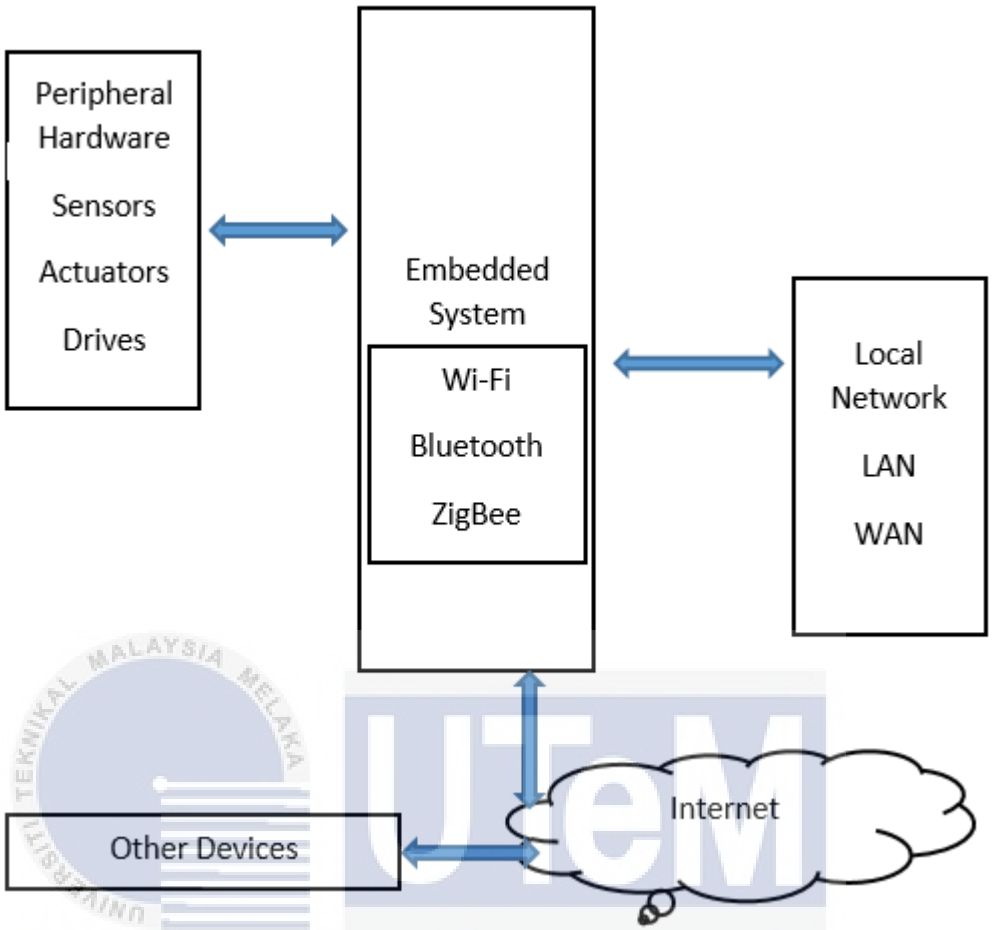


Figure 2.2 Embedded System with IoT

In this research paper, there is a discussion or an analysis which is entitled as interfacing for the Internet of things. The first microcontroller in the discussion that have been interfacing with internet of thing is Arduino. This arduino board has some pre-programmed functionality which is considered as a pure embedded system. Even though arduino board has some special functionalities that is some special purpose shield to add the internet connectivity.

Meanwhile the Interfacing for the Internet of things with raspberry Pi was the next segment. Raspberry Pi is considered as a computer-based which runs Raspbian linux distribution. Raspberry pi model 2 has no Wi-Fi embedded in it so Wi-Fi adapter could be a

solution, but the latest version o Raspberry Pi modules are integrated with Wi-Fi modules with runs with Phyton coding or scripting.

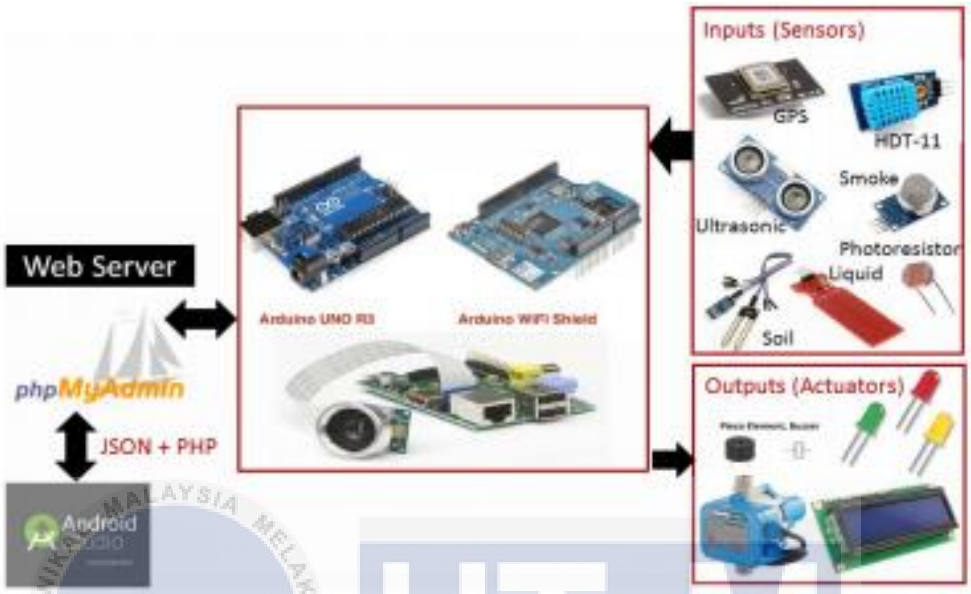


Figure 2.3 General framework of friendly in-house IoT system

The third segment is general framework. General framework is to build a friendly in-house IoT system, The general frame work in this research paper was demonstrated as the picture above. So it clearly shows that according to the middle figure the microcontroller could be Arduino with wi-Fi shield or Raspberry Pi. In the right upper side of the figure it shows that different type of sensors were used as input to receive data. On the other hand, the lower right side of the figure clearly shows that buzzers, LED and LCD will display the output data, in the form of notifications and also the output could be useful to control the machines which is connected to the embedded system by using actuators and Motors. The characteristic of an IoT system is to keep the embedded system in the control of the user through the android application or any web server. So this Android application or the web server will able to received data or send instruction according to the time and situation. From this internet of things technology we can redesign the basic structure of the traditional embedded system, which is using buttons, switches, LED and so on.

The fourth segment in the research paper, is sensing for the Internet of things. This segment is especially presented to discuss about the different sensors and sensing mechanism for IoT system. This discussion included with GPS acquisition, weather sensing, liquid sensing, smoke sensing, soil and nurture sensing, and ultrasonic sensing. At the first stage the presenter shows all the general framework in a simpler form according to the respective sensors. GPS acquisition will be the first section for segment. Global positioning system (GPS) shield will be connected to the Arduino to show the data of the longitude and latitude of the place where the GPS is placed. according to the to the picture shown below. Meanwhile the Mobile or Android application will display the GPS data. This could be a milestone to The IoT system industry because it could be a tracker which helps to track the devices or belongings that is lost.

Figure 2.4 GPS acquisition IoT system

.

Figure 2.5 Mobile Application with GPS system.

The next section is weather sensing. The weather sensing accuracy can be obtained through various parameter aspects, which is such as temperature, pressure, light, humidity and so on. The general framework for the weather sensing is shown below. In this framework is HDT-11 sensor was used to monitor the temperature and humidity of the surrounding area. This sensor work as an input which will notify to the user through the mobile application or a web server if there is any changes in it.

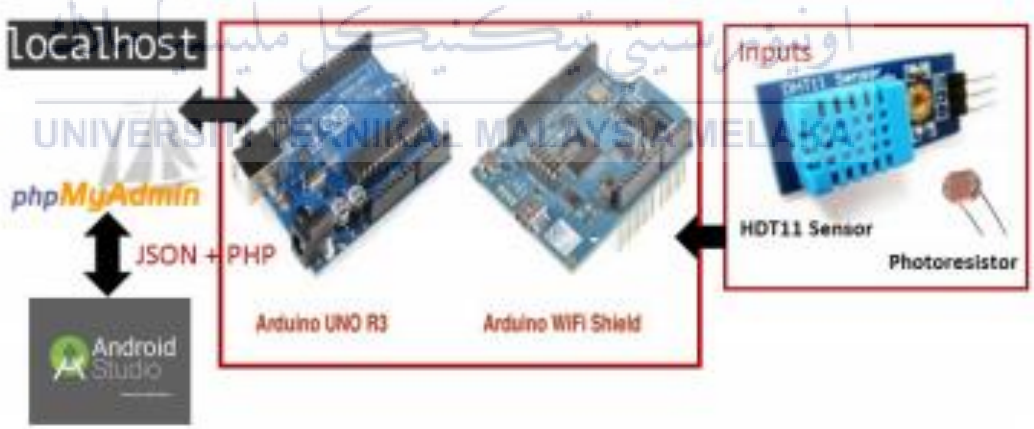


Figure 2.6 Temperature, Humidity, Light Sensing Iot based system

Figure 2.7 Mobile Application that monitors weather date

Then the following segment is water sensing. There was an android application was developed and connected with the smart water bottle. The purpose of this development is to help the people who have to consume water according to their goals. So the water consumption level monitor will be useful to a lot people such as dialysis patients, to the people who need to in proper diet, the people who have is suffering with nutrition deficiency and so on. This application specially designed to complete the daily water goal based on the predefined personal parameters. This application send reminder notification through the mobile application to remind the user to drink water. The smart water bottle system which is conjunction with internet of things will assist and remind a person to meet their daily water goals which leads to a positive results on the person's health. The general framework and android application which deal with water level will be shown below.

Figure 2.8 General framework of water level sensor

Figure 2.9 Android Application to monitor water level.

Then the next segment is smoke sensing. In this segment smoke sensor play the role of input which is connected to the arduino. Usually most of the smoke sensor embedded system will be designed to give alert to the owner in the form of alarm or any notification, but this implementation brought an innovation which is, this is also deaf people friendly smoke sensing system. The purpose of this IoT system innovation is to warn the deaf people in the emergency situations. The mobile application that have been designed was with the feature of sending light alerts to the iot device make a map showing the location of the emergency exit which is nearest.

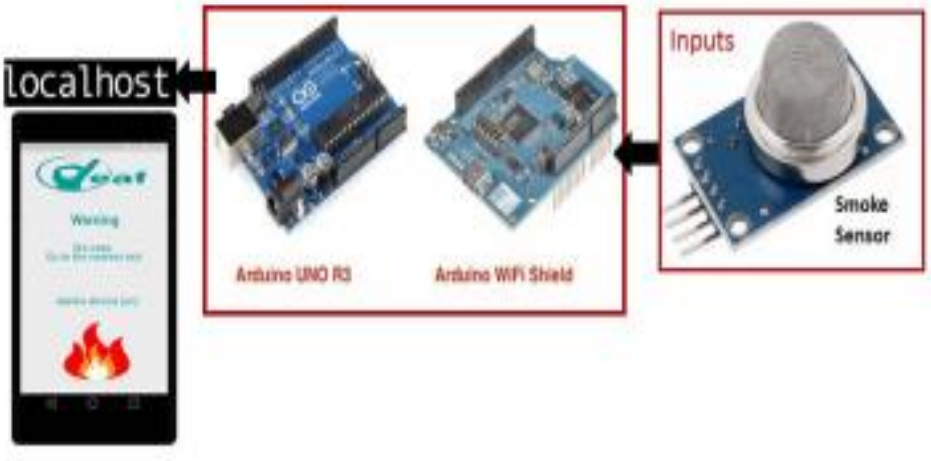


Figure 2.10 The general framework of Deaf People friendly IoT system

The next segment is soil sensing IoT system. Smart automatic irrigation is considered as a sophisticated application for IoT based soil sensing system. This idea implemented to avoid the excessive water usage in agricultural field. When humans usually make mistake by forgetting to turn off the water tap, sometimes humans might forget to monitor the plants. To avoid this kind of human errors a programmed machine or a device is necessary. According to the general framework of this idea implementation, a moisture sensor will an input which is placed in the soil and this sensor also connected to the IoT system. This IoT system will sense the humidity level of the soil and pump the sufficient water automatically. This project intentionally designed to make a revolutionary transformation in agricultural field. Regardless of Distance this system can be controlled from anywhere, it also can control the water distribution, saturation of the soil and it can avoid the excessive water wastage. The owner or the farmer can monitor their farm without their presence.

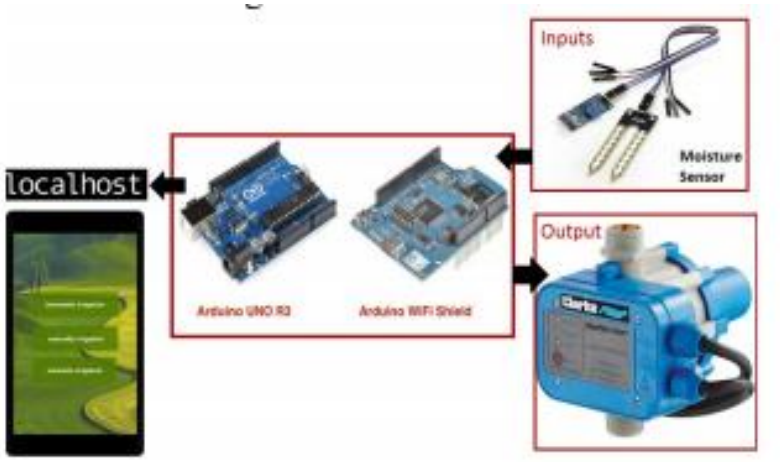


Figure 2.11 The general frame of Soil sensing IoT system

Figure 2.12 Smart Home Plants Irrigation

The last section of this research paper is ultrasonic sensing. Ultrasonic or ultrasound sensors are specially designed to measure the distance. When this sensor integrated with internet of things system it can make a lot of useful projects which is for many application uses. For example the researcher proposed a solution which is very useful for medical industry, especially for blood bank authorities. The basic idea of this project is to inform and indicate the blood bank authorities and also the donors about the need of blood donation. So this project basically to inform the shortage of blood in the blood bank according to the blood group. So from this technology a victim who in need of blood, and the blood bank authorities

can overcome panic situation because the ultrasonic sensors which is attached to the blood bank refrigerator will inform the public or donors about the need of which type of blood, through the smartphone application. In addition this project designed and fabricated with LCD screen which will be attached to the refrigerator to display the current quantity of the blood types through the ultrasonic sensor. The IoT system which is integrated with the ultrasonic sensor will provide the sufficient information to the medical staff and donors.

