T.C.

ALTINBAŞ UNIVERSITY

Electrical and Computer Engineering

DESIGN AND IMPLEMENTATION OF INTELLIGENT SECURITY AND SAFETY SYSTEM BASED ON GSM AND IOT TECHNOLOGY

OMAR KHALAF MOHAMMED

Master Thesis

Supervisor

Prof. Dr. Oguz Bayat

Istanbul (2019)

DESIGN AND IMPLEMENTATION OF INTELLIGENT SECURITY AND SAFETY SYSTEM BASED ON GSM AND IOT TECHNOLOGY

by

Omar Khalaf Mohammed

Electrical and Computer Engineering

Submitted to the Graduate School of Science and Engineering

in partial fulfillment of the requirements for the degree of

Master of Science

ALTINBAŞ UNIVERSITY

2019

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of ” Master of Science”.

Prof. Dr. Khalaf Jehad ABED	Prof. Dr. Oğuz BAYAT
Co-Supervisor	Supervisor

Examining Committee Members (first name belongs to the chairperson of the jury and the second name belongs to supervisor)

Prof. Dr. Oğuz BAYAT	School of Engineering and Natural Sciences, Altinbaş University	_____
Prof. Dr. Osman Nuri UÇAN	School of Engineering and Natural Sciences, Altinbaş University	_____
Prof. Dr. Hasan Hüseyin BALIK	Faculty of Engineering, Milli Savunma University	_____

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

Asst. Prof. Dr. Çağatay AYDIN

Head of Department

Prof. Dr. Oğuz BAYAT

Director

Approval Date of Graduate School of Science and Engineering: ____/____/____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Omar Khalaf Mohammed

ACKNOWLEDGEMENTS

In the beginning Praise be to Allah, the Lord of the Worlds very much, always stay with us in the end of this work. I thank my father and mother for what they had as well as a great and influential in my life and they have always been my supporters and support me in this world. Acknowledgment and appreciation to my dear supervisor for his cooperation and support to complete this work. Special thanks to Mr. Hamzah Mohammed Marhoon Al-Azzawi at Al-Esraa University college in Iraq/Baghdad for his continued and continuous support and guidance to complete this work and make it in the best form. Thank you my dear friends and my beautiful friends.

ABSTRACT

DESIGN AND IMPLEMENTATION OF INTELLIGENT SECURITY AND SAFETY SYSTEM BASED ON GSM AND IOT TECHNOLOGY

Omar Khalaf Mohammed

M.S, Electrical and Computer Engineering, Altınbaş University

Supervisor: Prof. Dr. Oğuz Bayat

Co-Supervisor: Prof. Dr. Khalaf Jehad Abed

Date: May-2019

Pages:47

The safety systems and security systems take a big role in our lives because of their importance in protecting homes, company, gold shops or other institutions and properties from disasters such as exposure to fire or gas leakage and even being robbed by burglars. The security and safety systems have begun to evolve with the development of technology and the emergence of various types of smart microcontrollers and intelligent electronic parts such as cameras, Infrared sensors, gas leak sensors and others smart sensors. In this proposed system can implement multi-level home security and safety system by using the Arduino microcontroller board supported with the some hardware sensors like that PIR sensor for the motion detecting , flame sensor for fire detecting , gas sensor for the gas leak detecting , GSM module, laser, storage camera, other chock equipment device such as alarm , fire extinguishing pumps , also can use this hardware to design and implement more smart and intelligent systems by using a wide range of available sensors, shields and modulus which provide us a powerful functionality with low power requirement , cheap price and good performance also the easy programming language of Arduino and the big project examples and large community push the Arduino to be one of the most famous controllers. The proposed system will solve a big problem that's which related with the home security and home safety. In additionally the home owner can turning ON/OFF the various of home appliances, monitor the gas leak, fire, security through the IoT technology where the home owner can be doing all of this wirelessly and from any area of the world via specific IP address granted by the microcontroller.

Keywords: Arduino Microcontroller, PIR sensor, GSM, gas sensor, IoT.

TABLE OF CONTENTS

page

ABSTRACT ..... **vi**

LIST OF TABLES ..... **ix**

LIST OF FIGURES ..... **x**

LIST OF ABBREVIATIONS ..... **xi**

1. INTRODUCTION 1

1.1. MOTIVATION 2

1.2. HOME SECURITY AND AUTOMATION SYSTEM 3

1.3. BENEFITS OF HOME AUTOMATION SYSTEM 4

1.4. RELATED WORK 5

1.5. OBJECTIVE OF THE PROPOSED SYSTEM 7

1.6. PROBLEM STATEMENT 8

2. SYSTEM PARTS 9

2.1. INTRODUCTION TO ARDUINO UNO 9

2.2. ARDUINO UNO 10

2.3. THE ARDUINO IDE 12

2.4. ARDUINO SENSORS 13

2.4.1 Flame Sensor 13

2.4.2. Passive Infrared Sensor (PIR) 14

2.4.3. MQ-50 Gas Sensor 16

2.4.4. Light Dependent Resistance 18

2.4.4. Laser Module 19

2.5. GSM SIM 900 MODULE 20

2.6. WIFI/P2P CAMERA Q7 HD 20

2.7. NODE MCU 22

2.8. ARDUINO NANO 24

3. SYSTEM DESIGN AND IMPLEMENTATION……..26

3.1. WORKING PRINCIPLE……...……...…….26

3.2. RESULTS……...……...…….……...29

4. CONCLUSION AND FUTURE WORK……...32

4.1. CONCLUSION …….……...32

4.2. FUTURE WORK…….……...…….……...…...32

REFERENCES…….33

APPENDIX A.....37

LIST OF TABLES

Pages

Table 1.1: Arduino UNO specifications. 11
Table 2.2: Arduino NANO properties. 25

LIST OF FIGURES

Page

Figure 1.1: An example of home automation system. 4
Figure 2.1: Source of dust in air (2015). 5
Figure 2.2: Some Arduino families. 10
Figure 2.3: The Arduino UNO. 11
Figure 2.4: The Arduino IDE. 12
Figure 2.5: Flame sensor value over distance. 14
Figure 2.5: Flame Sensor Module. 14
Figure 2.6: The passive infrared sensor. 15
Figure 2.7: Object Passing through PIR Sensor. 15
Figure 2.8: PIR Sensor Mounting Views. 16
Figure 2.9: Voltage divider circuit. 17
Figure 2.10: The sensitivity characteristic curve of the sensor. 17
Figure 2.11: The MQ-2 gas sensor. 18
Figure 2.12: The SIM 900 GSM module. 19
Figure 2.13: WIFI/P2P Camera Q7 HD 19
Figure 2.14: The laser module 20
Figure 2.15: The SIM 900 GSM module 21
Figure 2.17: Pin configuration of NodeMCU 23
Figure 2.18: NodeMCU 23
Figure 2.19: Arduino NANO microcontroller 24
Figure 3.1: The block diagram of first part of implemented system 27
Figure 3.2: The second part of implemented system 28
Figure 3.3: The implemented system 29
Figure 3.4: The appears messages on the mobile phone 30
Figure 3.5: The result on GUI in case of fire, gas leak and motion 31
Figure 3.6: The result on GUI in safe mode 31

LIST OF ABBREVIATIONS

WI-FI : Wireless-FI.

GSM : Global System for Mobile.

LCD : Liquid Crystal Display.

LPG : Liquid Petroleum Gas.

IoT : Internet Of Things.

LED : Light Emitting Diode.

LDR : Light Dependent Resistor.

PIR : Passive Infrared.

IDE : Integrated Development Environment.

DC : Direct current.

SRAM : Static random access memory.

GPRS : General Packet Radio Service.

AC : Alternating Current.

SMD : Surface Mounted Device.

1. INTRODUCTION

At the beginning of human living and since last years the security was one of the most important requirement needs to keep the life of home owners and protect the immovable of invaluable persons the, security methods development with the evolving of the human life and technology. now we living in 21st century where divergence of live style and the great technology development of IT, network and automatic control technologies bring to light our need to remote home security monitoring and alarming system has not require consuming human time with the lowest possible cost and maximum efficiency , Since the targets to be secured are very different for that reason we see a wide range of security systems and which are different in there control methods , sensor types , alarm ways to meet the duty which made for and the different requirements of all the objectives , so now we can define the home security system that is the device that detect the unauthorized people or unwanted events and do a specific job about this situation like alert the owner , call police , run the fire extinguisher and etc. [1].The science and technology in 21st century is the era for them. In keeping with the variation of time with the technology of the home has been modernized a lot. Now most home devices are automated. The connotation of Home Automation is first putted in water heater at 1889. After that, Increased the uses of Home Automation day by day. Depending on the API research in 2012, more than 1.5 million Home Automation systems are built-up in USA [2]. These days, Home Automation is more prevalent and quickly makes a better position in market and gives a major scope to work and research for the engineers. It is the expected that within 2020 the market rate of Home Automation become more than 10 billion US$. Several types of wireless network technology like an internet, WI-FI, GSM makes the Home Automation system more efficacious. And by Using these technology home devices are easy to control from afar distance through the android or web based application. To construct a smart and intelligence home is now very potential by combining GSM module and Home automation system [3]. A security system is defined to disclose obstructions, unauthorized access to a building or a protected area and to decline such illicit access to personal and property protection from damages or harms. The security systems are used in the defense against theft or property damage, as well as personal protection against meddlers in commercial, residential, military and industrial properties. Alarms protect cars and their contents like vehicle alarms. Prisons also use prisoners ' security systems to control them. Home security is the most prominent in residential areas. Today, home safety and home

monitoring are the main elements of every modern automated home. The basic design of a security system starts with the analysis of the residents ' needs, the survey of existing technologies and hardware, the review of system cost and the monitoring option as well as installation planning. Now, by looking at one of the rich countries in the USA in the world, we see they put sixth in car theft and 9th in carjacking. The results from their survey show that the majority of burglars have occurred in residential areas, in offices and in banks. Non - automated safety systems have been found to be untrusted. The doors were equipped with an opening lock and key system. Even the person of a safety guard is not completely confident. It has been found that each system from the past is very weak. Home is a place where safety is necessary to maintain all the expensive things and equipment safe. The owner should be confident that he can leave the house with the feeling that nothing can happen in the home. This feeling will emerge only when a reliable security system is in place at home. That is why it has focused in our project on maintaining the home safety and security system [4]. The introduction into the home environment of technology to ensure the adequacy, convenience, safety and energy permeation of its residents can be considered home automation or intelligent houses. Here we design Home Automation project based on GSM module using the Arduino microcontroller board and GSM module to control electronics appliances and devices and make a security alarm [5].

1.1. MOTIVATION

In recent years, the CEO of Facebook, Mark Zuckerberg has built an Artificial Intelligence (AI) voice controlled assistant for his home. His inspiration came from the character “Jarvis” from the movie called Iron-Man. He has described that it is like a digital butler who can speak, play music, control lights and toasters. It can also say who is at the door. This project has made a movie character almost come to real. This excellent work of his has inspired us to do the project of home automation. There are many smart home appliances like underground refrigerator, smart almost all houses will be a smart house. This project is a small step to reach this goal. Almost every house has smart phones, smart television, smart watch, smart refrigerator, smart washing machine, smart garage which ultimately leads to a smart home. From there it is predictable that one day almost every house will be a smart house with automatic control system [6].

1.2. HOME SECURITY AND AUTOMATION SYSTEM

The wireless Arduino based system includes controlling of home appliances like light, fan, air conditioner, television, show date, time, dust sensor, room temperature, smoke and motion sensing and finger print sensor security system. This project proposes remotely controlling of home appliances with security of home both inside and outside. The project is composed of [7]:

1. Controlling of appliances like light, table fan, TV, air conditioner, curtains etc. will be controlled with Android phone through Bluetooth communication using Bluetooth module. This is used inside the house only.

2. Density of dust level will be detected with dust sensor and purify.

3. The system will show date, day, time and temperature. For this we have chosen DS1307 RTC module. LM35 will show the temperature. All of them will be displayed in LCD 16 x 2 displays too.

4. Gas sensor MQ-2 will sense risky gas and smoke.

5. The movement of the curtains will depend on the requirement of light which is measured with Light Dependent Resistor (LDR).

6. PIR Sensor (HC – SR501) is used for motion detection.

7. Through GSM module we will control the above appliances from a distance via text messages. This will ensure safety inside the house with the help of PIR sensor.

8. The fingerprint recognition module is for automatic door locking and unlocking system.

9. Arduino Mega 2560 is the microcontroller in Windows operating system.

10. Finally, all appliances are controlled by Voice Application and Android Application through Android mobile phone.

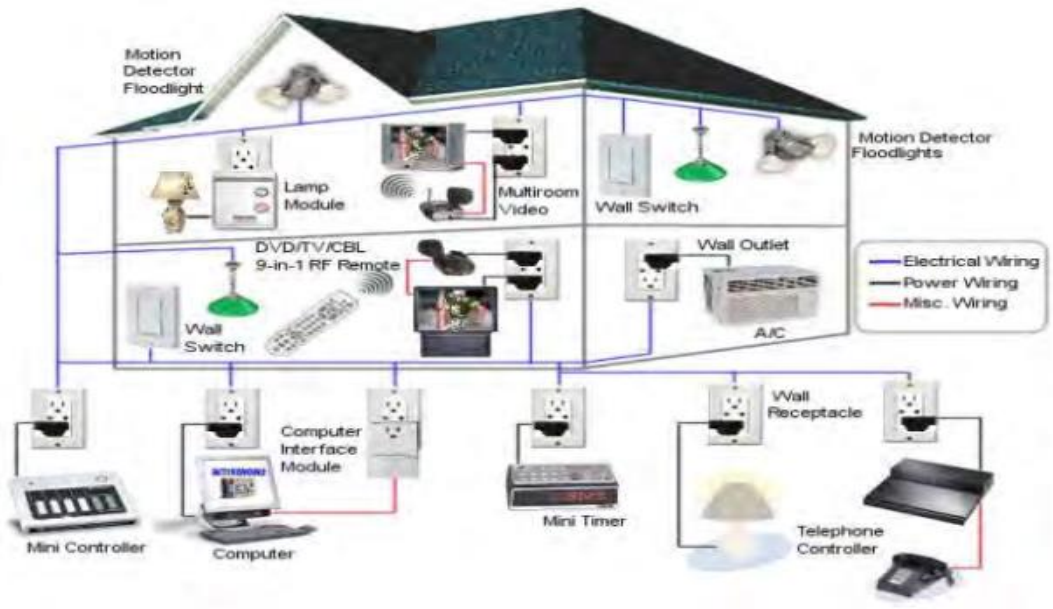

Figure 1.1: An example of home automation system.

1.3. BENEFITS OF HOME AUTOMATION SYSTEM

Today, home automation is essential for the improvement of the way of life. Domestic automation offers a future - oriented way of life when a person controls the whole House with a smartphone, from TVs to locking or unlocking doors. It also provides an efficient energy utilization. The automation system also enables us to control the home appliances and monitor the building from afar. It is useful for grandparents who usually stay alone. It also helps the handicapped person to care for the home and to inform them whether there are problems in the house. In Bangladesh, heart diseases such as asthma or stroke caused by air pollution kill 37,000. In the region of the South East Asia Regional Office, our country is third in the 11 Asian Air Pollution countries. Therefore, an adjustment level detector is a must in every house of Bangladesh Some respiratory disorders due to excess dust leads to infection.

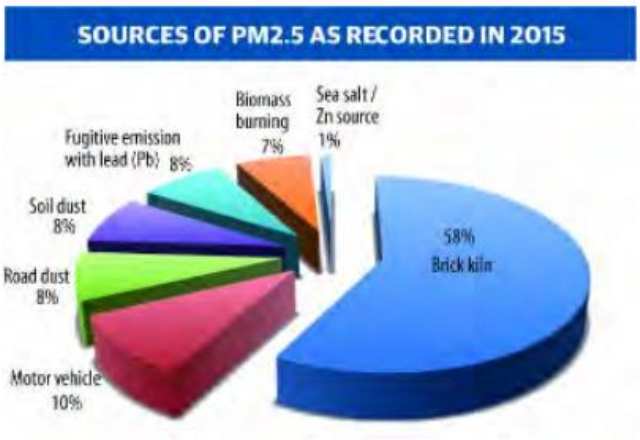

Figure 1.2 Source of dust in air (2015).

BBC News says dust particle level in Dhaka is seven times higher than Singapore. Dust level increases further in winter season. Therefore, it is very important to reduce the dust level in possible places [8].

1.4. RELATED WORK

In different countries there are many other domestic automation projects. They differ in designs, characteristics, devices, elements and algorithms from each other. They were prepared to meet specific requirements and component availability in the areas concerned. Some of them are cheap; some are costly. Availability of both hardware and software is necessary to work. After a long searching, we have found a lot of essay. Searching for security purpose essay, we also found some projects done for garage security. These are mainly done in westerner countries. Many projects are conducted with Arduino or Raspberry Pi for protection purposes only. Once again, projects are only carried out to control home appliances with Arduino or Raspberry Pi [9].

In [10] suggested that a microcontroller be built on an automatic system that offers strong protection against fracture or physical interference by sending a message directly to the law - enforcement group. The system consists of a micro - controller with a passive infrared radiation system, a shock sensor and a display panel keyboard.

In [11] suggested to collect the information from 2 PIR sensors to identify obstacles, treat the data and transfer SMS to GSM mobile phone equivalent number with GSM modem, and serial camera, module of the SD card, to reserve this image.

In [12] Proposed Arduino based surveillance increase the detecting capability of theft by vibration, PIR and password pedant. Arduino Microcontroller is connected to USB and transfers a photograph analog to a digital signal, and stores images on the cloud server to save the impact of the person who was involved in the steal. Photos are transmitted to android users as a warning against mistresses.

In [13] Offer the innovative low cost design and automated weather, device and home security control, and the design of the Android app to enable the smart phone to send orders and get warning via the server-based system. The Arduino Microcontrollers process the system.

The GSM - Arduino web - based indoor air quality system was proposed by three researchers from Malaysia. The system consists of the Wireless Sender gas sensor, moisture, temperature, particulate dust and wireless sensor network (WSN). The base station is a desktop computer [14].

There are few home automation systems for wireless connection using ZigBee or Bluetooth. The most unlimited number of integrated devices can be connected by Wi - Fi and by the IPv6 introduction [15].

In [16] The system operates at different levels of user access control based on password policies, using SMS communication from the available GSM network. the proposed cameras and sensors based on the input system.

In [17] described the remote control system of home devices utilize android phone across GSM network. They focused on the Android station design, the ARM-GSM module connection. One of the tasks was also to reduce the difficulty of providing the convenient low voltage DC for MCU and wireless module with a single live wire. Only the control of devices using android were found here, nothing more than that.