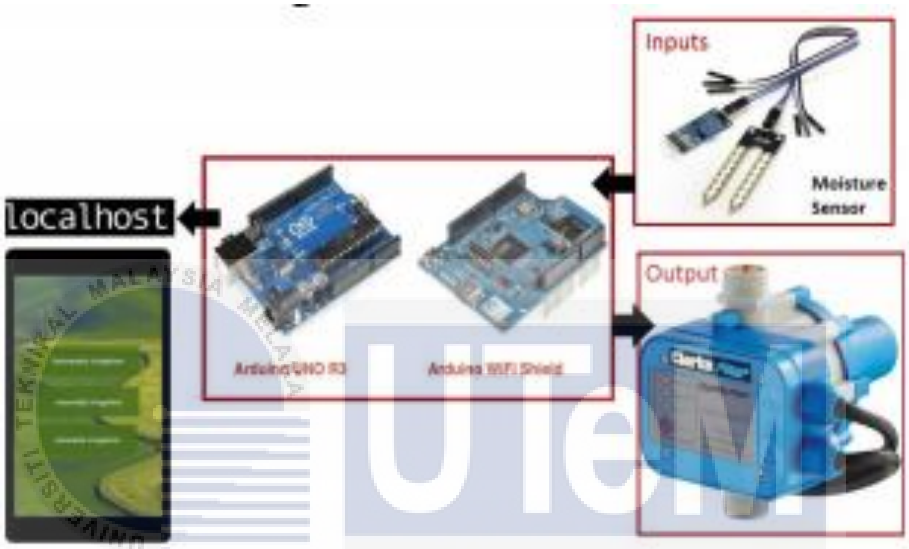


Figure 2.13 The general framework using ultrasonic sensor

Figure 2.14 IoT based ultrasonic sensor in blood bank refrigerators.

2.3 Microcontroller

Dr. Tabbsum Mujawar et al[2] proposed development of wireless sensor network system for LPG gas leakage detection system. This system is developed to monitor any gas leakage in the early stage itself. This contribution will avoid any future accidents. This system gives alert signal to the users before the gas leakage getting severe and from here we can avoid any disasters, because LPG gas is highly Flammable and may explode when it ignites.

This research paper presents the idea development and design of wireless gas leakage monitoring system by using Arduino and XBee. This system is configured in star type topology which include with all the sensors and devices. So all the devices were controlled through a gateway node with XBee network. XBee used as a wireless device for this project. So this project was implemented using MQ2 sensor or MQ 6 gas sensor. XBee, GSM module. The sensor was recommended for excellent sensitivity and quick response time. Once the gas started to leak the critical condition of the gas leakage message will be sent to the authorized person with the help of Arduino GSM shield. When gas leakage detection system is Mornington by wired network, it requires higher cost and higher maintenance, meanwhile using wireless sensor network like Bluetooth, Wi-Fi, Zigbee will be more user friendly. The monitoring work was done with LabVIEW tool.

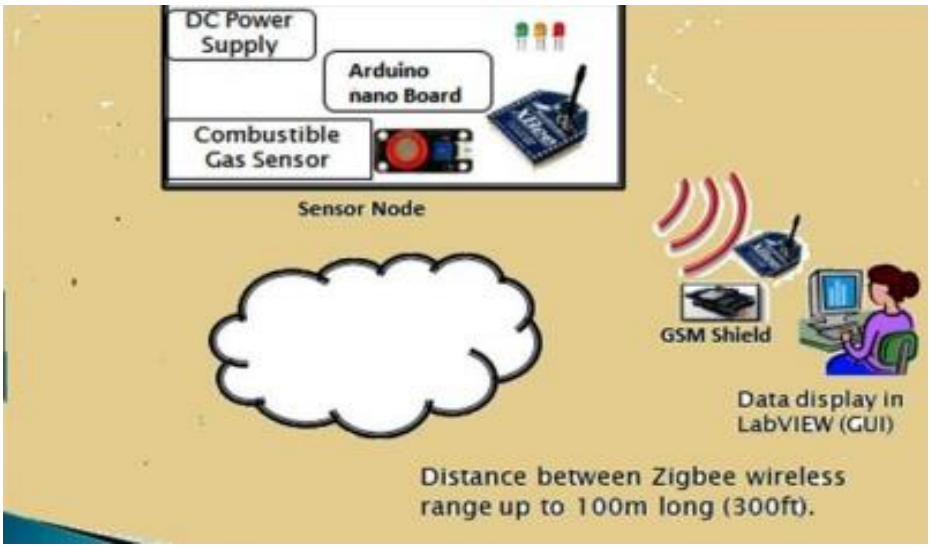


Figure 2.15 The general framework of office project

Even though there is lot of gas detection system available this research people purposely proposed to create a wireless gas sensor detection system in a small scale and with low cost devices as shown in the general framework picture.

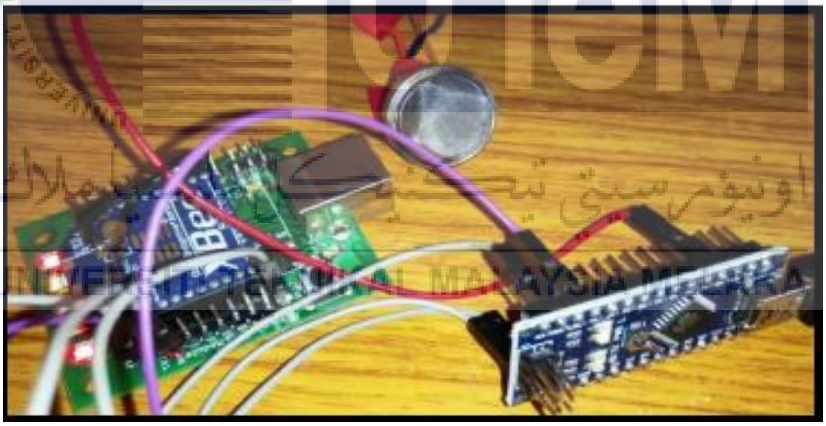


Figure 2.16 The prototype

MQ2 gas sensor was used for this project because when the LPG gas detected the sensors conductivity rises. The conductivity of the sensor is proportional to the amount of gas leakage. The gas sensor calibration was conducted by using gas chamber and also a standard medical syringe. The voltage after sensor is corresponding to the LPG concentration in various level.

Figure 2.17 The sensor calibration unit

The zigbee transceiver was used for this project. Zigbee is specially invented for controlling the sensor networks. It was built on IEEE 802.15.4, which is the standard for low data rate WPAN. This zigbee transceiver is a low data rate, low cost and also low energy conception device. Meanwhile the Arduino GSM shield was used for this project, it allows the Arduino board to connect to the internet and with the help of Arduino GSM shield an Arduino Board can make or receive call and send or receive message.

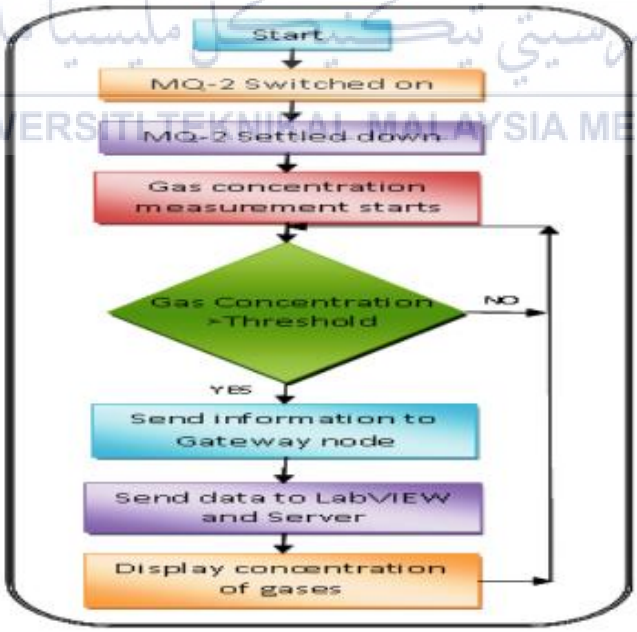


Figure 2.18 Flowchart of the Wireless gas leakage system

The flowchart shows that once the sensor node received the data from gas sensor, XBee transceiver send the output to the Gateway Node. The labVIEW tool was provided for hardware and software parts interfacing.

Mr. Sarhan et al[4] proposed Arduino based Smart Home Warning System. This system a bit advanced, it has more than one function. This paper presentation is about the design and implementation of an Arduino based home Warning System. The features of this project is monitoring fire accidents, housebreaking situation and giving early alert signal to the owner. This project involves gas sensor, humidity and temperature sensor,

Buzzer module, GSM shield. Its consider as a wireless operating system.

The microcontroller was used in this project also Arduino. So the Arduino Microcontroller will assign the sensor's working process. This assigning method can be done by uploading the code to the arduino board by its usb port with the help of arduino coding programming language.

This system is specially designed to monitor all the indoor environment to give life update about the unwanted and dangerous conditions that could happen when the owner is away from the house. The purpose of this project is to create a warning system which can interpret the sensory data gathered from the surrounding in order to perform some action accordingly.

For an example fire in a house could happen for many reasons. At this situation the fire alarm system will be very useful to prevent any severe loss. In addition the liquefied petroleum gas LPG leakage is also a dangerous situation where a small fire ignition can

cause a blast. The gas leakage detection system can prevent this mishaps, and also motion based system can detect any movement due to a robbery.

The monitoring process of this proposed idea can be done through several sensors such as temperature sensor, motion sensor and gas sensor. There is also some actuator, buzzers, lights and relays involved in output process. Wireless communication is an important criteria for this project.

The next important segment is software simulation Arduino programming language has been used for this entire system. DHTT22 sensor library, MQ2 sensor library, camera sensor library, microSD card library and GPRS library are the modules that have been used for the simulation.

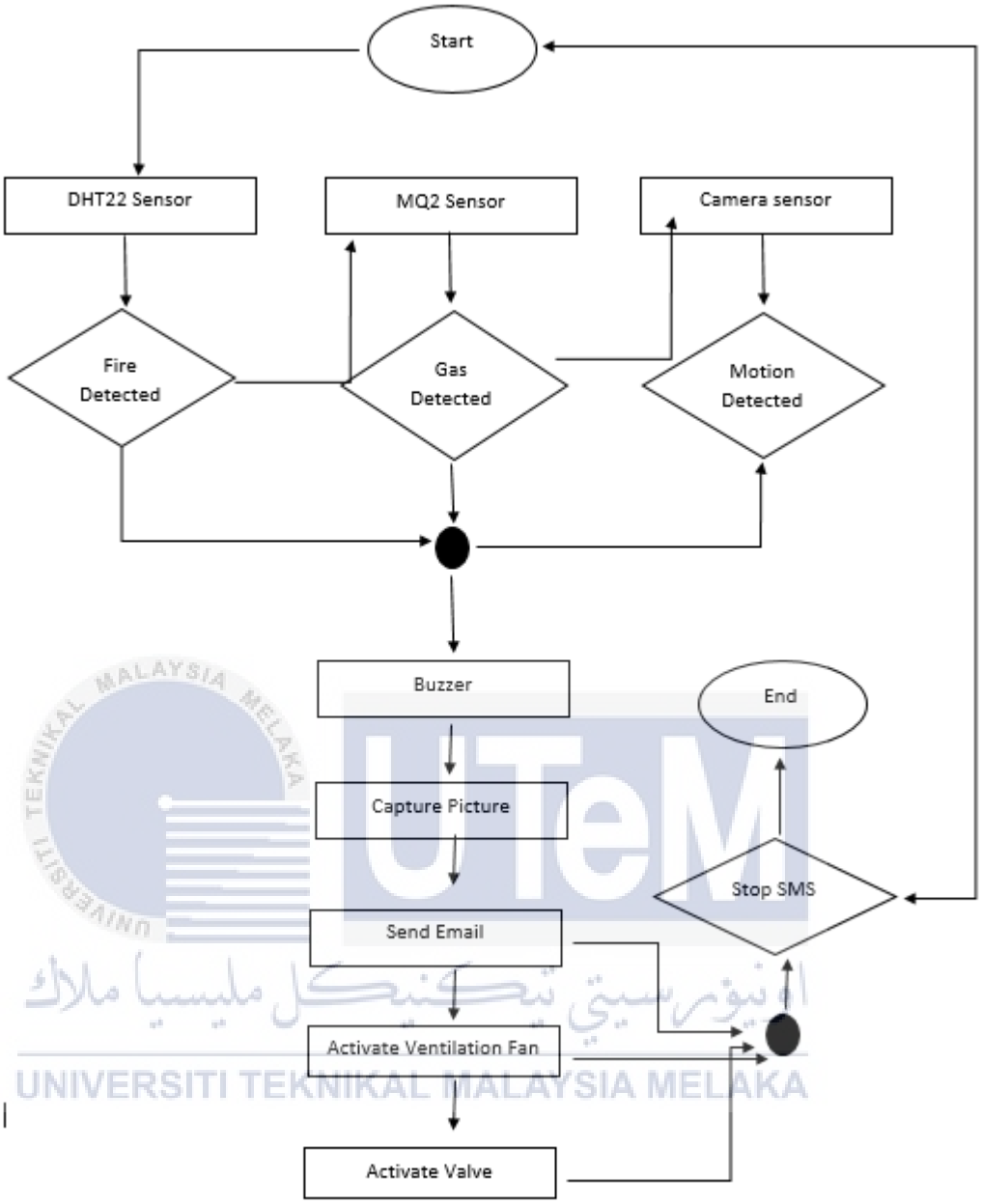


Figure 2.19 The Flowchart of the Arduino Based Smart Home Warning System

According to the flowchart, Arduino Uno will be the microcontroller board where it can control all the functionality of the entire system and also it can control all the devices that have been connected to it. DHTT22 sensor module was used for this project as a low cost digital humidity and temperature sensor. This sensor is very useful to detect fire existence. MQ2 sensor module used for LPG gas detection. TTL Serial JPEG camera is

image acquisition device, where it has been used to capture undesired events. Buzzer module played notification alarm role in this project. MicroSD card module is an Arduino compatible storage device. It can be used to store all the images which is captured by the camera.

3 channel relay module was used in this project for 3 main purpose. First it is used to operate the ventilation fan to clear the smoke or leak gas, then to continuously blink the bulb and finally to operate the solenoid valve for water pump.

2.4 Microprocessor

Mr.S.Tanwar et al [5] proposed an advance Internet of things based security alert system for smart home. This idea was proposed in 2017. Basically the idea of this project is to detect unusual activities and movements which is happening around the house. This idea itself gives ultimate satisfaction to every house owners. This proposed project is extremely suitable to all kind of people especially old age house owners who facing difficulties to move. This project consist of two main functions, which is detecting the unusual movement through motion sensor, meanwhile the second function is to capture the movement from that particular place through a camera. Then the idea itself tells us this project is an IoT based project so the updates will buzz to the owner through their e-mail. Raspberry PI have been used in this project.