In [18] The Home Automation Device Protocol (HADP) protocol standard was shown in the article. Their components were Wi-Fi, Bluetooth 4.2, ZigBee IP, 6LoWPAN, IEEE 802.15.4 and IPv6-supporting Ethernet network layer. They mainly suggested a protocol that uses WIFI connection to connect many devices together.

In [19] They proposed the ATM counter for PIR sensors and smart power saving mode. This detects walkers and ATM users using infrared pyro electric sensors. In order to distinguish day

and night with a monitoring video, the system is controlled by the RTC DS 1307 in-time clock. This provides the ATM counter with perfect security.

In [20] design and implement of smart home security system based on GSM/GPRS (Global System for Mobile Communication /General Packet Radio Service) and response rapidly to alarm incidents and has a friendly user interface including a LCD (Liquid Crystal Display) and keypad.

In [21] design a system to transmit to a centralized server and upload to the website Raspberry pi and GSM is used. Through this system people of all ages can be benefitted. The system can be upgraded and improved by further additions of features. When a human will bend his fixed finger after facing any kind of danger, the resister value of flex will be changed and system will be on. At that moment not only SMS including location will be sent to the fixed numbers but also it will be uploaded and saved as still images to the website.

1.5. OBJECTIVE OF THE PROPOSED SYSTEM

The main objective of this proposed system is remote monitoring of any house device and ensuring security. The proposed system contains the following points:

- Send SMS to alert the home owner in case of LPG leakage detected and also turning ON the alarming system and in the same time shows a message on a GUI with help of IoT technology.
- Send SMS to the home owner when the thief tries to enter the home where the system consists of two level of security the first level based on the PIR sensor and the second level based on the laser beam in the same time turning ON the Wi-Fi camera, this type of camera allows the user to monitor his house from anywhere of the world.
- Send SMS when the fire happens inside the home and runs the extinguisher system and also shows alerting message on the GUI.
- The user can be turning ON/OFF the features of appliances and monitor his house wirelessly through the web via the IOT technology.

1.6. PROBLEM STATEMENT

The main problem that gives motivation in the design and implementation of this work is the increase in cases of theft of houses, restaurants, shops and other institutions, as well as cases of fire occurring in homes, restaurants or gas leakage which leads to suffocation or even fire.

2. SYSTEM PARTS

Many of sensors and modules used to established and developed the implemented system, in this part will describes.

2.1. INTRODUCTION TO ARDUINO UNO

An Arduino is a microcontroller board with a software package for programming it to been embedded system. The hardware consists of a simple open hardware design for the controller with an AVR processor and on-board I/O support. The software consists of a standard programming language based on multi programming languages and the boot loader that runs on the board. In other meaning, an Arduino is a small computer that can programmed to process inputs and outputs between the microcontroller and any other external components can have connected with the board. The Arduino board executes the writing of the code. It can only be controlled and reacted by electricity (direct tension), so that the board interacts with the actual life with specific components. The sensors may become the ingredients that transform some aspect of the physical world into electricity so that the Arduino board can feel it or actuators that take electricity out of the board and transform it into something that changes the world. Sensors, such as switches, accelerometers and ultrasound distance sensors, are examples of sensors. Actuators are like lights and lamps, speakers, motors and displays. Pulse Width Modulation is an applicable process for many applications. Using an Arduino is one of the easiest ways to perform this. This application note will examine what Pulse Width Modulation is and explain how to use two different methods to perform Pulse Width Modulation. This can be done in several ways by the Arduino [22], [23]. the Figure.2.2 illustrate some of Arduino types.

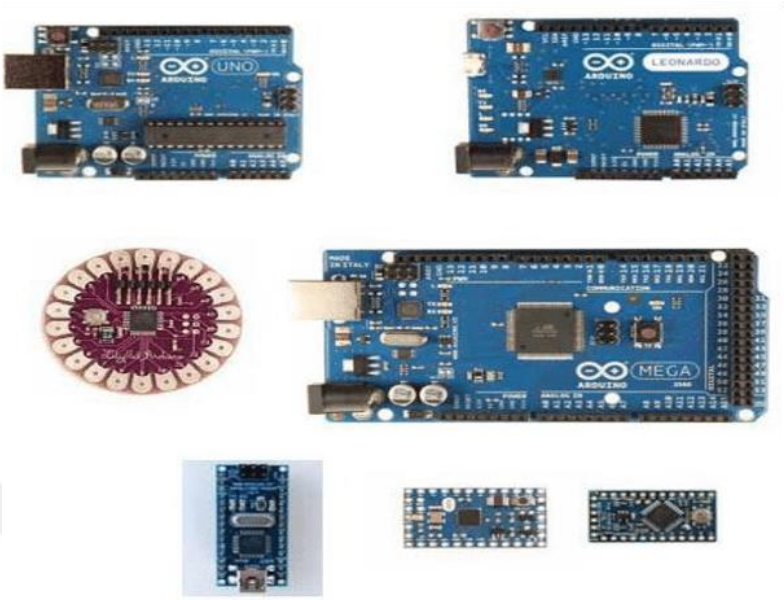

Figure 2.2: Some Arduino families.

2.2. ARDUINO UNO

The Uno is one type of Arduino families, a microcontroller board based on the ATmega328P It has 14 digital pins can have used for digital input or digital output specify that through programming (6 pins of which can using for analog output by PWM outputs), It consists of 6 analog inputs, a 16 MHz crystal oscillator, USB jack, an ICSP heading, and a reset button, all of which are needed to support the microcontroller, just connect it to computer via a USB cable or power it with a DC adapter or battery to get starter, the figure.2.3 below shows the Arduino UNO kit. It is the most widely used and common in building projects and it is easy to use. It is used in the programming of microcontroller of the company ATmega328. The microprocessor is like a small computer unit with all the calculations and logic in it. Atmega328 contains a 16 MHz processor and a total memory of 32Kilo Byte [24].

The memory stored in the controller varies depending on the type of interface and is divided into**:**

- Boot loader: The program is responsible for how to understand the Arduino C language circuit with a size of 0.5 KB.

- SRAM: Memory used to register variables is temporarily 2 KB in size.
- Flash Disk: A storage space used to save a program used to run a 32 KB control.
- EEPROM: The memory responsible for the recording of certain variables permanently within the control and retain its residual even after the separation of electricity 1 KB.

  The Arduino Uno Specifications and description of memory are list in table.2.1.

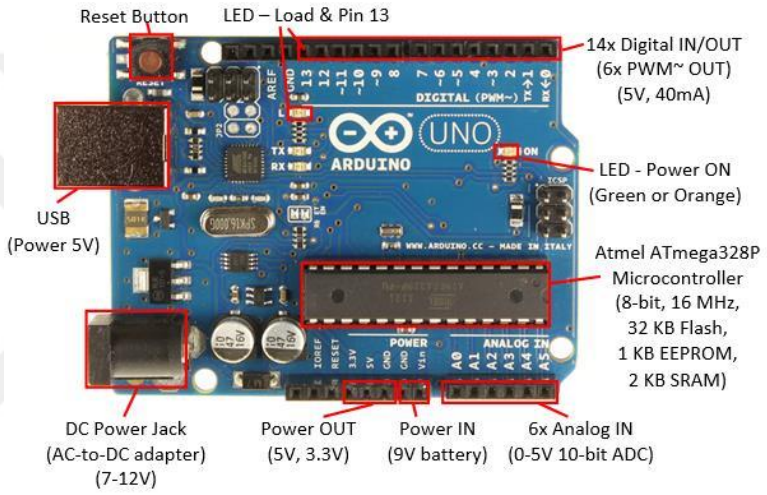

Figure 2.3: Arduino UNO kit.

Table 1.1: Arduino UNO specifications.

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

2.3. THE ARDUINO IDE

An Arduino IDE - written program is called a sketch. Sketches are saved as text files with the file extension (.ino) on the development computer. which is refers to the last three letters from the word “Arduino”, Arduino Software (IDE) pre-1.0 was saving sketches with the extension. pde which is the refers to Source code file written in the Processing programming language.

Only two functions comprise a minimum Arduino C / C++ program:

- setup (): Each code is placed within this function, it will be executed for one time and not repeated and Usually used to defines the pin mode either input or output and give the initial values to the serial port.
- Loop (): After setting up) (the function exits (end), the loop) (repeatedly executed and the main program inside the void loop) (should be written. It controls board operation until the board is switched off or reset, the Arduino IDE is shown in figure.2.4 [25].

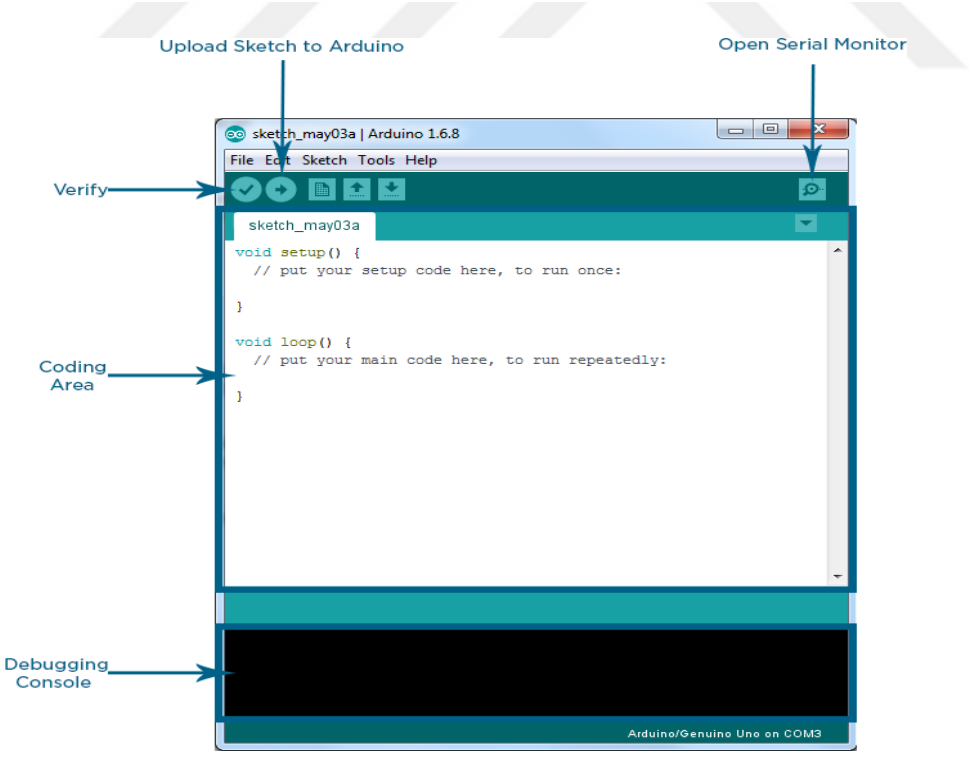

Figure 2.4: The Arduino IDE.

2.4. ARDUINO SENSORS

For the different interactions of Arduino with the outside world a different sensor is required to do so. Different applications for different sensors, many applications require different types of sensors according to the required purpose of the application, some applications work with motion then it is required a motion sensor, some applications work with fire then flame sensor is required. Some types of sensors that is compatible with Arduino.

2.4.1 Flame Sensor

The type of sensor is designed to detect and respond to the presence of flame. Due to the mechanisms it uses to detect flames, a flame sensor can often detect faster and more accurately than a smoke detector or heat. The light source or other light sources in a range of wavelengths (760 nm-1100 nm) are detected by using a flame sensor. The module consists of an IR sensor, a potentiometer, an OP-Amp circuit and a led indicator. In addition, it based on the YG1006 sensor, which is a high velocity and highly sensitive NPN silicon phototransistor. The module will switch on its red led when a flame is detected. This module is flame sensitive, but it can detect ordinary light as well. The point of detection is 60 degrees. This sensor's sensitivity can be adjusted; it has stable performance. The Figure.2.5 shows the flame sensor value over distance, and the figure.2.6 shows the flame sensor [26].

The flame sensor module has the following features.

- The operating voltage: 3.3–5V.
- The output of sensor is analog and digital
- Contains A led indicator indicating or not detecting the flame.
- The threshold level may change if the rheostat is changed.
- The detection range, the lighter flame test can be initiated with 0.8 m and the detection distance increases when the intensity of the flame is high.
- Sensor detection angle around 60^{c}

Figure 2.5: Flame sensor value vs distance.

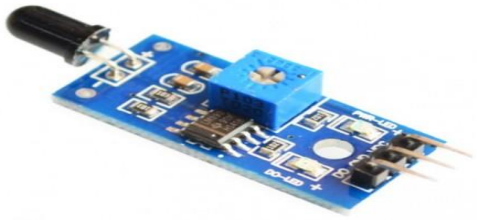

Figure 2.6: Flame Sensor Module.

2.4.2. Passive Infrared Sensor (PIR)

This type of sensor can detect the motion when the amount of heat level (infra-red) changes. The sensor has three pins - VCC or + ve (positive 5V); GND or -ve (negative) and data. When changes are detected the data pin goes up (e.g. 5V) and since changes can be identified in a background infrared, the average background IR reading is about 60 seconds at startup., the lens placed on the top of sensor work on increase the detection area [27]. The figure.2.7 illustrate the passive infrared sensor.

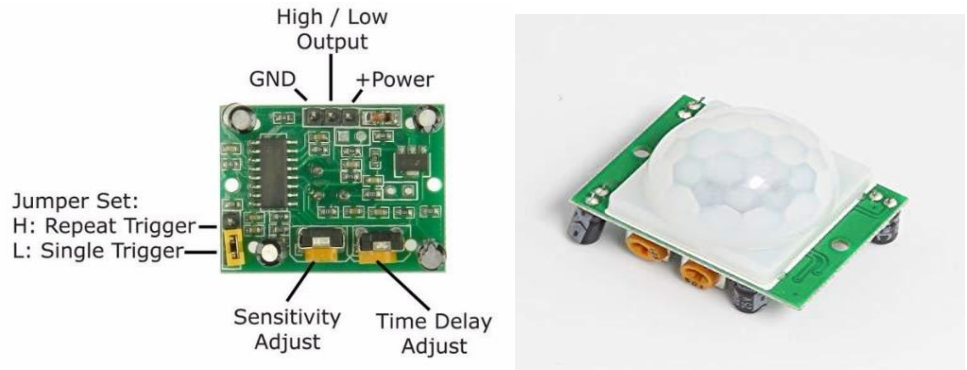

Figure 2.7: The passive infrared sensor.

In Figure.2.8, the PIR motion sensor itself has two slots in it; each slot is Made of special material sensitive to infrared radiation. The slots detect the same amount of IR when the sensor is idle. When warm bodies like a human or an animal go through, the PIR sensor intercepts for the first time half, which means that the two halves are changing positively. The opposite occurs when the warm body leaves the area of the sensor, where the sensor causes a negative difference. What is discovered are these impulses of change [28].

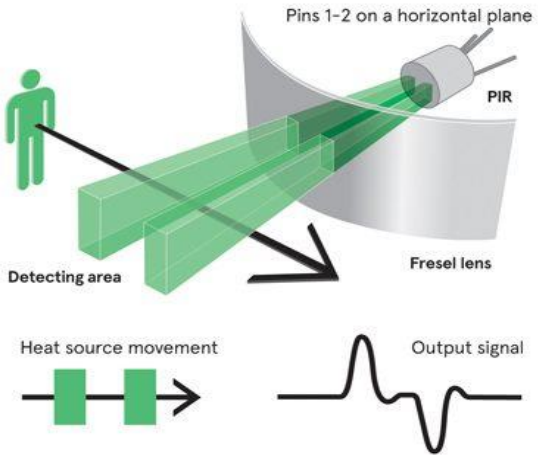

Figure 2.8: Object Passing through PIR Sensor.

The PIR motion sensor performance differs depending on the mounting type, as shown in Figure.2.9.

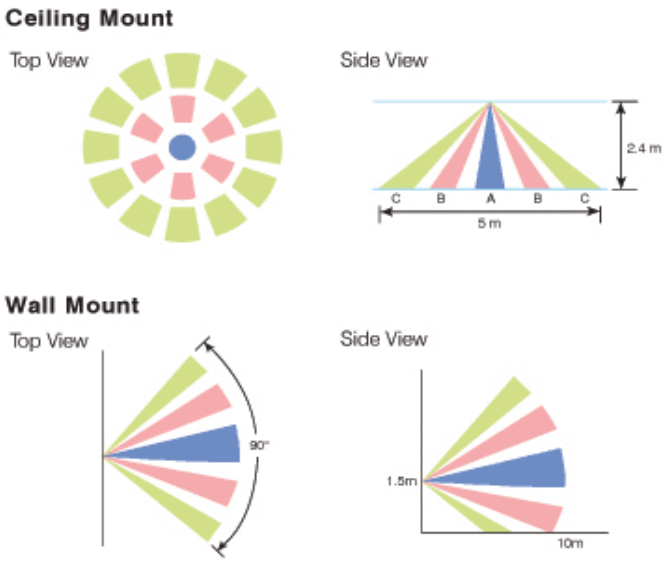

Figure 2.9: PIR Sensor Mounting Views.

2.4.3. MQ-50 Gas Sensor

The gas detection unit MQ-2 detects gas leakage at home and industry. A small hatch inside which is an electrochemical sensor is used by the MQ - xx gas sensor series. They are sensitive to a variety of gasses and are used at room temperature indoors. The output is an analog signal and can be read with a microcontroller analog input.

Features it's as the following:

1. Large range of detection.
2. Great sensitivity and quick response.
3. Life is long with good stability.
4. Simple circuit of driver.

Measurements can be taken as soon as possible due to the rapid response time and high sensitivity. You can adjust the sensitivity of the sensor using the voltmeter. Sensor applications are useful for detecting LPG, propane, methane, I - butane, alcohol, hydrogen, smoke and gas leaks. The MQ2 is equipped with an electrochemical sensor that changes its strength for a variety of gas concentrations, connecting the sensor in series to a variable resistor forming a tensile circuit divider (2.10). After heating, when one of the gaseous elements above comes into contact with the sensor, the resistance of the sensor changes. The resistance change will change the

voltage across the sensor and a microcontroller can read this voltage. By knowing the reference voltage, the voltage value can be used to find the resistance of the sensor and resist the other resistor. The sensor is sensitive to different gas types. The characteristic curve sensitivity figure.2.11 is shown below for the different gas types. The figure.2.12 illustrate the MQ-5 gas sensor [29].

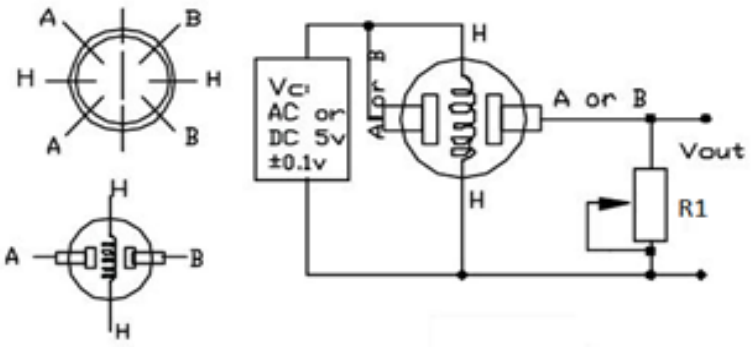

Figure 2.10: Voltage divider circuit.