When an embedded system integrated with Internet of things, it will have the capability to monitor objects through internet. The theft threat at a person home would cause major inconvenience when the owner is not around. So the basic framework can be explained in a simple way. When the owner is not in the home, the burglar trying to enter the home, the framework that have been proposed for this project able to give caution to the on it even

though the owner is not around. First of all the PIR sensor which is connected to the framework will sense the unusual movements around the house, then it will offers flag to the Raspberry Pi, then the Raspberry Pi will utilize the camera to capture the present action of the owners home. Once the camera captured it will send the data to Raspberry Pi, and then finally raspberry Pi will send the captured image to the owner through email id that have been programmed.

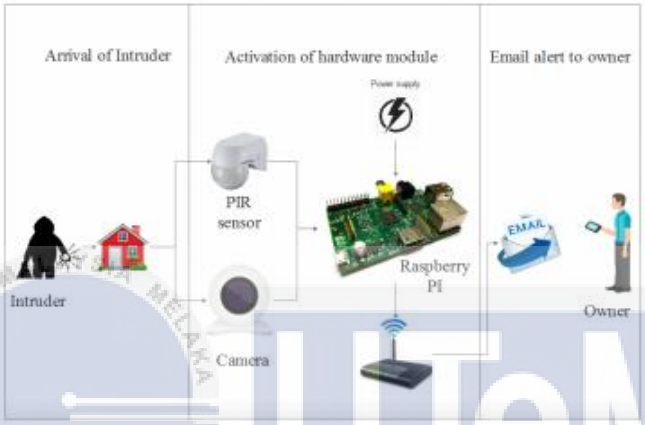


Figure 2.20 Framework for Internet of things based security alert system for smart home

Raspberry Pi is the main computational device which is used to perform signal fetching and processing and also it will automatically send email to the owner. This device has the capability to fetch signal or data from the webcam and PIR sensor and send the captured images to the owner's email. Webcam is purposely used for monitor the house when no-one is around. Meanwhile PIR sensor what's used for this project because this sensor has the ability to detect the infrared light which is transmitting from every moving object within the sensor range.

Marjan Ralevski & Stojkoska et al [6] Intoduced a project which is titled as Internet of things based system for detection of gas leakage and house fire in smart kitchen

environments in the year of 2019. This project mainly proposed to monitor the safety of a kitchen in a house. As they proposed this project will detect the fire or flame and also to detect the gas leaks. This project were designed and implement a technology which can monitor and observe the rising possibility of house fire in a kitchen environment, through measuring the temperature of the place and monitor the gas concentration through a gas sensor. This project uses Raspberry PI.

The main idea of this project is to notify the owner once the system detects intolerant presence of at least one of the 3 gases is better been measured. By using this way the user will become more aware about the dangerous situation in earlier stage itself. This project executed and accomplished by using two Raspberry PIes which is equipped with several sensors. The Raspberry Pi that have been used to measure the temperature is referred as piTemp. Meanwhile the other one which is used to measure LPG, CO and also smoke concentration mentioned as piGas. The role of been given to the laptop is gateway.

The Raspberry Pi is which is used to measure the temperature, once any unusual temperature rises the information immediately sent to the gateway. Once the piGas detects the gateway's alert, the piGas starts to measure LPG, CO and smoke concentration of the surrounding. So if the concentration of these gases are not almost similar with regulative value and reading above the regulative value the system will automatically switch to the notifying the end-user state. This message will be sent to the end users mobile device via HTTP PUSH request.

For the piGas unit subsytem, MCP3008 analog-to-digital converter was used in the project in order to transform analogue signal which is given by MQ5 sensor to digital signal

where Raspberry Pi easily can understand. Meanwhile for piTemp subsystem DS18B20 temperature measuring sensor were used to measure precise temperature. In additional the both Raspberry Pies were running with the help of Debian operating system.

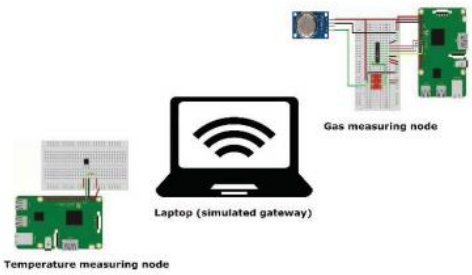


Figure 2.21 The simplify framework of the whole system

Figure 2.22 Example of Raspberry PI

Raspberry PI is a small single board which is equivalent to a computer. This microcontroller has the capability to act like a mini computer with the help of keyboard,

mouse, display connection. This component is slower than a laptop or desktop but still please consider as a microcomputer which can provide all expected features or abilities, in the expenses or low cost. This component also consumes low power.

Raspberry PI foundation officially provides Raspberry PI foundation officially provides Raspbian OS. Nowadays official Operating System of Raspbian OS is available and free for the users. This OS is designed and fabricate specially for the fair use of Raspberry Pi. Raspbian have GUI which includes tools for Browsing, Python programming and so on.

A minimum 8GB SD card is required to store the OS operating system. This micro-SD storage used to store the other informations too. Raspberry Pi is more than computer when we compare in the aspect of accessability provides by the Rasperry PI. It can access to the on-chip hardware GPIOs for developing an application. By accessing GPIO, we can connect devices like LED, motors, sensors, and can control them too.

Raspberry PI hardware have some specific components which make it looks more advanced. First of all HDMI(high definition multimedia interface) port, this part will support the transmission of digital audio and video data. Then CSI (Camera Serial Interface), from here we can connect Broadcom Processor and PI camera. After that DSI (Display serial interface) this part will take care of the displaying process, which connected between display serial interface port and LCD is going to be used. Then composite video and audio output, this port will be carry out the combination of video and audio signal. And most commonly it also has a power LED which indicates the Raspberry Pi turned on or turned off.

Mohammed Shahanas.Ka & Dr.Bagavathi Sivakumar P.b et al [7] has proposed a new idea, which is entitled as framework for respond water management system in the context of Smart City initiatives in India in 2016. This project is all about a further step to transforming a normal City into a smart City. Meanwhile water is the important resource that we should preserve so that they have decided to propose a design of smart water management system. The acknowledgement we are getting from this journal is the comparison between Arduino and Raspberry Pi. They have mentioned that Raspberry Pi is low cost fully functional computer where Arduino is single component which is a microcontroller. They have declared that Raspberry Pi is Step ahead of Arduino in term of software application, however in terms of hardware application Arduino is the best. Arduino can be used in places where real time and analogue data has to be captured, and also arduino have the capability to work with any kind of sensors and chips, but raspberry Pi don't have this feature.

2.5 Gas Sensors

Varma et al [8] introduce a new idea which is titled as gas leakage detection and smart alerting and prediction using internet of things in the year of 2017. The basic concept of this project is two detect the LPG gas leakage and alerting the house owner. LPG gas explosion is one of the dangerous thing that could happen just because our carelessness. So this project invention meant to increase the accuracy of gas leakage detection in the early stage it self. So obviously this project has the ability to predict hazardous situation in the early stages self. This LPG gas sensor was connected to arduino uno board as it is the microcontroller. Once the LPG gas detected by the MQ-2 sensor, it will send an email alert and also immidiately the puzzle will start to activate.

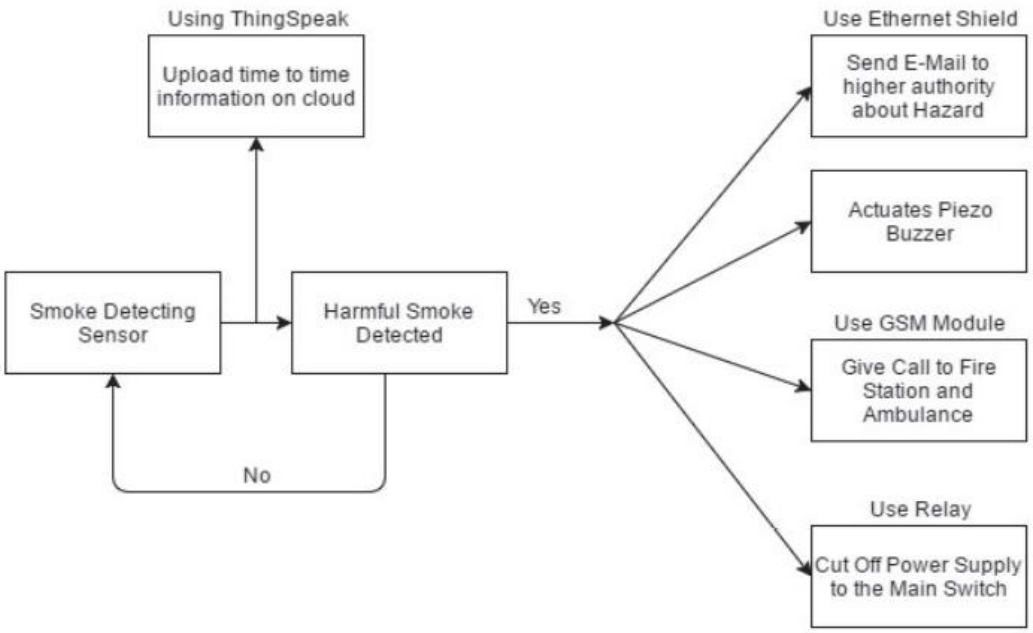


Figure 2.23 Gas leakage detection system processing steps

The general framework. Arduino UNO (ATMEGA328P) is the microcontroller that have been used for this project. The gas sensor is connected to this board for processing the sensor readings according to the program. Arduino powers the Ethernet Shield which is stacked upon it, used for connectivity to Internet. It

also powers the GSM Module which is used for making a call. The Piezo Buzzer used as an audible alarm and a 5V relay used for the power cut off feature are also mounted on this board. Ethernet Shield (W5100), is an Arduino Ethernet Shield which enables the internet connection the Arduino Board. The Wiznet W5500 provides a network (IP) stack capable of both TCP and UDP. It has an operating voltage of 5 volts which is supplied from the Arduino Board and provides a connection speed of 10/100Mb.It helps in uploading sensor values on cloud and

sending email when the sensor value crosses the threshold limits. Meanwhile the GSM module was used in this project this helps the Arduino Board to make calls and send messages instantly when the threshold crosses the limit. MQ2 sensor is used to detect the hazardous gases which LPG. The relay and buzzer also used in this project.

Aastha Singh et al [9] introduced a new idea which is titled as detection of liquefied petroleum gas (LPG) using sensor through Arduino uno microcontroller. This product also how to detect LPG gas. This is to allow the house owners about the gas leakage in their kitchen before it get worse. This project proposal aim is to provide such a safety design by detecting the LPG gas leakage which is applicable to every houses, especially to the residential area. In this project they have mentioned that they used MQ-2 sensor as LPG gas detecting sensor. The owner can get the alert signal, through their phone, in the form of SMS or a phone call.

The component that has been used for this project are Arduino Uno microcontroller, which can interact with various sensor and devices such as push buttons, motors, speakers, sensors, and even internet. Mq2 sensors was used because it is highly sensitive to the LPG gas. The current conductivity of this sensor is directly proportional to the concentration of LPG gas. Buzzer is used as an audio signaling device which will be playing the role of alarm. Sim 800 GSM module was also used in this project. This GSM modem can accept any GSM network operator SIM card and act just like a mobile phone, in addition it can be use to communicate with its unique phone number. Advantage of using this modem will be able to use its RS232 port to communicate and develop embedded applications

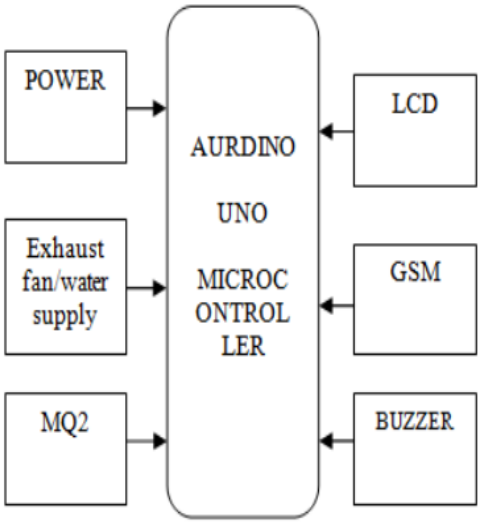


Figure 2.24 The block diagram of gas leakage detection system

2.6 Motion Sensor

Khirod Chandra Sahoo et al [10] propose an idea which is titled as internet of thing (IoT) based intrusion detection system using PIR sensor. This idea is proposed to avoid the robbery in residential areas. This paper discusses the application of passive infrared sensor (PIR) in detecting the unwanted or unusual movement in a particular area. This project designed in the concept of wireless network system.

Passive infrared sensor (PIR) is used as a motion detector in this project. The pyroelectric sensor which is present in the PIR sensor is the main component for a PIR sensor. This pyroelectric sensor has been divided into 2 parts. When there is no motion the both part will the same amount of infrared radiation from the surrounding but once anything moved the infrared radiation level received to another half which is higher than the first half.

Zigbee is considered as a global standard wireless communication technology with low cost and low power consumption. Zigbee communication protocol has the capability to

support a lot of networks at one time such as point to point network topology and point-to-multipoint network topology. Zigbee can be configured as router, coordinator, and end device. Yes and model is a mobile communication model which is interfaced with Arduino to send text message using AT commands. The Wi-Fi module that have been used for this project is ESP8266 Wi-Fi module. This model system comes with integrated TCP and IP stack which able to access with the Wi-Fi network. Arduino mega was used in this product as the microcontroller which is the heart of The Project. The IP camera is considered as a digital camera that have been used for surveillance process. This IP camera has the capability to send and receive data to internet.