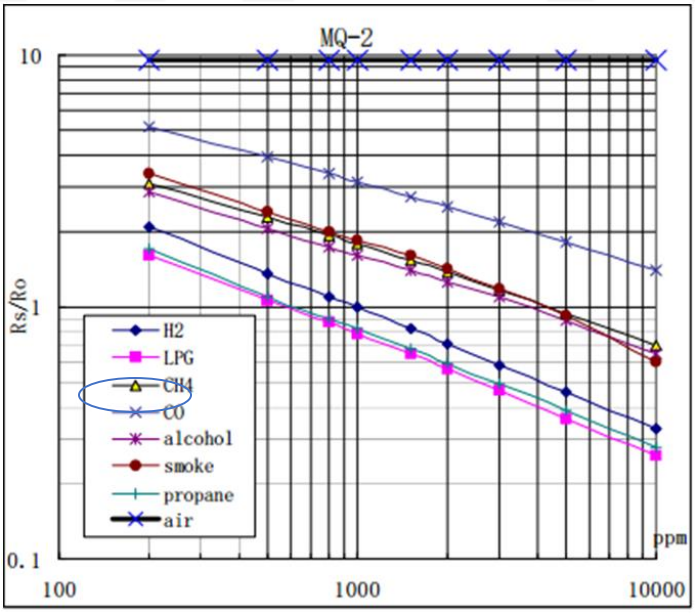

Figure 2.11: The sensitivity characteristic curve of the sensor.

Figure 2.12: The MQ-2 gas sensor.

2.4.4. Light Dependent Resistance

Its LDR symbol is a light-sensitive electrical resistor, less resistive when the brightness of the light is on it, exploits the property of light resistance. There are light alarms and also a dark alarm. One of the most popular applications is street lamps, which are used for automatic operation and extinguishing. Its other name is the photoconductor. In the dark, this instrument has a resistance of 1000000 in other words (MΩ), but when exposed to light brightness, this resistance decreases to a few hundred ohms. A dielectric material such as ceramics is covered with a thin layer of light-sensitive semiconductor. Its electrical connections are made of two metal ends in the form of two opposite sides. After the light is removed, some of the charge carriers in the freezer remain free, causing a current to pass even if it is a weak current, called the current of darkness. The dark stream can be reduced by lowering the temperature of the castor. Technicians and electric circuit dwellers use this feature to perform many functions, exploiting the ability to resist light resistance. There are light alarms and dark alarms. One of the most popular applications is street lamps, which are used for automatic operation and extinguishing. The figure.2.12 shows the Light Dependent Resistance and the figure.2.13 shows the relationship between the resistance value and light [30].

Figure 2.12: The Light Dependent Resistance.

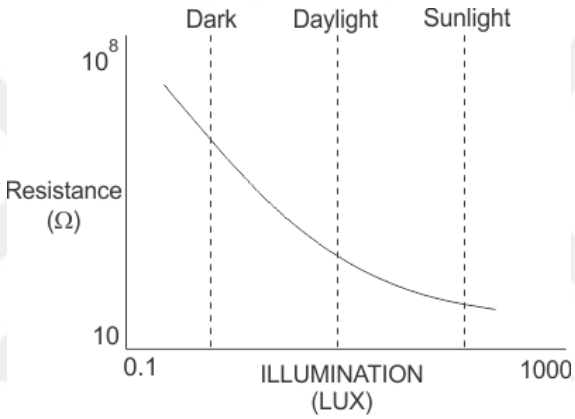

Figure 2.13: The plot of resistance value VS. light intensity.

2.4.4. Laser Module

A small internal beam is produced on the LASER module or the red laser beam is shaped like a dot. The laser sensor is displayed in figure 2.14. There are three pins for that module i.e. Signal output is from left to right pin 1, pin number 2 + 5 volts and pin number 3 is GND. Using this system, we have experimented a laser sensor which has both transmitter and receiver units into one module. This sensor theoretically measures up to 1000 cm or 10000 mm. Laser is mainly used as a source of light. The photodiode and the phototransistor LDR (Light Dependent Resistor) sensor are used for the detection of the beam laser as in figure 2.20 [31].

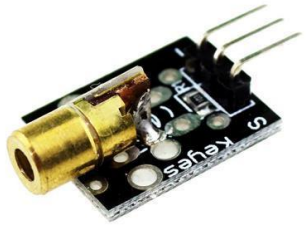

Figure 2.14: The laser module.

2.5. GSM SIM 900 MODULE

The GSM means the Global System for Mobile communications, reigns as the earth should widely using mobile phone. By searching for cell phone towers in the nearby area, cell phones use the GSM network of a cell phone service carrier. A globally accepted standard for digital cellular communication is the Global Mobile Communication System (GSM). The GSM is the mobile cellular radio system operating at 900 MHz, The GSM modem is a specialized modem type that accepts a SIM card and operates like a mobile phone over a subscription. A GSM modem looks just like a mobile phone from the perspective of the mobile operator. This enables the microcontroller or computer to use the GSM modem to communicate over the mobile network when a GSM modem is connected to a microcontroller or computer. Although those GSM modems are used most often for mobile internet connectivity, many of them can also be used to send and receive SMS or control applications via GSM. The Arduino GSM module is used for the sending / receiving of messages and for making / receiving calls using a network provider's SIM card. This can be done by connecting the GSM shield into the Arduino board and plugging in the SIM of a GPRS-covered operator. The shield uses SIMComm's radio modem. The shield is easy to communicate via AT commands. There are many communication methods in the GSM library with the shield. This GSM modem can work just like a mobile phone with its own unique phone number with any GSM network operator SIM card. Using this modem will have the advantage that it can use its RS232 port to communicate and develop embedded applications. This can be easily used to develop applications such as SMS Control, data transfer, remote control and logging. The modem can either be directly connected with a PC serial port or

via a MAX232 Microcontroller. It can also be used for internet connection and many data logging and control applications in GPRS mode. You can also connect to any Remote FTP Server in GPRS mode and upload data recording files This GSM modem is a very flexible SIM900A GSM modem plug-in / play quad bands for direct integration with RS232 applications. It provides support for voice, SMS, data / fax, GPRS, and built-in TCP / IP stack [32]. The figure.2.15 illustrate the SIM 900 GSM module.

Figure 2.15: The SIM 900 GSM module.

2.6. WIFI/P2P CAMERA Q7 HD

Mini camera Q7 is powerful device which can used to record a video and store it in SD card or stream it online with WIFI internet connection , this camera record Video resolution 640*480 VGA (about 15 frame per second) with 4:3 proportion and AVI video format , this device has its own CD mini card slot , also it has internal memory up to 32 GB used to save recorded videos , also this camera require low voltage to run (5V DC) so we can connect it easily with Arduino , also it has Built-in battery rechargeable run up to 45 mins time , also this device include 5 LEDs Infra-Red night vision the figure.2.16 shows WIFI/P2P Camera Q7 HD[33]**.**

.

Figure 2.16: WIFI/P2P Camera Q7 HD.

2.7. NODE MCU

It is an open source program that can be programmed for the IoT (Internet of Things, and understanding them through the internet. It means things in it all smart devices such as: TV, mobile, watches, glasses, alarms, surveillance ... and other devices that can be connected to each other over the Internet. This board comes with built-in esp-8266 Wi-Fi module. The board contains a ten pins (D1-D10) can used for digital input or digital output this pins provides the pulse width modulation (PWM) technique except the D0 not supports the PWM, the PWM technique used to provides the analog output by changing the pulse width also contain a single pin (A0) that used for analog input the pins configuration of this module illustrated in the figure.2.17.

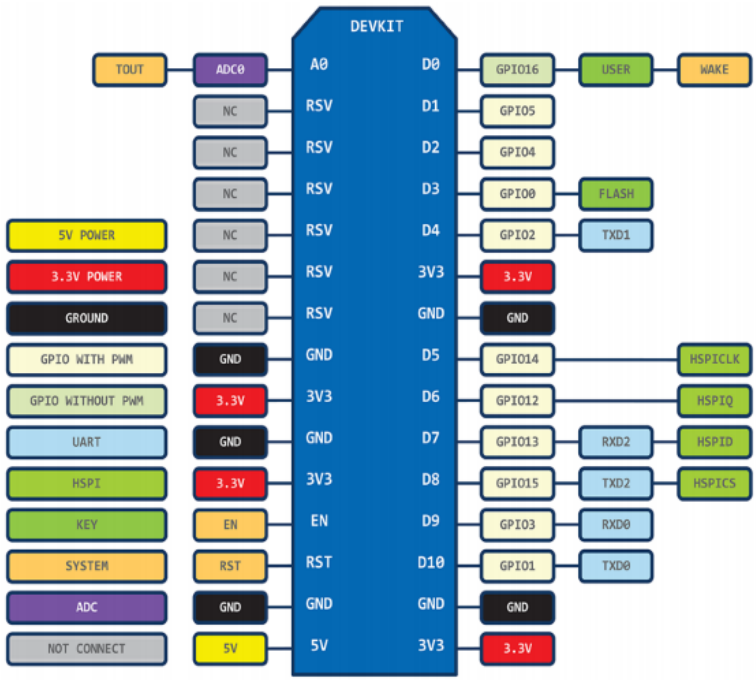

Figure 2.17: Pins configuration of NodeMCU

The ESP-8266 chipset operates on a voltage of 3.3 volts. As well as the output value (output) in the ESP-8266 chipset is 3.3 volts, but the first version NodeMCU can be operated on a voltage of 3.3V or 5V volts the reason is that it is equipped with a regulator to reduce the voltage from 5V to 3.3V. The figure.2.18 illustrate the nodeMCU board [34].