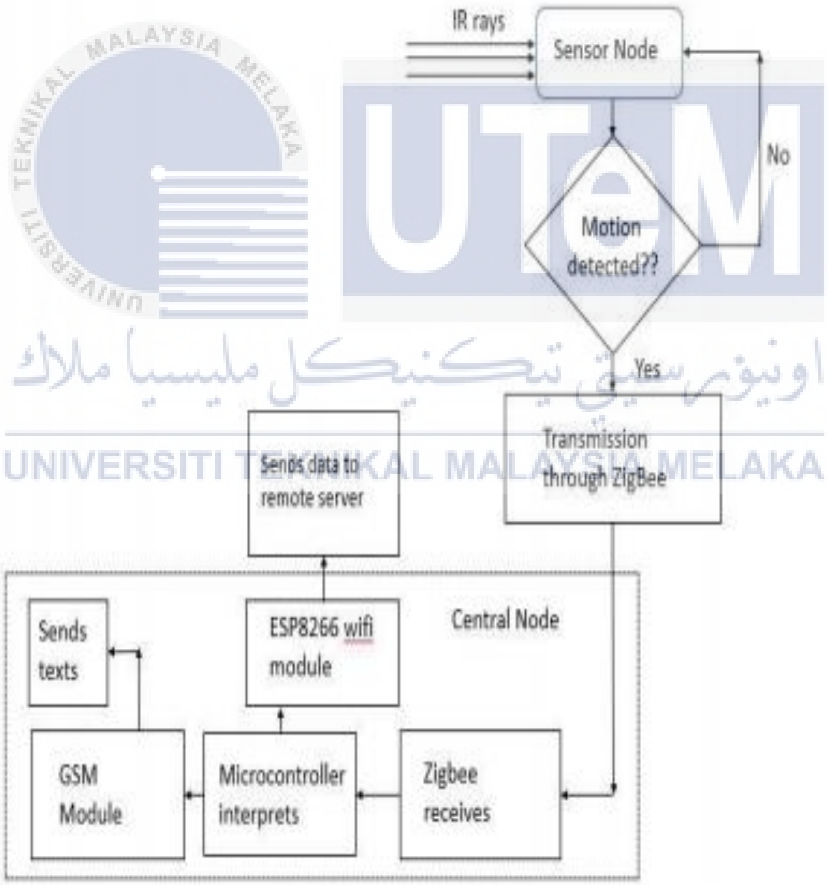


Figure 2.25 Flowchart of working process

Aditya & Chand Gupta et al [11] introduced a technology which is entitled an Internet of things based smart surveillance and monitoring system using Arduino. Nowadays security is a major concern it is growing rapidly. It's so hard to save our money, property and other valuable things from robbers. When we have our advanced technology to secure our valuable things. This theft monitoring system will be a great satisfying Factor for the owners. With the help of Arduino mega microcontroller's we can control and grab data from the PIR sensor. Through this approach, Arduino mega will act as a microcontroller, meanwhile PIR sensor will act as a motion detector which can sense any kind of movement, and send the data app that they have created.

The smart surveillance and monitoring system is proposed with an integrated idea of internet of things. The goal of the IOT is to enable everything to be associated at whenever, wherever, with anything in a perfect world utilizing system. IOT innovation can be made another thought and wide advancement space for shrewd houses to give insight and to enhance the personal satisfaction. The important criteria of Internet of things are communication, control and automation, cost reduction, and proper structure of embedded system.

The proposed idea was executed, with Arduino Mega 2560 which is connected with PIR sensor by attaching the wires between pins of Arduino and PIR sensor. Then arduino mega is connected with internet using Wi-Fi. The coding modification of the existing code helps to add the wi-Fi connection part. The researcher have used firebase API to send a push notification. To do that so researcher created a project in firebase console and programmed it to receive notification from the arduino. If any woman addicted the message will be sent

to the Android smartphone using firebase API Android application. This firebase API Android application possibly can be create my coding knowledge.

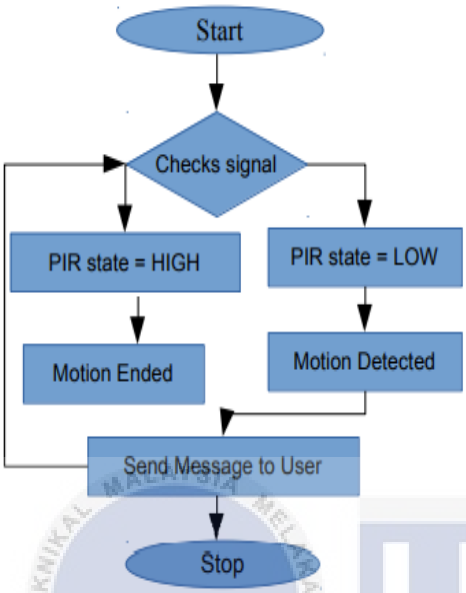


Figure 2.26 The flowchart of IoT based smart surveillance and monitoring system

2.7 Earth Quake Sensor

Venita babu & Dr.Vishnu Rajan et al[12] proposed a project which is entitled as flood and earthquake detection and rescue using IoT technology. Flood and Earthquake are of the most devastating natural disaster in the world. When we having a monitoring system to detect this kind of things earlier, we can take the precaution steps way too earlier. This can helps to reduces the damages by these kind of natural disasters. The proposed system based on IoT technology gives the real time analysis of flood and earthquake. This product uses Arduino mega as their microcontroller, Meanwhile MPU6050- accelerometer and gyroscope used as Earthquake sensor and they have also used rain sensor module to detect the flood.

Pathak, Bhavishya, and Rajiv Kumar et al [13] introduce a new idea which is entitled as earthquake detector using Arduino Uno. This project is specially designed to predict and give warning through an alert signal about upcoming earthquake disaster. This project is suitable to many peoples especially house owners too. Arduino Uno was choose as a microcontroller for this project. Meanwhile LED and buzzer works as the output for this project. MPU-6050 sensor works as the main detector of earthquake vibration.

2.8 Flood Sensor

Finsa Nurpandi & Ai Musrifah & Ilham Rizaldi et al [14] introduce a new technology which is entitled Prototype Residence Monitoring and Automation System Using Micro controller Arduino. The project idea is to monitor door security, Fire monitoring, Garbage Clearing, Flood monitoring. Especially for the Flood monitoring part rain sensor module were used to monitor the flood.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter intended to provide detailed and confirmation on how this project will be conducted and all the components and description of the component that plan to use in this project. The design and development on this project will be the starting from this chapter. This approach is very important so that introduce satisfied outcome Development of Arduino and IoT-Based Smart home Safety System.

3.2 Material

Based on the studies in the aspect of materials, to design this project there will be a few materials needed into of software and hardware. For the hardware part some integral components should be used to demonstrate the project. The more adequate components should be used to avoid any hardware issues. In the term of software, a proper Circuit simulation software is needed to design and simulate the circuit. Additionally, according software also is very important to program the microcontroller and IoT based software to check the projects through the Wireless technology.

3.2.1 Hardware requirement

3.2.1.1 Arduino Board

Figure 3.1 Example of Arduino Board

An Arduino is an microcontroller which is an open source electronic component. This Component is usable in two ways which is hardware and software. Arduino boards are able to receive alerts from sensors and this arduino Boards can automate motors and activate some other devices. We can execute these both actions by writing a proper program and upload into that in a Arduino board. Meanwhile it can support various kind of sensors which includes the sensors that we are trying to execute in this project.

In Additional this Arduino board can be connected to Wi-fi module but sometimes it already built in in the Arduino board itself so this arduino board is compatible to perform and IoT projects too. Arduino is not only usable in hardware but also in software. This arduino software is flexible enough. It runs on Mac, Windows and Linux. The Arduino uses its own programming language.

Arduino board consist of power source port, to receive power from a source, then is has usb port to upload the codes in the arduino board. The input and output pins and it consist

of Ground pin,5V & 3.3V pin, Analog pins and digital pins, PWM pins, AREF, reset buttons, Power LED indicator, TX RX LED, Ic, Voltage regulator.

3.2.1.2 MQ-2gas sensor

Figure 3.2 Example of MQ-2 Gas Sensor.

In MQ sensor series MQ2 is one of the most commonly used gas sensor. It's a metal-oxide-semiconductor type gas sensor which has the ability to detect based upon change of resistance of the sensing material when the specified gas come in contact with the material. This MQ2 sensor has the ability to detect LPG gas which is very important to our project. This MQ2 sensor also have the ability to detect smoke, alcohol, propane, hydrogen, methane and carbon monoxide. This sensor will detect the gases with the concentration calibration from 200 to 10000 PPM.

Operating voltage	5V
Load Resistance	20K
Heater Resistance	33
Heater Consumption	<800mw
Sensing Resistance	10k - 60k
Concentration Scope	200 -10000ppm

Table 1 Specification of MQ2 Sensor

3.2.1.3 PIR Sensor (Motion Sensor)

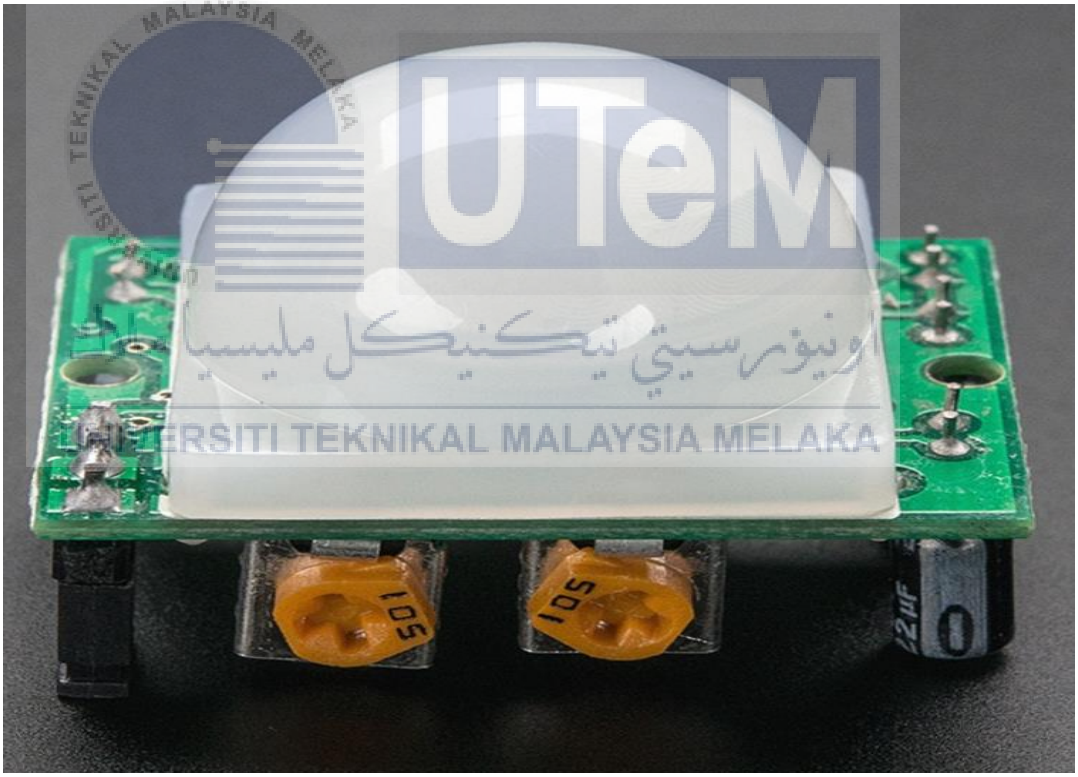


Figure 3.3 Example Of PIR Sensor

Every object with the temperature of absolute 0 image of heat and energy in the form of infrared radiation. This mechanism is also applicable for human bodies. In a nutshell radiation of an object increases, when the temperature of the object increases. PIR sensor specially designed and fabricated to detect this kind of infrared radiation.

The maximum sensitivity distant can be set in this sensor. The range setting of this sensor is about 3 meter to approximately 7 meters. We can set the range setting according to the size of our room. In Addition we also can set the timing of this sensor. This mechanism determines our wish on how long the sensor should remain high, after any movement detected.This sensor have three pinouts. First The VCC power supply is about 5V. Then the output pin which is about 3.3V. And finally the ground pin.

3.2.1.4 Earth Quake Sensor (MPU- 6050)

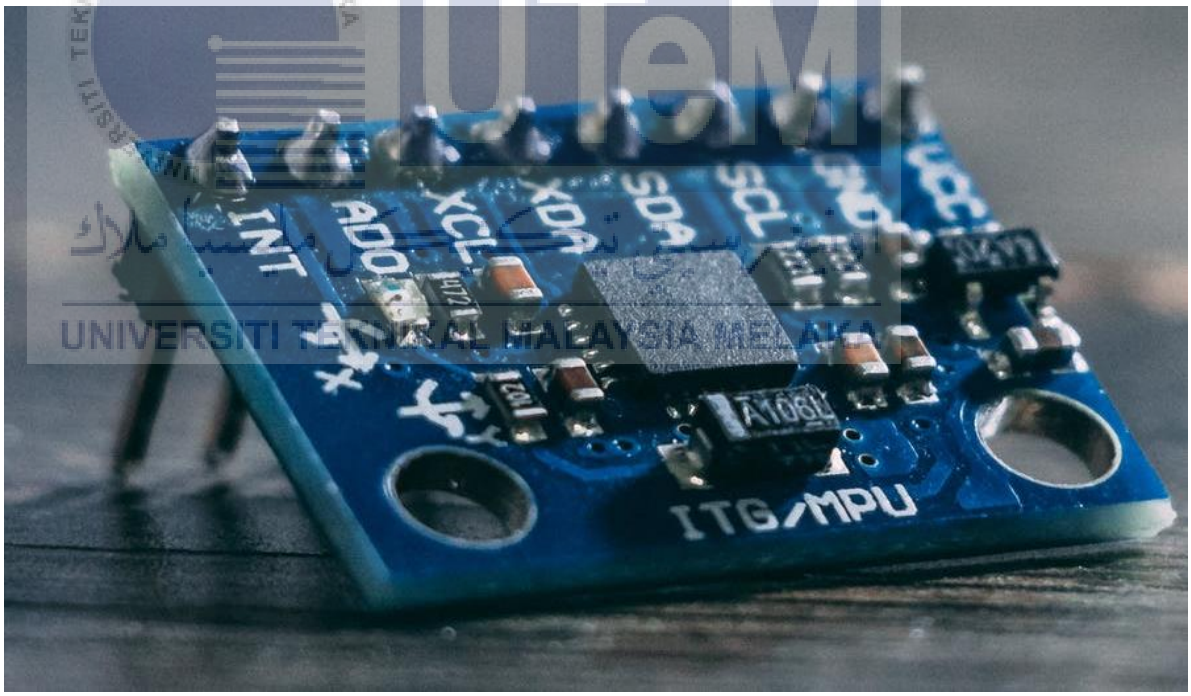


Figure 3.4 Example of MPU-6050(Gyroscope and Accelerometer)

Engineers successfully made micro sized gyroscope. Actually gyroscope and accelerometer great in their own way, but when we combine this both characteristic together,

we can get extremely accurate information of a vibrating object. This is what MPU-6050 made of, this component has both gyroscope and accelerometer. This component able to measure rotation along all three axis, static acceleration due to Gravity. Not only that this component also able to detect motion, shock, and also dynamic acceleration which caused by vibration.

The Working Principle of MPU-6050

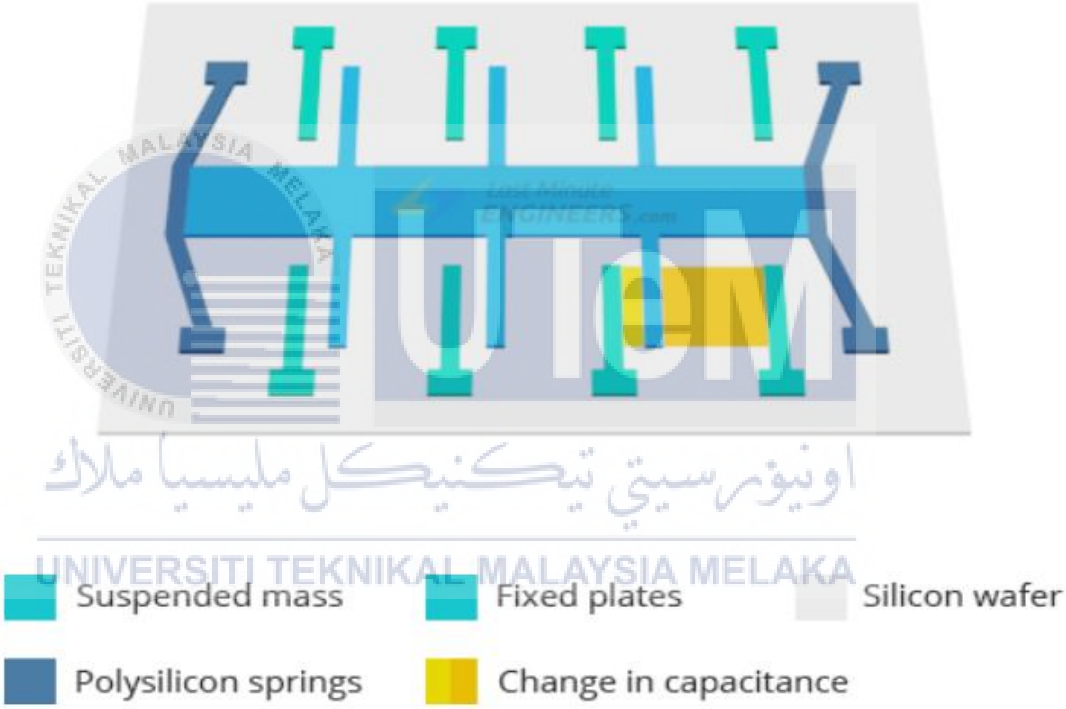


Figure 3.5 The structure of MPU-6050

This whole structure placed on a silicon wafer. The poly silicone springs which is placed on the silicon wafer allows the structure to move due to the force or acceleration applied to the component.

When the movement happens the capacitance between fixed plate and please attach to the suspended structure is change. This change in capacitance is proportional to the acceleration on that axis.

3.2.1.5 Water sensor

Figure 3.6 Rain Sensor module

This rain sensor module has a typical characteristics , which is it conduct electricity when it is in contact with water, when the more water on the surface there will be more conductivity. Meanwhile the amount of water decrease is on the surface, the conductivity also decreases. This sensing pad designed with exposed copper traces. Meanwhile if the

copper traces exposed to the water, the sensor will start to work. This sensor is suitable to the arduino microcontroller. We also can adjust the sensitivity of this component. This sensor has 4 pinouts which is analogue output, digital output, ground and finally VCC.

3.2.1.6 Esp 32 Wi-Fi module

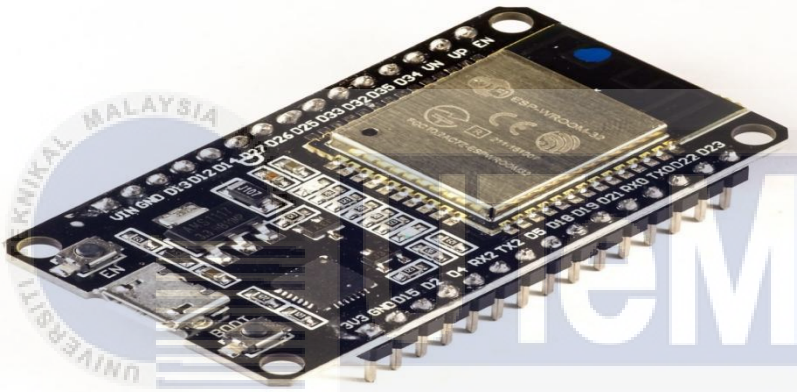


Figure 3.7 ESP32 (Wi-Fi module)

ESP32 is considered as a Wi-Fi module which is developed by Espressif system. This chip able to provide Wi-Fi and bluetooth connectivity to the embedded devices. This module has Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, with a clock rate of over 240 MHz. The ESP32 Wi-Fi specially designed for mobile devices and IoT applications.

ESP-32	DESCRIPTION
Core2	2
Arquitecture	32 bits
Clock	Tensilica Xtensa LX106 160-240MHz
Wi-Fi	IEEE802.11 b/g/n
Bluetooth	Yes - classic & BLE
RAM	520KB
Flash	Extern QSPI - 16MB
GPIO	22
DAC	2
ADC	18
Interface	SPI-I2C-UART-I2S-CAN

Table 2 Description of ESP32

EP32 Wi-Fi module has various application which involved with Internet of things. First of all this Wi-Fi module is used for networking, the module's Wi-Fi Antenna and dual-core enables embedded devices to connect to routers and transmit data between each other. Then the next function is data processing. This process includes processing basic inputs from analogue and digital sensors to far more complex calculations. The following function is peer to peer connectivity, this functional allows direct communication between the Wi-Fi module and other devices with the help of IoT P2P connectivity.

3.2.1.7 Jumper

Jumper wire comes with many sizes, shapes, and colors but the working principle will be the same where it is used to jump the current form one location to another location from breadboard to the Arduino, microcontroller, component and so on. At the end of the jumper wire the will be a connector at both side which is to make the connection easy with port in method. This make the connection between two components in the breadboard are easy even the distance of both component in the breadboard are far enough.

Figure 3.8 Jumper Wire

3.2.2 Software Requirement

3.2.2.1 Arduino IDE

The Arduino Integrated Development Environment (Arduino IDE) is a set of software tools for creating structural code for Arduino controllers. This is a Windows-based

application created in the C and C++ programming languages. Furthermore, it is an open-source software that is not only built for usage on Windows but can also be used on a variety of platforms and is extremely simple to use. A text editor for writing code, a message area, a text console, a toolbar with buttons for basic tasks, and a column of menus are all included in this software. This software's purpose is to connect the Arduino and authentic hardware so that they can upload programmes and communicate with one another.

3.2.2.2 Telegram Application

In every IoT projects the application or platform is needed to display or show the output. Telegram is a platform where people can create their own bot to monitor and or to control the components. This application is open for everyone to use and no need any payment for purchasing or to using it. So, to use this application in our project we should register the account with signing up with our own mobile number. This application can be used in our mobile phone as an application and also in our laptop as a software. There is more than 1 billion users are using this application all around the world. So here we can create our own bot which can send the alarm signals directly to our phone.

3.2.2.3 Proteus

Proteus are known as proprietary software tool used primarily for electronic design automation. This software is mainly used by electronic design engineers or technician to create a schematic for manufacturing printed circuit boards. This software is developed by Labcenter Electronics Ltd in Yorkshire, England. The language available for this software is English, French, Spanish, and Chinese. With using proteus student can make a circuit design which is based on two-dimensional. The benefit of using proteus is there were zero

chances of burning or damaging the component in the PCB board. So, it is suitable to use for circuit testing purpose without any charges or damages by the student, teachers, engineers and many more.

3.3 Flow chart

A flowchart is a diagrammatic representation of what a program should do. A flowchart is made of arrows, shapes, and description. In fact, there were many ways or method can be used to explain the step or process of our project. Among that option flowchart is one of the best ways because the process or step can be explained by using images, shapes, and various other metrics to represent the whole project. According to this project, there is 3 flow chart is required to represent the workflow appropriately.

3.3.1 Hardware

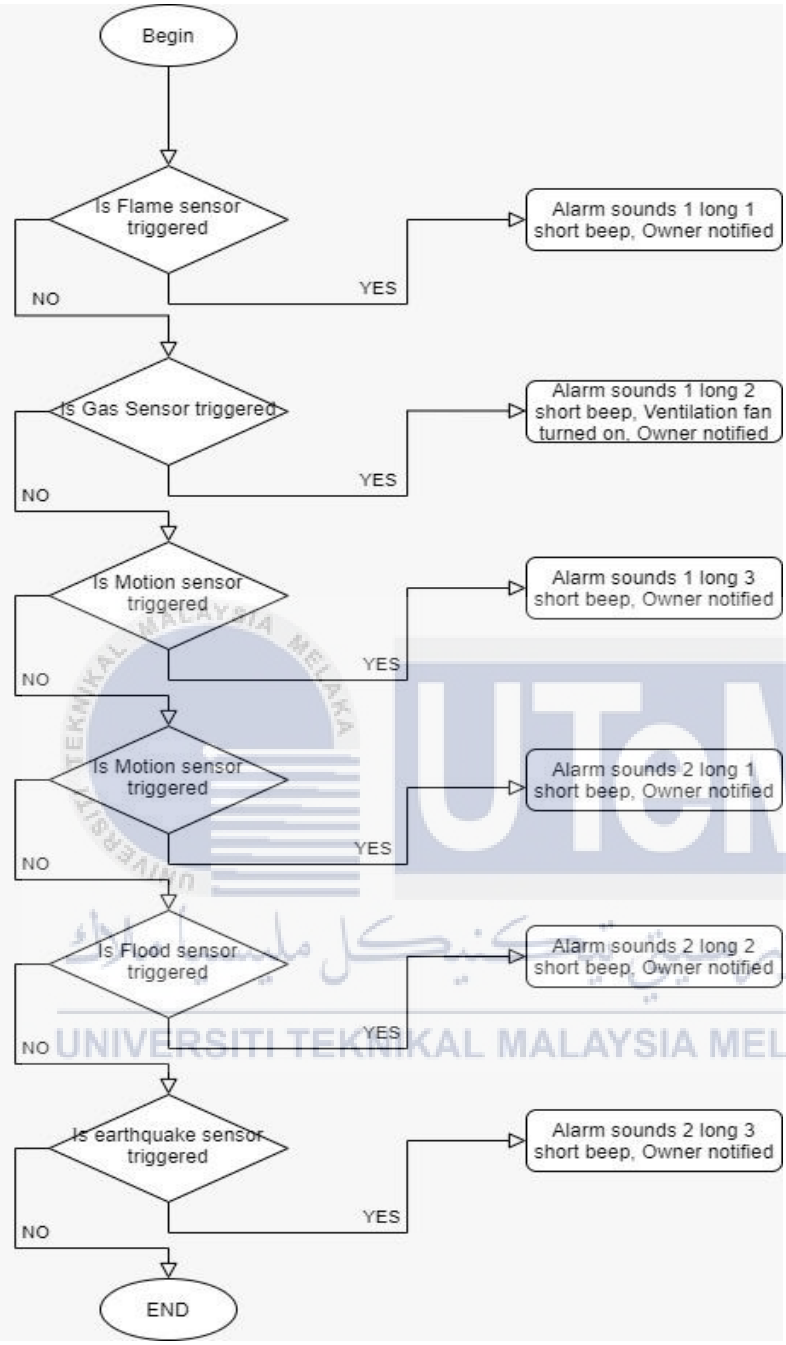


Figure 3.9 Hardware Flow chart

According to the flowchart if there is any ignition flame sensor triggered an alarm buzz and owner get notified. Then if there is any LPG gas leakage gas sensor triggered the alarm sounds along with the ventilation fan will turn on. Then if there any motion is detected

the motion sensor will be triggered and will sounds an alarm and also notify this to the owner. Same goes to the flood sensor and earthquake sensor.

3.3.2 Software

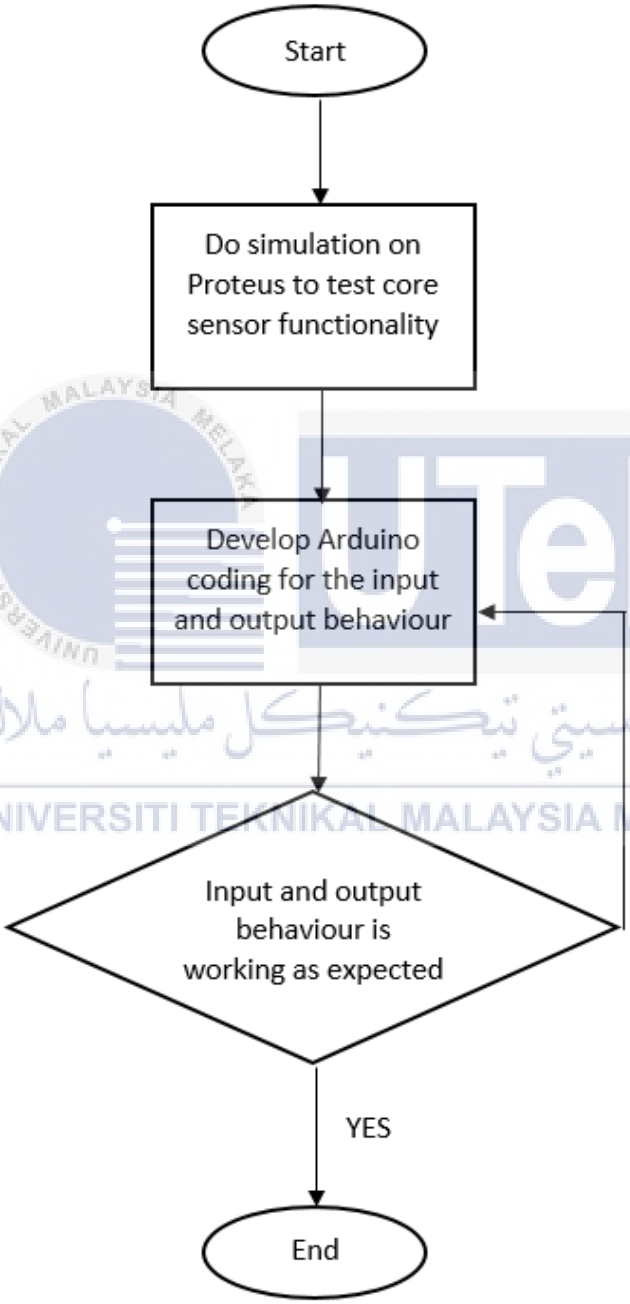


Figure 3.10 Software Flowchart

Arduino IDE coding is one of the integral part for this project. There is two different types of coding should be build in order to program the Arduino Uno and the Esp32. First part

of Arduino coding is to program the Arduino Uno, sensors and the buzzer. The first part can be considered as an embedded system. The second part of Arduino coding is to program the Esp32.