Figure 2.18: NodeMCU board.

2.8. ARDUINO NANO

The Arduino Nano is a computer installed electronic board with a microcontroller but fewer possibilities for digital and analog signals and inputs, and a USB port for programming. Arduino is a board of electronics developments that consists of an electronic, open source circuit with computer - programmed microcontrollers designed to facilitate multidisciplinary use of interactive electronics. Arduino is primarily used in interactive project design and construction projects for the construction of various sensors in the environment such as temperature, wind, light, pressure, and more. Arduino is linked to different programs on your PC and depends on the open source programming language, the Arduino code is similar to a C - language and one of the easiest languages in programming for the writing of microcontroller programs. And it's easy to write a program which controls the transmission of signals through the engine outputs or switches, or can disconnect electricity to a panel, or even read the data through an input so that, for example, the actual distance between the board and obstacle Using a sensor such as a laser or ultrasound. The Arduino NANO has the same specifications of Arduino UNO but the difference between the two controllers is the size of Arduino NANO and the type of controller, where the Arduino NANO based on ATmega 328p microcontroller and the Arduino UNO based on the same controller but the main difference in Arduino NANO the controller SMD (Surface Mounted Device). The figure.2.19 illustrate the Arduino NANO microcontroller and the table.2.2 shows the Arduino NANO specifications [35].

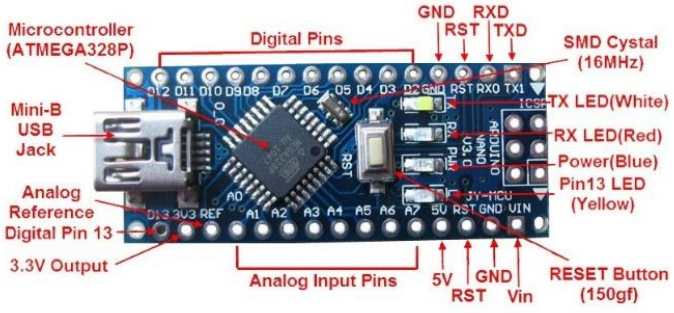

Figure 2.19: Arduino NANO microcontroller.

Table 2.2: Arduino NANO properties.

Microcontroller	ATmega328 SMD
Rated Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Number of Digital I/O Pins	14 (of which 6 provide PWM output)
Number of Analog Input Pins	6 pin
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) ,0.5 KB used by bootloader.
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

3. SYSTEM DESIGN AND IMPLEMENTATION

In this section will describe and explain the implemented system and also will clarify the operation principle of the implemented system.

3.1. WORKING PRINCIPLE

In this implemented system, an integrated safety and security system has been designed based on Arduino Microcontroller and various of available sensors. The implemented system divides into two main parts the first part responsible on the security, the security part is based on two levels of security. The first level is the use of the motion sensor (PIR sensor), which senses the movement through the change of the infrared radiation emitted from the human body. The second level of security is the use of laser beam line and optical resistance (LDR sensor), which in turn will be the reader(receiver) of the laser beam, when the thief tries to pass from the front of PIR sensor or cutting the laser beam the Arduino NANO will be turning ON the alarm buzzer, send message through the GSM module to the mobile phone of home owner to alert him there is thief attempt and in the same time through the programmed GUI, the NodeMCU will send a message also to alert the home owner. In this work the GSM module is connected to an independent controller and the motion signal is received from the Arduino NANO, the reason of this connection because the GSM module suffers from the input current, if the input current lower than the rated current the GSM module would not be work and this has been proven in practice. The figure.3.1 illustrate the block diagram of the implemented system for the security part.

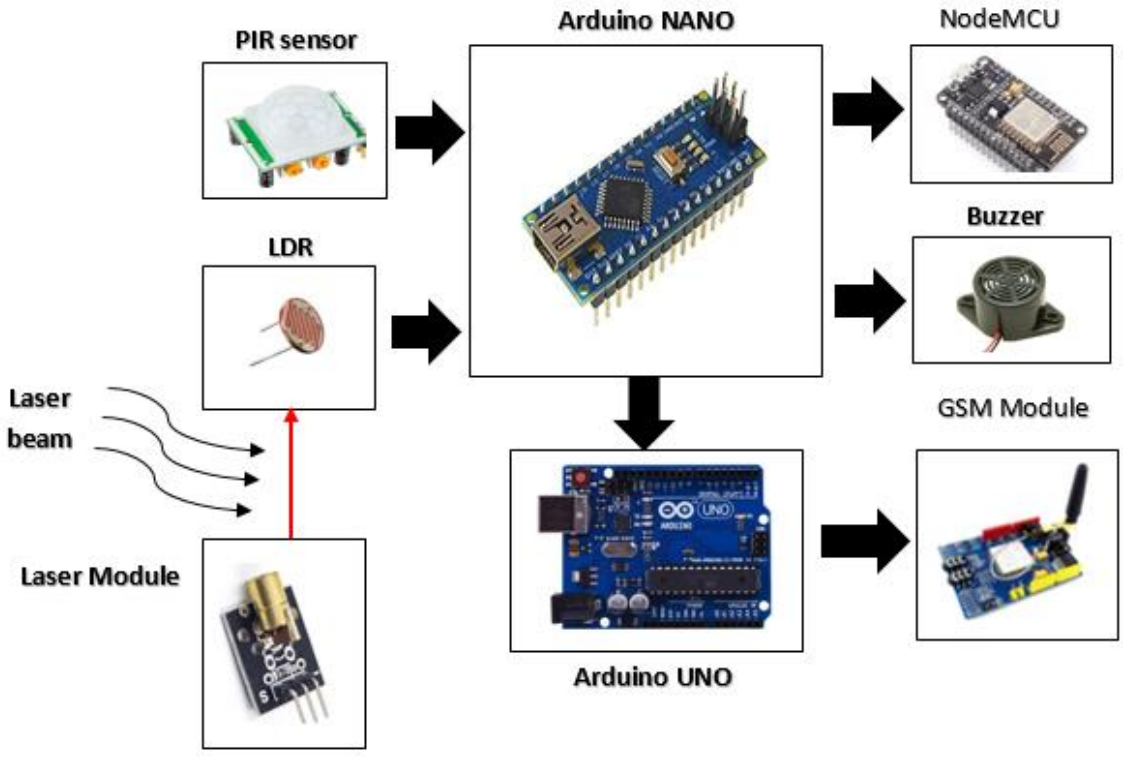

Figure 3.1: The block diagram of firs part of implemented system.

The GSM SIM 900 module suffers from the feeding power where this module required current level not less than 2A, if the supplied source less than 2A the module will not work, to solve this problem in this work the GSM module connected to separated microcontroller (Arduino UNO was chosen) and this microcontroller reads the signals from another microcontroller for example, when the motion detected the Arduino NANO will send 5V from certain pin, the Arduino UNO will read this voltage from certain pin if the voltage from Arduino NANO 5V this means motion detected in this case Arduino UNO through GSM module and thus with the rest of the cases fire and gas leakage. The second part of the implemented system is responsible on the safety such the detection of the leakage of cooking gas by the MQ-04 gas sensor and detection the fire by the flame sensor. In the case of fire detection, when the flame sensor detects the fire the owner of the house will be alerted by sending a short message through the GSM unit and water dispenser will be operated. In case of gas leak the gas sensor detects the gas leak and the home owner also alerting by a message, at the same time, the status of the house can monitored remotely via

Internet of Things technology (IOT), which is supported by the NodeMCU controller where all the alarm messages will appear on the special GUI programmed inside Arduino environment, the NodeMCU grant to the user a local IP allows him to monitor his house wirelessly and the user can convert this local IP into public IP by some algorithms or by using the some websites that's powered by network companies, the public IP allows the user from monitor his home from anywhere of the world. Additionally, the home owner can be turning ON/OFF the outdoor light through the GUI to provide the comfortable to home owner. The figure.3.2 illustrate the block diagram of the safety part and the figure.3.3 illustrate the implemented system.

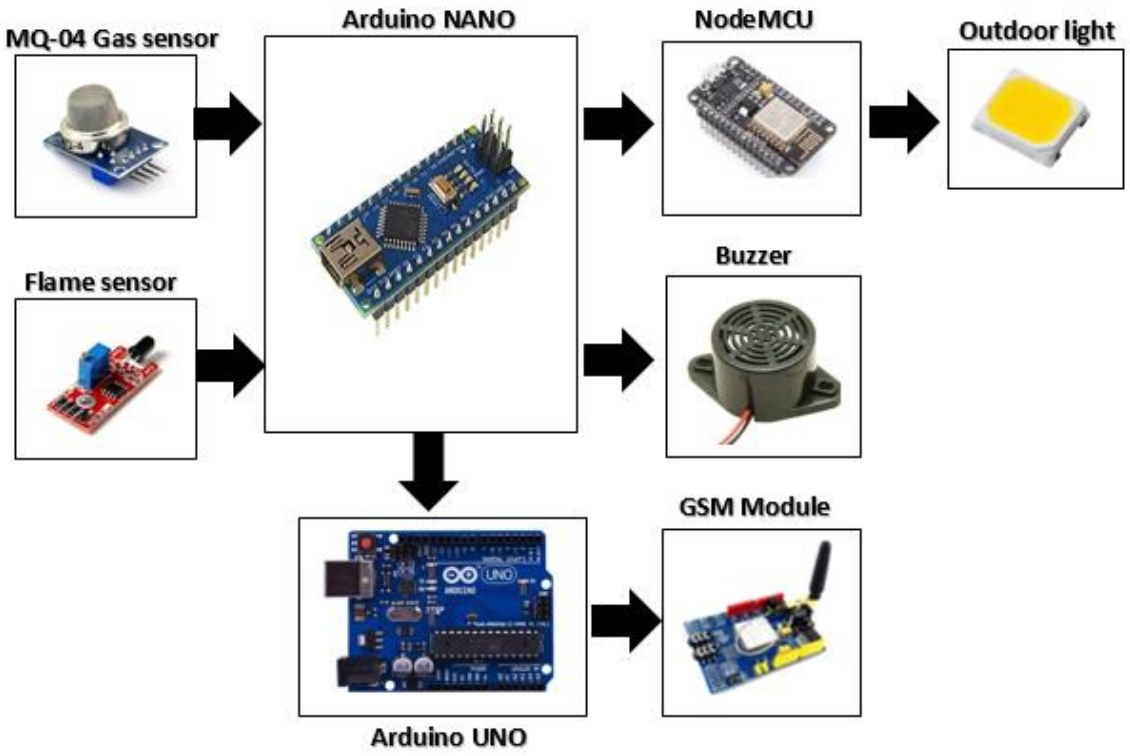

Figure 3.2: The second part of implemented system.

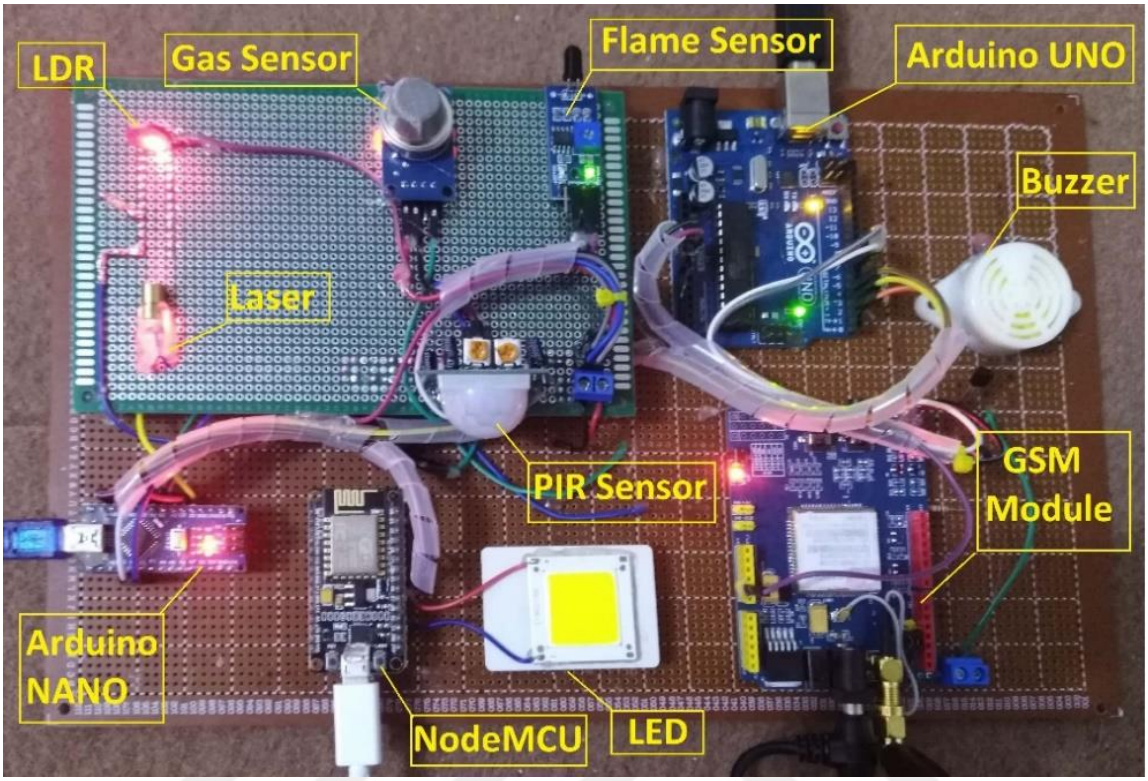

Figure 3.3: The implemented system.

3.2. RESULTS

In this section all the results obtained after the practical test of the implemented system will be discussed. The figure.3.4 shows the alerting messages that arrived to the mobile phone of the home owner in case of motion detection (theft), gas leak and fire detection. The figure.3.5 shows the messages appears on the GUI in all cases that mentioned, the button shown on the GUI used in order to turning ON or OFF the outdoor lights, this provides the comfort to the home owner and contribute to energy saving as the owner of the house can turn ON and OFF the lights while sitting in her place in the same times using the technology instead of traditional switches.

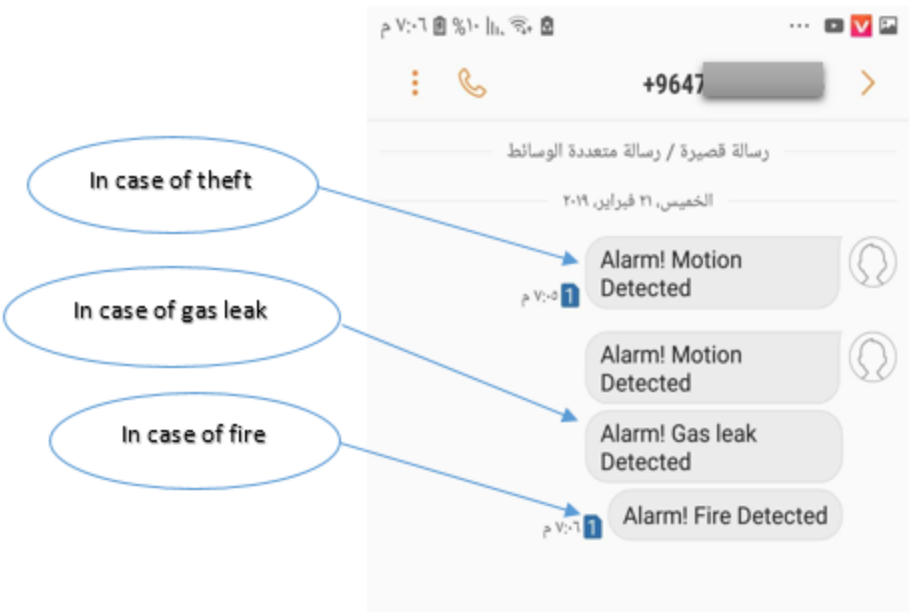

Figure 3.4: The Appears messages on the mobile phone.

The figure.3.5 and the figure.3.6 shows the results obtained in case of fire detection, motion detection, gas leak detection and in safe mode on the special programmed GUI that's programmed via HTML language inside Arduino language, the button shown on the GUI used in purpose of turning ON/OFF the outdoor light. This make the system more reliable where the alerting messages appears on GUI and on the mobile phone of home owner. The user can be accessing to this GUI via the local IP granted by the NodeMCU microcontroller.

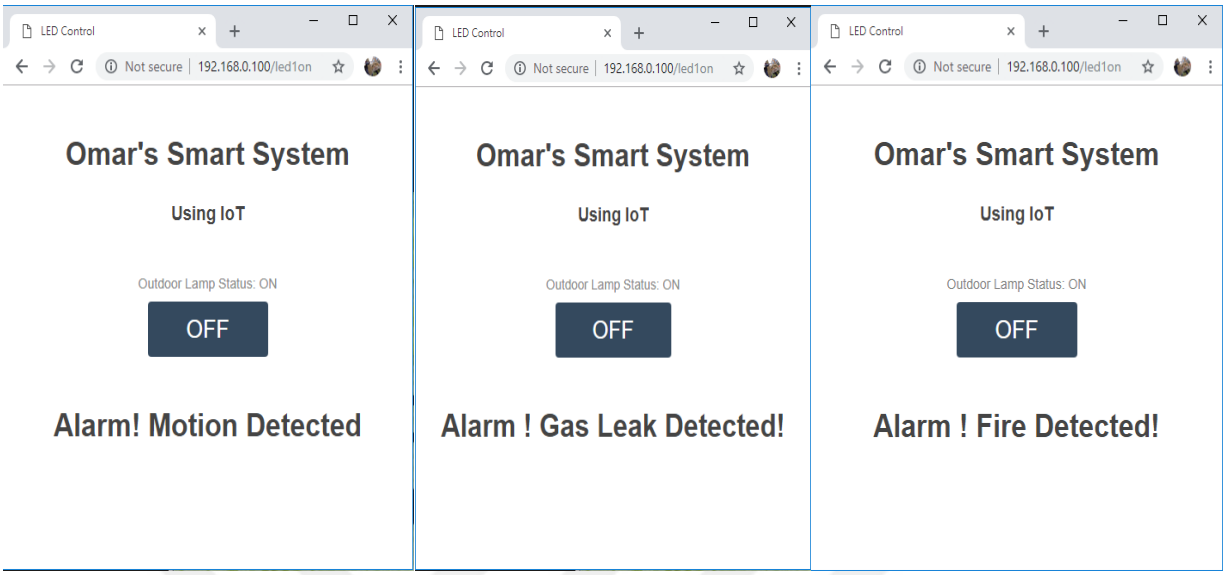

Figure 3.5: The result on GUI in case of fire, gas leak and motion.