3.3.3 Application Link

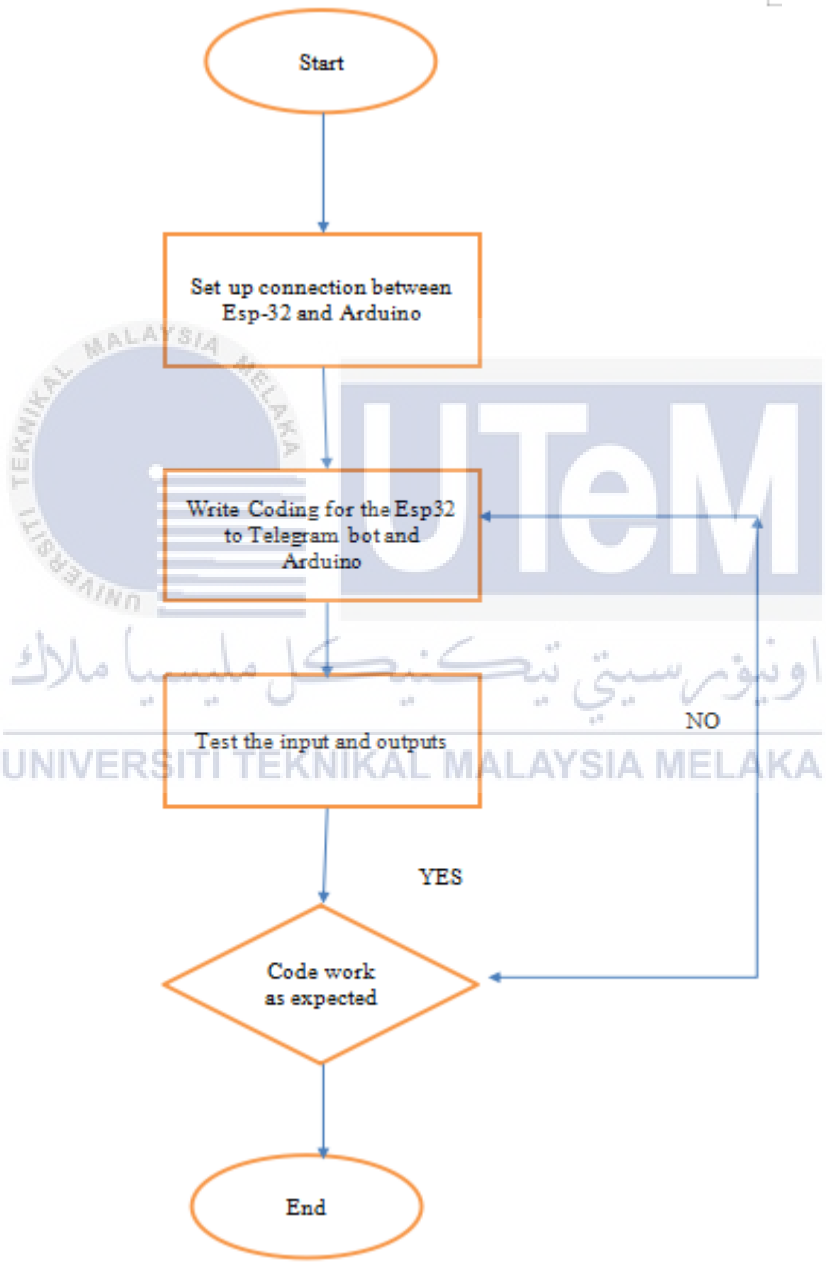


Figure 3.11 Application Linking Flowchart

After testing all the Arduino Uno, sensors, buzzers and Esp32 with Wi-Fi connection, the Arduino Uno should be linked with the Esp32. This is where any Arduino Uno sensors triggered and it will ping to the Esp32 through Arduino Ide. Then creating a telegram bot which will connect to the esp32 is the IoT part where all the triggered sensor's information will be receiving as a mobile notification through the telegram application.

3.4 Block Diagram

A proper block diagram can be a concise visual explanation offer proposed project in term of input and also output. The components that has been used should be considered as inputs and outputs. Block diagram is to give a broad view of the component and the role of the components in the project which is easy to understand when designing the project. Below shows a block diagram that represent to the model of Arduino and IoT Based Smart Home Safety System.

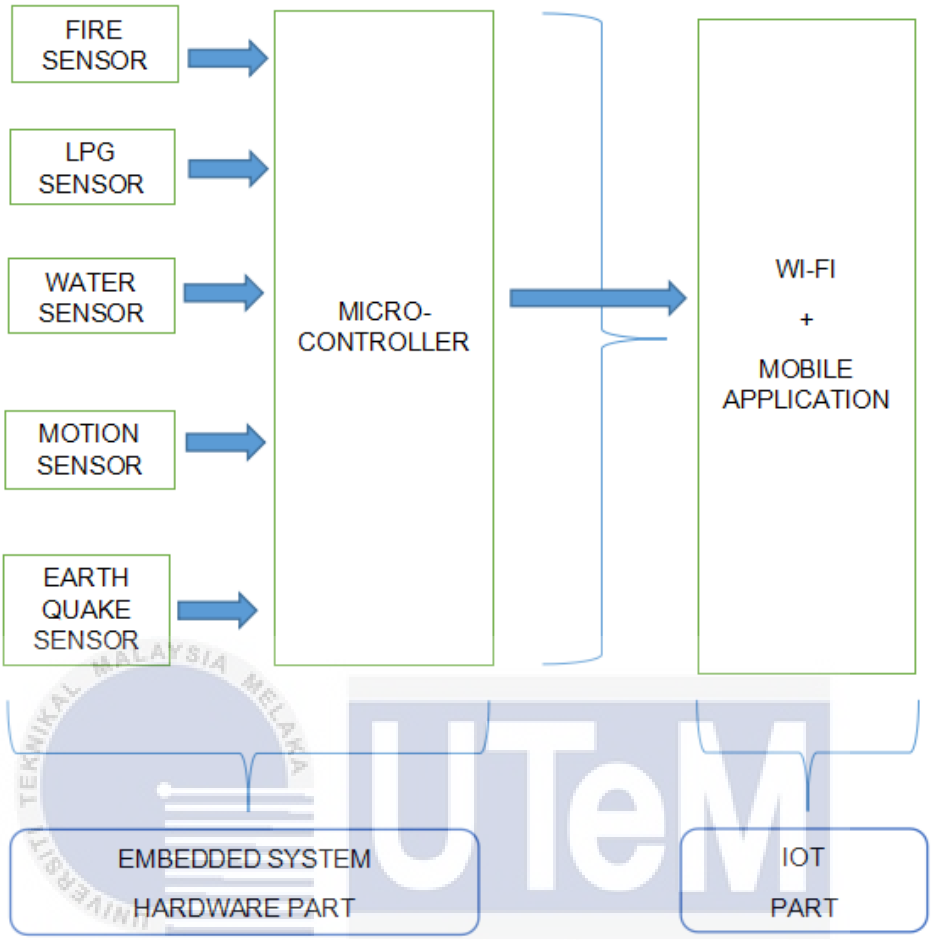


Figure 3.12 Basic block diagram

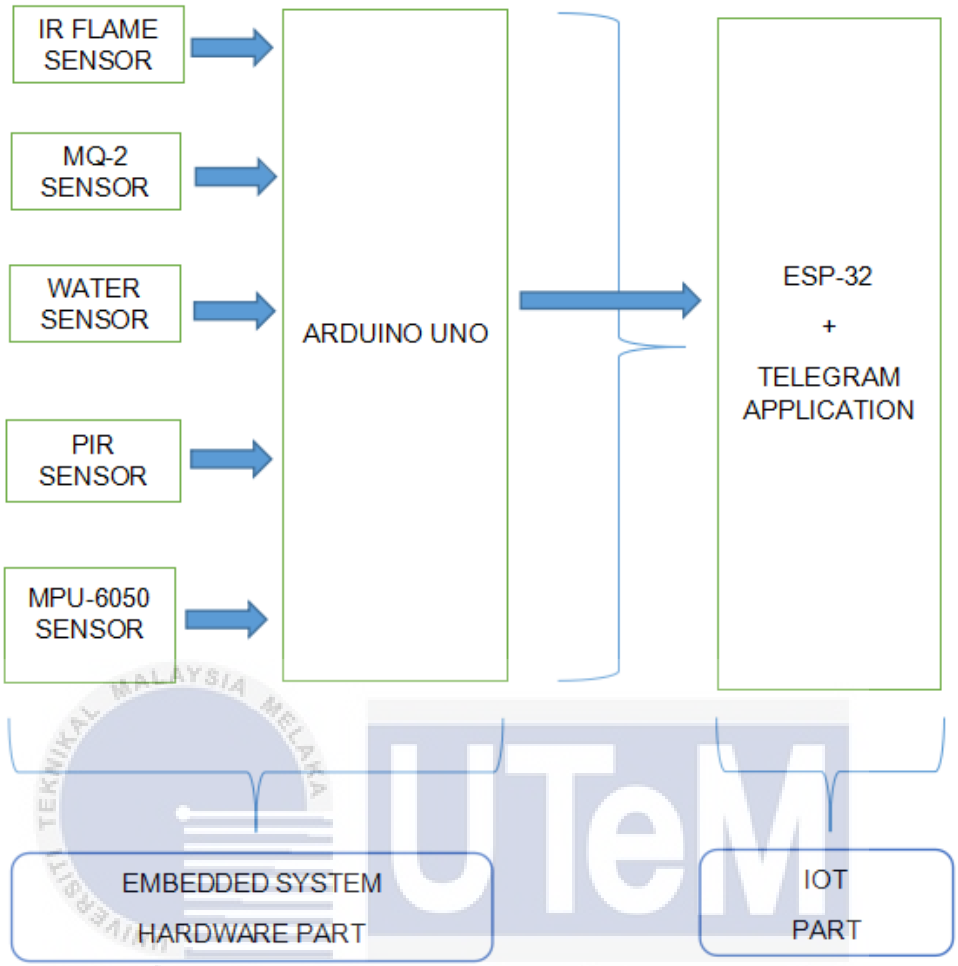


Figure 3.13 Main block diagram

This system has totally 5 inputs which is in the form of sensors. Those sensors are Flame sensor, MQ-2 sensor, Water sensor, PIR sensor, MPU-6050 sensor. Those sensors will work according to the Arduino IDE coding though Arduino Uno.

This is System also has 4 outputs which is buzzer, ventilation fan, Esp32 and Telegram notification. If there is any ignition Flame sensor triggered an alarm buzz and owner get notified. Then if there is any LPG gas leakage MQ-2 sensor triggered the alarm sounds along with the ventilation fan will turn on. This specification is specially for the kitchen area. Then if there any motion is detected the PIR sensor will be triggered and will sounds an alarm and also notify this to the owner. If there is any suspicious movement around the

house it will immediately alert the owner. Meanwhile if there any flood level increases and Earth Quake detects Water sensor and MPU-6050 sensor will be triggered respectively and notify to the owner through the telegram application. Esp32 will be the Wi-Fi module which connects the Arduino Uno to the Wi-Fi and also to the telegram application.

3.5 Cost Analysis

The table below shows the cost analysis of hardware and component to be used to build the prototype of a Arduino and IoT Based Smart Home Safety System.

Table 3 Cost Analysis

NUM	NAME OF COMPONENTS	QUANTITY	PRICE
1.	Arduino Uno	1 Unit	RM 30.00
2.	WIFI module (Esp 32)	1 Unit	RM 32.00
3.	MQ-2 sensor	1 Unit	RM 5.70
4.	PIR sensor	1 Unit	RM 5.60
5.	MPU-6050 sensor	1 Unit	RM 10.00
6.	IR Flame sensor	1 Unit	RM 2.80
7.	Water sensor	1 Unit	RM 3.90
8.	Buzzer	1 unit	RM 0.90
9.	Jumper Wire	2 unit	RM 6.00
10.	DC fan	1 unit	RM 4.90
		TOTAL: RM	101.80

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This section is to describe the general analysis and discussion about all the data required to determine achievement of the Project. Analyses were conducted based on method and the result achieved.

4.2 Software Design

As mentioned in previous chapter, Arduino Ide, Proteus and telegram application were used to design this project. All the sensor of modules which found in Proteus library were programmed via Arduino Ide. This coding will be uploaded to the Proteus to test the functionality of the coding. After successfully finishing the Proteus testing, the coding will be uploaded to the Arduino Uno microcontroller. Every component will be programmed according to the specific function.

4.2.1 Telegram Application Notification

Figure 4.1 shows the design of Telegram application that have been choose for the purpose of monitoring and get notified about the warnings. The title given for this project in the Telegram application bot is “Homesecuritybot” and it can be seen on the top of the app when the telegram bot chat is opened. In the telegram App there will be 5 function and that is monitoring Fire sensor, Flood sensor, LPG gas sensor, Earth Quake sensor, Motion Sensor.

Figure 4.1 Telegram Application Notifications


```
WiFiClientSecure client;
UniversalTelegramBot bot(BOTtoken, client);

void setup() {

  Serial.begin(115200);
  Serial.print("Connecting Wifi: ");
  Serial.println(ssid);
  WiFi.mode(WIFI_STA);
  WiFi.begin(ssid, password);
  client.setCACert(TELEGRAM_CERTIFICATE_ROOT); // Add root certificate for api.telegram.org

  while (WiFi.status() != WL_CONNECTED) {
    Serial.print(".");
    delay(500);
  }
```

Figure 4.2 The Program of Esp32 module

The Figure 4.2 describe the Wi-Fi connection setup for the ESP32 microcontroller. When an attempt done for the process of connecting the device to the Wi-

Fi the serial monitor will show Ip adress and “Wi-Fi connected”. And when the device is successfully connected to the Telegram application Bot through the Wi-Fi connection then have to send message to the bot “/start” the bot will be start up.

4.2.2 Arduino instruction programming for sensor detection

```
unsigned long currentMillis = millis();

if(currentMillis - previousMillis >= interval){
  previousMillis = currentMillis;

  code1Val = digitalRead(code1);
  code2Val = digitalRead(code2);
  code3Val = digitalRead(code3);

  if(code3Val==0&&code2Val==0&&code1Val==1){
    bot.sendMessage(CHAT_ID, "PIR sensor triggered");
  }
  if(code3Val==0&&code2Val==1&&code1Val==0){
    bot.sendMessage(CHAT_ID, "Flame sensor triggered");
  }
  if(code3Val==0&&code2Val==1&&code1Val==1){
    bot.sendMessage(CHAT_ID, "Water sensor triggered");
  }
  if(code3Val==1&&code2Val==0&&code1Val==0){
    bot.sendMessage(CHAT_ID, "Gas sensor triggered");
    bot.sendMessage(CHAT_ID, "Turning on ventilation fan");
  }
  if(code3Val==1&&code2Val==0&&code1Val==1){
    bot.sendMessage(CHAT_ID, "Vibration sensor triggered");
  }
}
```

Figure 4.3 The Programs of output notification

The figure 4.3 describe the instruction that have given for the telegram bot application for the sensor monitoring purposes. For an example once any motion detected through the PIR sensor the message will be sent to the telegram bot "PIR sensor triggered". Let's say ignition detected in the surrounding area of sensor, Flame sensor will detect that ignition. Once any ignition detected immediately esp32 will send information to the telegram bot. This telegram bot will notify about the sensor triggered to the notification and messages. Same goes to other sensors too.

4.3 Arduino Uno Coding

4.3.1 The Arduino Uno Coding

```
//This is the Arduino Uno Coding

const int buz = 9;
const int pir = 8;
const int flame = 10;
const int fan = 11;
const int water = A5;
const int gas = A0;
const int mpu1 = A2;  //vibration sensor
const int mpu2 = A3;

void setup() {
  DDRD = DDRD | B00011100;  //sets pin 2,3,4 as output (2-18, 3-19, 4-21)
  pinMode(8, INPUT);
  pinMode(10, INPUT);
  pinMode(A5, INPUT);
  pinMode(A0, INPUT);
  pinMode(A2, INPUT);
  pinMode(A3, INPUT);
  pinMode(9, OUTPUT);
  pinMode(11, OUTPUT);
}
```

Figure 4.4 The pins and ports for all the sensor

As mentioned in previous chapters this project contains two different types of coding. So the figure 4.4 shows a part of the coding for Arduino Uno. This shows the pin declaration of each and every sensor. PIR sensor connected to the 8th port, flame sensor connected to the 10th port, water sensor connected to the 5th port of analogue part, gas sensor also connected to the port 0 in the analogue part, meanwhile vibration sensor which is MPU-6050 have 2 analogue pins where it is connected do the 2nd and 3rd port of analogue part. The physical output like buzzer and fan was connected port 9 and 11 respectively. All the sensors were declared as input while fan and buzzer declared as output.

4.3.2 Arduino Uno send pulse to the Esp32

```
void trig0()  //PIR
{
  errorTone();
  PORTD = B00000100;  //sets pin 2 high (001)(1)
  delay(1500);
  PORTD = B00000000;
}
void trig1()    //Flame
{
  errorTone();
  PORTD = B00001000;  //sets pin 3 high (010) (2)
  delay(1500);
  PORTD = B00000000;
}
```

Figure 4.5 Coding for send pulse to the Esp32

Each and every sensor coded with different binary numbers, for an example PIR sensor consist of (001) which sets the pins high and delay for 1.5 seconds the sets the pin low (000). All sensors able to send the unique pules to Esp32.

4.3.3 Arduino Uno physical output


```
void errorTone(){
  tone(9,400,500);
  delay(500);
  tone(9,400,500);
  delay(500);
  tone(9,400,500);
  delay(500);
}
```

Figure 4.6 Buzzer Coding

Figure 4.6 shows the coding of the buzzer which is technically known as physical output of Arduino Uno. The buzzer connected to the port 9. This tone is the keyword to make the buzzer sounds. Then the buzzer high for 0.5 second and low for 0.5 second.

4.3.4 Declaration of Arduino Pin

When all the libraries have been integrated into a coding, then a process of identified should be done for all the analogue and digital pins that have been employ in the Arduino UNO board. The purpose of this identification is to identify each component port that are pinned into the Arduino board by listing out each of the component name, pin that have been pinned, and description of the component pins and its function.

Table 4 Pin Declaration

COMPONENT	PIN	I/0	DESCRIPTION
Buzzer	9	OUTPUT	The Buzzer have total of 2 pin which is VCC +5V,GND
PIR Sensor	8	INPUT	The PIR sensor have totally of 3 pins which is power, ground and output. The power connected with VCC +5v ,then GND, and the output connect to pin 4 of the Arduino.
ESP32 WIFI MODULE	2,3,4 to D18,D19,D21	OUTPUT	The Wi-fi module totally connected 3 pins of Arduino Uno (2,3,4) and Connected to the Esp32 pin (D18,D19,D21)
Flame sensor	10	INPUT	The Flame sensor have total of 3 pins, so the GND is connected to the GND, and the output pin is connected to pin 10 , VCC connected to the +5
Fan	11	OUTPUT	The fan have total of 2 pin which is VCC +5V,GND

Water sensor	A5	INPUT	The water sensor have total of 3 pins, so the GND is connected to the GND, and the output pin is connected to pin A5 , VCC connected to the +5
MQ2 sensor	A0	INPUT	The gas sensor have total of 4 pins, so the GND is connected to the GND, and the output pin is connected to pin Ao , VCC connected to the +5. The pin also can be connected with Do as an output.
MPU-6050	A2,A3	INPUT	The vibration sensor have total of pins 8, but only 4 pins were used. So the GND is connected to the GND, and the output pin (SCA) is connected to pin A2 , and the output pin (SCL) is connected to pin A3, VCC connected to the +5.

4.3.5 Final Circuit Design

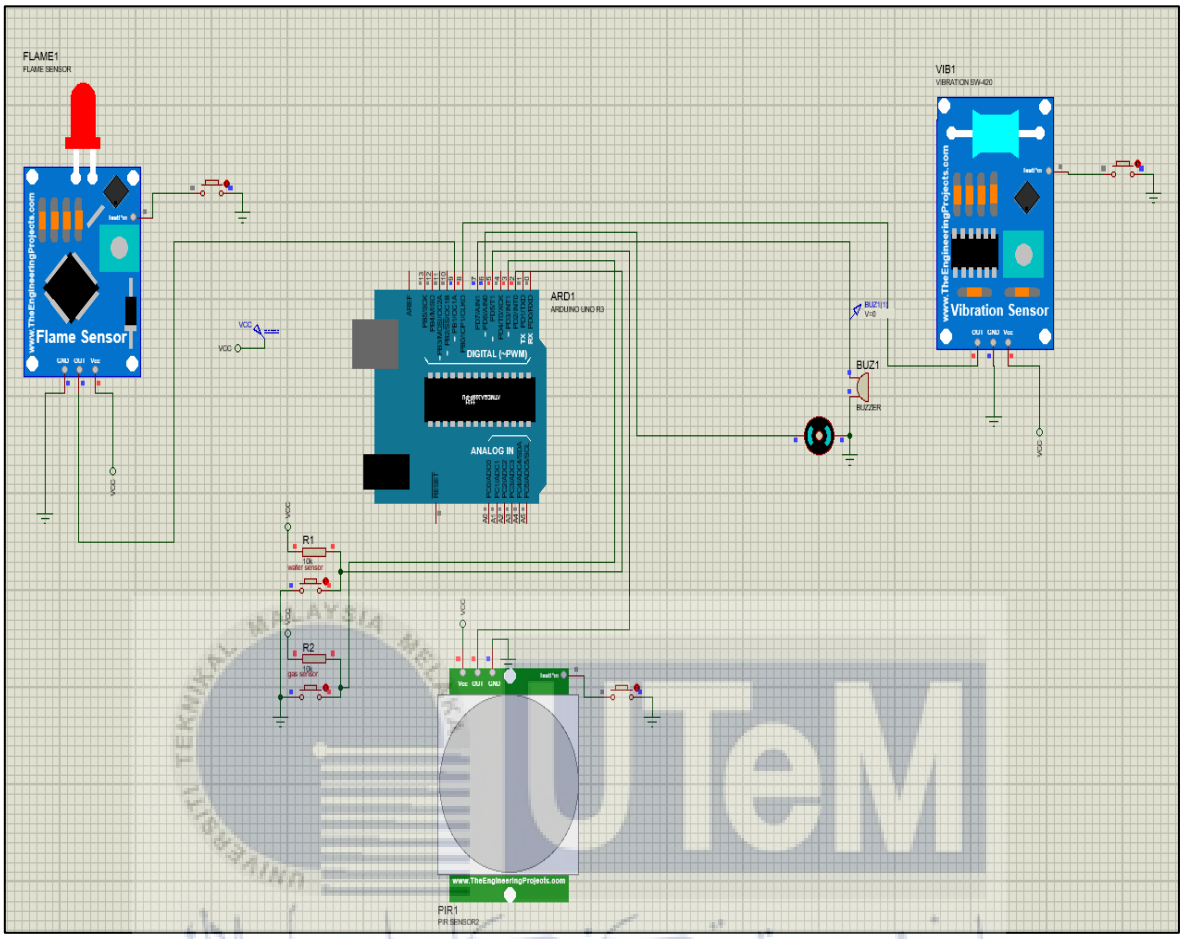
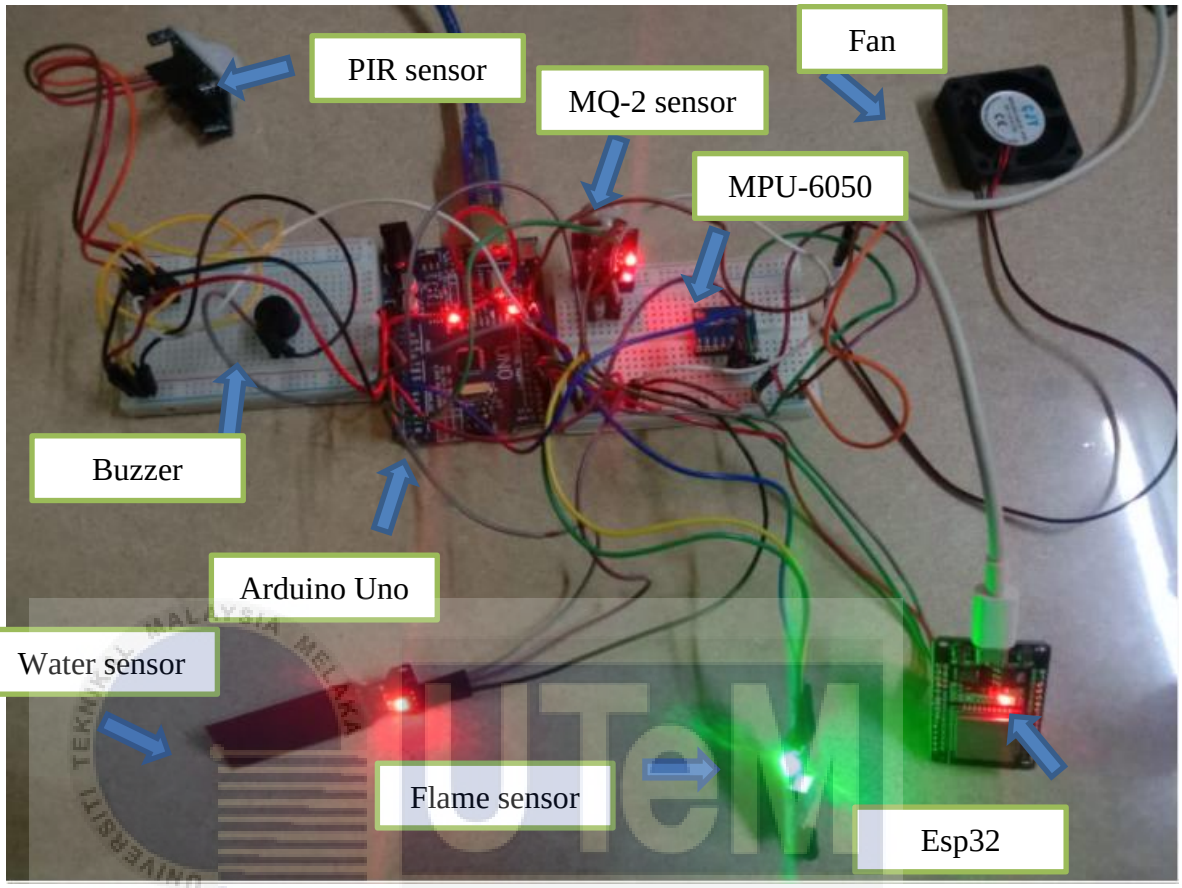


Figure 4.7 Final Circuit Design

The figure above shows about final circuit design. The water sensor button considered as push button. (Flood Sensor) this will warn the owner about water level rises in the house. The gas sensor also replaced as push button. (MQ-2 Sensor) LPG gas detector will is to monitor LPG gas leakage and once it detects the ventilation fan will turn on. PIR sensor is the sensor module the have been included in this simulation. This is to ensure there is no suspicious movement in the house when owner not in the home. Flame sensor module is to detect the fire or flame. This is to avoid fire accidents in the house. Vibration sensor can be consider as MPU 6050 and this earth quake sensor will give warning to the owner. The arduino software programming was edited according to the addition of each and every sensor in proteus.

4.4 Hardware Circuit

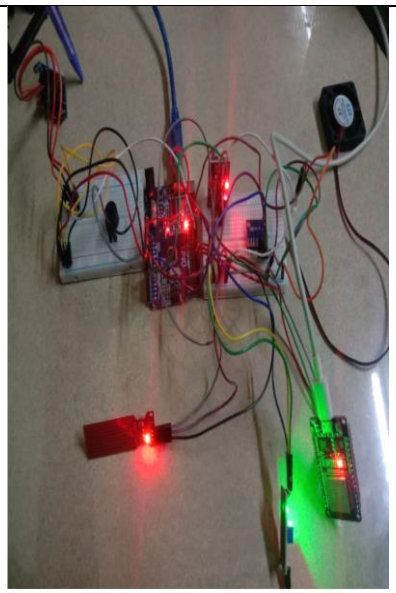
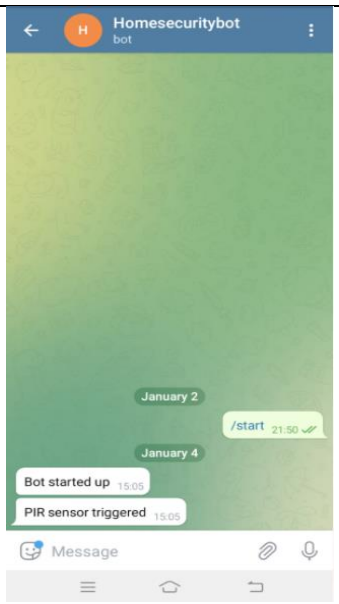
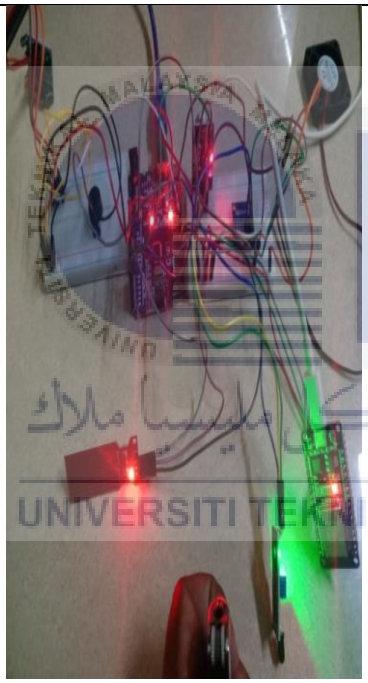


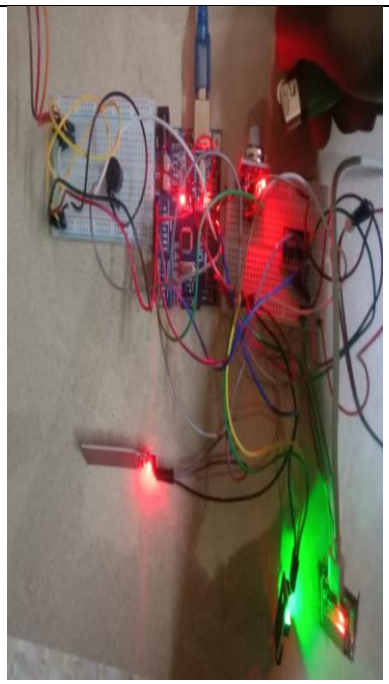
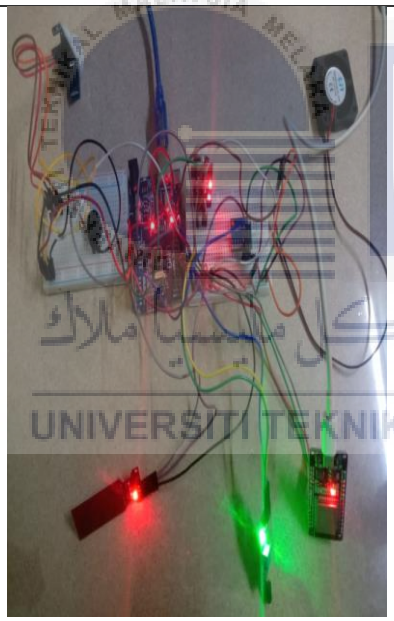
4.5 Field Testing

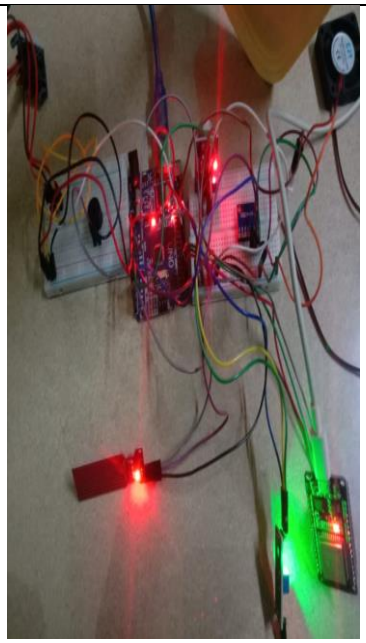
Field testing is a efficient step to produce actual output of that product in which it will be consumed or used. This test is totally opposed to a laboratory testing or testing a product in its development environment. The reason on doing this test on newly made product is to identify its working ability and problem that will be occur when used in real situation. To identify the ability of the project the test has been carried out by triggering all the sensors one by one.

Table 5 Field Testing

Sensor	Testing	Output	Description

PIR sensor			When the pen interrupted the PIR sensor was Triggered. So Esp32 Send the warning to the telegram bot.
Flame Sensor			When the ignition from lighter detected Flame sensor was Triggered. So Esp32 Send the warning to the telegram bot.

MQ-2 Sensor			When the LPG gas released from the lighter MQ-2 sensor was Triggered. So Esp32 Send the warning to the telegram bot. In addition, the ventilation fan will be turn on.
Water Sensor			Once the water Sprinkled on the Water sensor, it will be triggered and the warning notification will receive to the telegram bot through Esp32.

MPU-6050 sensor			Once the plastic hits the cardboard the vibration sensor triggered. Then the notification will appear in our phone.

4.6 Results and Analysis

Software project development

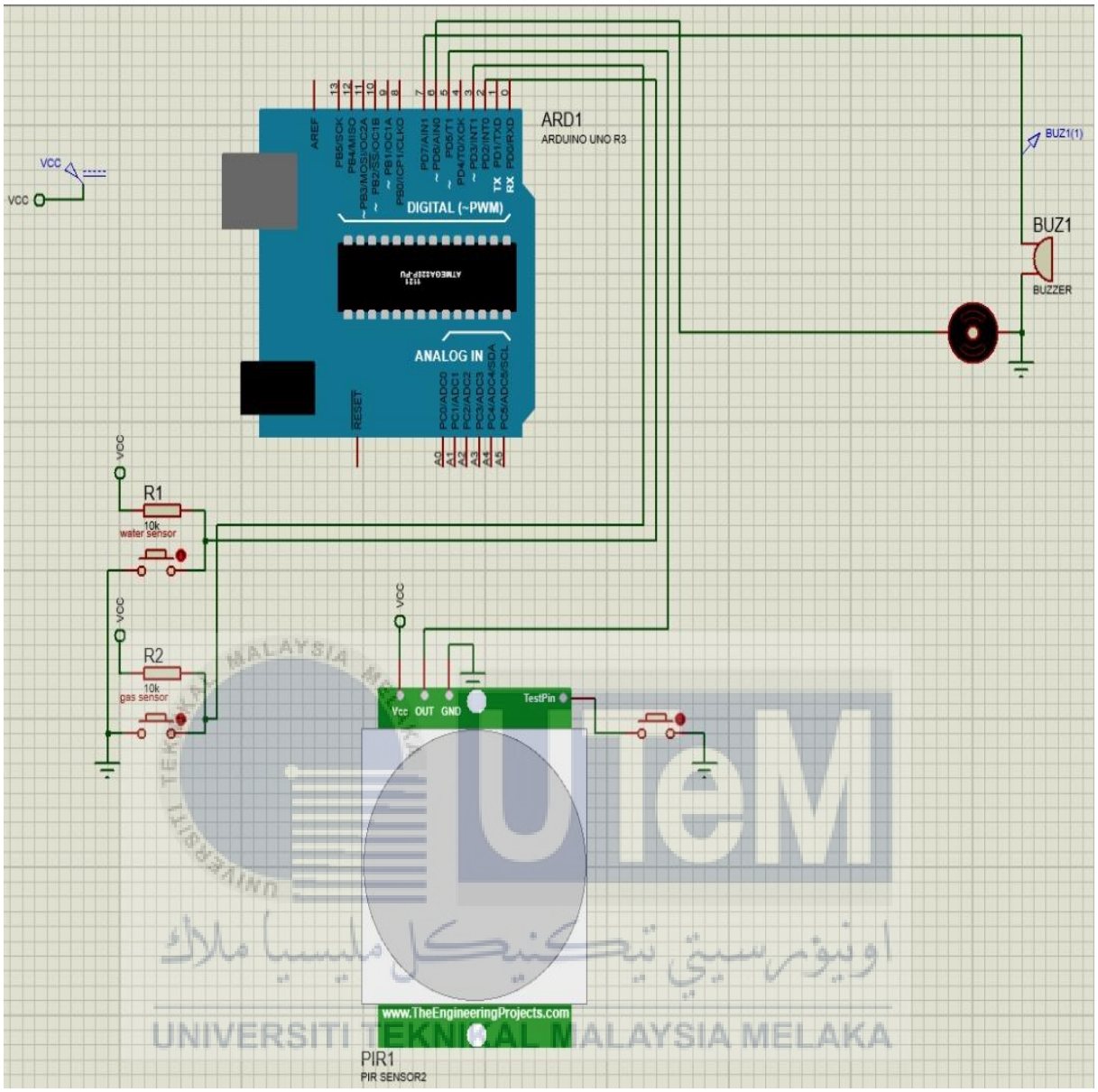


Figure 4.8 Schematic diagram

4.7 Summary

The schematic diagram shows the pre-result of Development of Arduino and IoT-Based Smart home Safety System. Arduino Uno microcontroller used for the simulation where all other devices and sensors depends on this microcontroller. Push button represents water sensor and also can be referred as rain sensor module. The next push button is an alternative of gas sensor (MQ2 sensor). The buzzer will represent the notification alarm or warning alarm. Meanwhile the servomotor represents the ventilation fan, which should be automatically activate once the gas sensor detects the LPG gas. The motion sensor module which is PIR sensor were used in the simulation, so once the push button which is connected to the test pin of the PIR sensor clicked the buzzer will turn on. Meanwhile the push button was used as an alternative for water sensor and gas sensor. Once the water sensor push button activated the buzzer will turn on. Finally Once the gas sensor push button turned on not only the buzzer will turn on but the servomotor too.

CHAPTER 5

CONCLUSION

5.1 Introduction

This chapter is to conclude about the overall process Development of Arduino and IoT-Based Smart Home Safety System. Furthermore, the purpose of this chapter is to give clear explanation to improve and develop the system to become more efficient that can be done in upcoming processes.

5.2 Conclusion

Even though there is various type of smart home safety system is available in current market, those products are mostly not affordable by the poor and middle class people. The aim of this project is to target the middle class and poor people who are not able to buy and pay for the maintenance of this kind of security system because they are most in numbers and they have all the rights to protect their belongings. In additional this smart home safety system is also recommended to people because it is a compilation of fire detection system, theft detection system, LPG gas detection system, earthquake detection system and also flood detection system. All these systems are in the process of compiling in one system is integrated with IoT system.

As the final result in implementing the project titled as "ARDUINO AND IOT BASED SMART HOME SAFETY SYSTEM" using Arduino Uno, Esp32 and Telegram application was successfully designed and tested according to the criteria. The telegram application is successfully received the notification from the intended sensors to make the

project successful in monitoring and in receiving warning notification. Other than that, every sensors like PIR sensor, Water sensor, Flame sensor, Earth-quake sensor, MQ-2 gas sensor works very efficiently to detect things that have been intended to do, without any obstacles. Finally using this smart home safety system lot of accidents and mishaps can be avoided. So the conclusion is with this project to objective was successfully achieved.

5.3 Future Works

For future improvements, accuracy of the Smart home safety system can be enhanced as follows:

i) In future it can be updated with surveillance camera, just to make sure there is really suspicious things were detected by the motion sensor.

ii) In future several new sensors also can be include to make it more useful. Lets say adding a voice controlled power system can make people's life easy.

iii) Other than that, setting some level of sensitivity to some sensors will be helpful to use it all day.

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APPENDICES

Appendix A : Esp32 Code

```
//This is the ESP32 Coding


#include <WiFi.h>

#include <WiFiClientSecure.h>

#include <UniversalTelegramBot.h>

#include <ArduinoJson.h>


// Replace with your network credentials

const char* ssid = "vivo 1902";

const char* password = "sample";
```



```
// Initialize Telegram BOT

#define BOTtoken "5039809377:AAFA4UctjEVB4bmOjH7yOBZ4Hs-TEEi3t6A"  // your Bot Token (Get from Botfather)


// Use @myidbot to find out the chat ID of an individual or a group

// Also note that you need to click "start" on a bot before it can

// message you

#define CHAT_ID "700448369" //700448369(225074436)
```

```
unsigned long previousMillis = 0;

const long interval = 1000;


const int code1 = 18; //2

const int code2 = 19; //3

const int code3 = 21; //4

int code1Val = 0;

int code2Val = 0;

int code3Val = 0;


WiFiClientSecure client;

UniversalTelegramBot bot(BOTtoken, client);


void setup() {


  Serial.begin(115200);

  Serial.print("Connecting Wifi: ");

  Serial.println(ssid);

  WiFi.mode(WIFI_STA);

  WiFi.begin(ssid, password);

  client.setCACert(TELEGRAM_CERTIFICATE_ROOT); // Add root certificate for api.telegram.org
```

```
  while (WiFi.status() != WL_CONNECTED) {
    Serial.print(".");
    delay(500);
  }

  pinMode(code1, INPUT);
  pinMode(code2, INPUT);
  pinMode(code3, INPUT);

  Serial.println("");
  Serial.println("WiFi connected");
  Serial.print("IP address: ");
  Serial.println(WiFi.localIP());

  bot.sendMessage(CHAT_ID, "Bot started up", "");
}

void loop() {
  unsigned long currentMillis = millis();

  if(currentMillis - previousMillis >= interval){
```

```
previousMillis = currentMillis;


code1Val = digitalRead(code1);
code2Val = digitalRead(code2);
code3Val = digitalRead(code3);


if(code3Val==0&&code2Val==0&&code1Val==1){
  bot.sendMessage(CHAT_ID, "PIR sensor triggered");
}
if(code3Val==0&&code2Val==1&&code1Val==0){
  bot.sendMessage(CHAT_ID, "Flame sensor triggered");
}
if(code3Val==0&&code2Val==1&&code1Val==1){
  bot.sendMessage(CHAT_ID, "Water sensor triggered");
}
if(code3Val==1&&code2Val==0&&code1Val==0){
  bot.sendMessage(CHAT_ID, "Gas sensor triggered");
  bot.sendMessage(CHAT_ID, "Turning on ventilation fan");
}
if(code3Val==1&&code2Val==0&&code1Val==1){
  bot.sendMessage(CHAT_ID, "Vibration sensor triggered");
}
```

```
    }

}
```

Appendix B : Coding for Arduino Uno

```
//This is the Arduino Uno Coding

const int buz = 9;

const int pir = 8;  //3

const int flame = 10; //6

const int fan = 11;

const int water = A5;

const int gas = A0;

const int mpu1 = A2;  //vibration sensor

const int mpu2 = A3;



void setup() {

  DDRD = DDRD | B00011100;  //sets pin 2,3,4 as output (2-18, 3-19, 4-21)

  pinMode(8, INPUT);

  pinMode(10, INPUT);

  pinMode(A5, INPUT);

  pinMode(A0, INPUT);

  pinMode(A2, INPUT);

  pinMode(A3, INPUT);

  pinMode(9, OUTPUT);

  pinMode(11, OUTPUT);
```

```
}


void loop()
{
  if(digitalRead(pir) == 1){trig0();}
  else if(digitalRead(flame) == 0){trig1();}
  else if(digitalRead(water) == 1){trig2();}
  else if(digitalRead(gas) == 1){trig3();}
  else if(digitalRead(mpu1)||digitalRead(mpu2) == 1){trig4();}
  //else if(digitalRead(mpu2) == 1){trig5();}
}

void trig0()  //PIR
{
  errorTone();
  PORTD = B00000100;  //sets pin 2 high (001)(1)
  delay(1500);
  PORTD = B00000000;
}
void trig1()    //Flame
{
  errorTone();
```

```
  PORTD = B00001000;  //sets pin 3 high (010) (2)
  delay(1500);
  PORTD = B00000000;
}
void trig2()    //water
{
  errorTone();
  PORTD = B00001100;  //sets pin 2 and 3 high (011) (3)
  delay(1500);
  PORTD = B00000000;
}
void trig3()    //gas
{
  errorTone();
  PORTD = B00010000;  //sets pin 4 high (100) (4)
  digitalWrite(11, HIGH);
  delay(1500);
  digitalWrite(11, LOW);
  PORTD = B00000000;
}
void trig4()    //vibration
{
```

```
  errorTone();
  PORTD = B00010100;  //sets pin 4 and 2 high (101) (5)
  delay(1500);
  PORTD = B00000000;
}
/*void trig5()    //vibration
{
  tone(9,400);
  delay(500);
  noTone(9);
  delay(1000);
  tone(9,400);
  delay(500);
  noTone(9);
}*/

void errorTone(){
  tone(9,400,500);
  delay(500);
  tone(9,400,500);
  delay(500);
  tone(9,400,500);
```

```
  delay(500);
}

/*if(code3Val=0&&code2Val=0&&code1Val=1){
    }
    if(code3Val=0&&code2Val=1&&code1Val=0){
    }
    if(code3Val=0&&code2Val=1&&code1Val=1){
    }
    if(code3Val=1&&code2Val=0&&code1Val=0){
    }
    if(code3Val=1&&code2Val=0&&code1Val=1){
    }
    bot.sendMessage(CHAT_ID, "PIR sensor triggered");*/
```