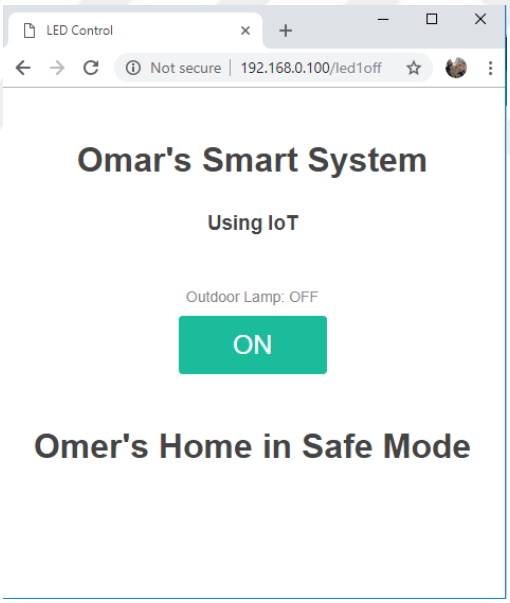

Figure 3.6: The result on GUI in safe mode.

4. CONCLUSION AND FUTURE WORK

In this section the conclusion after completing and operating this work will be discussed and the development of this work will be described also.

4.1. CONCLUSION

This work explores the concept of smart security and safety system. In this work the implemented system based many microcontrollers in order to increase the reliability and make the system independent on single failure point. The security based on two levels to make the system more secure. This system can be described as very useful to everyone in providing safety and security, the uses of IoT technology in this work to facilitate the system accessing by the user and gives another way to alerting the home owner, where the home owner can monitor his home wirelessly through the special programmed GUI and in additionally the GSM chosen alert home owner by SMS in the various cases in motion detection, gas leak detection and in fire detection this is a second way to alert the owner of the house and so while a malfunction in one of the controllers can the owner of the house to monitor his house through the another controller.

4.2. FUTRE WORK

This is not a full project but a fundamental structure of another complete system. We have all the basic needs of a safety and security system. The tasks we did are not the only tasks that the components can do. This project has a lot of other scopes. Manage the level of O_2 and CO_2 to increase or decrease for high gas for safety reasons. Otherwise, the entire project can be changed to help us prevent external dangers from being saved in our homes / industries when we get away from home. This system is extra - cheap and durable to the solar power system. The system can then run on solar energy. Also the door locking system that helps regulate your safety to control and control the authorized entry into the house according to user comfort.

REFERENCES

[1] P.B. Fleischer, A.Y. Nelson, R.A. Sowah, A. Bremang, "Design and development of GPS/GSM based vehicle tracking and alert system for commercial inter-city buses", *Adaptive Science & Technology (ICAST) 2012 IEEE 4th International Conference on*, pp. 1-6, 25-27, 2012.

[2] Mohammad Jahangir Alam," Home Automation and Security System", M.S thesis, Dept, Elect, Eng, Daffodil International University, October 2016.

[3] The Study of Access Control for Service-Oriented Computing in Internet of Things Guoping Zhanga, Jing Liub Published Online June 2012 in MECS

[4] G. Sowjanya and S. Nagaraju," Design and implementation of door access control and security system based on IOT", (ICICT), 19 January 2017

[5] Akanksha Singh, Arijit Pal and Bijay Rai," GSM Based Home Automation, Safety and Security System Using Android Mobile Phone", IJERT, Vol. 4 Issue 05, May-2015

[6] Rajiv Kumar and Pooja Mittal," A Novel Design and Implementation of Smart Home Security System: Future Perspective", International Journal of Applied Engineering Research, Volume 14, Number 2 (2019) pp. 363-368

[7] Sanjay Kumar S., Khalkho A., Agarwal S., Prakash S., Prasad D., Nath V. (2019) "Design of Smart Security Systems for Home Automation". In: Nath V., Mandal J. (eds) Nanoelectronics, Circuits and Communication Systems. Lecture Notes in Electrical Engineering, vol 511. Springer, Singapore

[8] Davit Marikyan, Savvas Papagiannidis and EleftheriosAlamanos," A systematic review of the smart home literature: A user perspective", Technological Forecasting and Social Change Volume 138, January 2019, Pages 139-154

[9] M.R. Alam, M.B.I. Reaz, M.A.M. AliA review of smart homes—past, present, and future IEEE Trans. Syst. Man Cybern. Part C Appl. Rev., 42 (6) (2012), pp. 1190-1203 Applications and Reviews

[10] S. Islam and Md. Saiduzzaman " Design Of A Bank Vault Security System With Password, Thermal & Physical Interrupt Alarm" International Journal Of Scientific & Engineering Research, Vol. 4, Issue 8, 70-73, 2013

[11] S. Budijono, J. Andrianto, M. Axis and N. Noor, "Design and Implementation of Modular Home Security System with Short Messaging System," EDP Sciences, EPJ Web of Conferences 68, 00025, 2014

[12] G. Sushma, M. Joseph, A.R. Tabitha and M.B.P. Yokesh "Image Tracking Based Home Security Using Arduino Microcontroller", International Journal of Innovative Research in Computer and Communication Engineering, Vol.3, Special Issue 8, October 2015.

[13] V. Choudhary, A. Parab, S. Bhapkar, N. Jha, and M. Kulkarni "Desgin and Implementation of Wi-Fi based Smart Home System" International Journal of Engineering and Computer Science, Vol.5 February 2016

[14] S. M. Saad, A. R. Mohd Saad, A. M. Y. Kamarudin, A. Zakaria and A. Y. M. Shakaff, "Indoor air quality monitoring system using wireless sensor network (WSN) with web interface," *2013 International Conference on Electrical, Electronics and System Engineering (ICEESE)*, Kuala Lumpur, 2013, pp. 60-64.

[15] R., Pecorella, T., Viti, R., &Carlini, C. Fantacci, "Short paper:Overcoming IoT fragmentation through standard gateway architecture.," *2014 IEEE World Forum on Internet of Things (WF-IoT)*, pp. 181-182,2014

[16] Isa, Eleni&Sklavos, Nicolas. (2017). Smart Home Automation: GSM Security System Design & Implementation

[17] Z. Annan, S. Lin, C. Shuying, "Design and Realization of Home Appliances Control System Based on The Android Smartphone", International Conference on Control Engineering and Communication Technology, China, 2012.

[18] Piyare, R., Tazil, M.: Bluetooth based home automation system using cell phone. In Consumer Electronics (ISCE), 2011 IEEE 15th International Symposium on, pp. 192- 195, 2011.

[19] K. M. Abubeker, J. J. Edathala and S. Sebastian, "Some investigations on 'PIR' SENSOR and their application on significant energy savings in ATM counter," *2013 IEEE Conference on Information & Communication Technologies*, pp. 37-41, 2013.

[20] Rajiv Kumar, Pooja Mittal, " A Novel Design and Implementation of Smart Home Security System: Future Perspective ", International Journal of Applied Engineering Research, Volume 14, Number 2 (2019) pp. 363-368

[21] John Boxall," Arduino Workshop: A Hands-On Introduction with 65 Projects", No Starch Press, California, 2013, p.362.

[22] Md Saifudaullah Bin Bahrudin , Rosni Abu Kassim and Norlida Buniyamin," Development of Fire alarm system using Raspberry Pi and Arduino Uno", ICEESE, 11 September 2014

[23] Indranee Mondal , Tasbi Binta Kibria , Prottasha Ghosh , Fahim Zaman Noman and Md. Saniat Rahman Zishan ," Design and Implementation of Smart Security System for Human Safety"**,** ICREST, 21 February 2019.

[24] Hamzah M. Marhoon, Ihsan A. Taha, " DESIGN AND IMPLEMENTATION OF INTELLIGENT CIRCUIT BREAKER FOR ELECTRICAL CURRENT SENSING AND MONITORING", International Journal of Core Engineering & Management Vol.-4, no.11,2018.

[25] OzenirDias, Maria CristinaTavares and FabianoMagrin" Hardware implementation and performance evaluation of the fast adaptive single-phase auto reclosing algorithm", ELSEVIER Electric Power Systems Research Vol.168, pp.169-183,2019.

[26] WenhuaChen, PengjuLiu, YuanLiu, QiWang, WenfengDuan," A temperature-induced conductive coating via layer-by-layer assembly of functionalized graphene oxide and carbon nanotubes for a flexible, adjustable response time flame sensor", ELSEVIER, vol.353, no.1, pp. 115-125,2018.

[27] Yang, D.; Xu, B.; Rao, K.; Sheng, W. Passive Infrared (PIR)-Based Indoor Position Tracking for Smart Homes Using Accessibility Maps and A-Star Algorithm. *Sensors* 2018, *18*, 332.

[28] Bodhibrata Mukhopadhyay , Seshan Srirangarajan, SubratKar ," Modeling the analog response of passive infrared sensor ", ELSEVIER, Volume 279, 15 August 2018, Pages 65-74

[29] Ahnaf Faisal and Lovely Son," Rancang Bangun Prototype Robot Pendeteksi Gas Metana Berbasis Mikrokontroler Arduino Untuk Eksplorasi Pertambangan" , METAL, Vol 1, no.1,2017.

[30] K.W. Lee, C.W. Jang, D.H. Shin et al., Light-induced negative differential resistance in graphene/Si-quantum-dot tunneling diodes. Sci. Rep. **6**, 30669 (2016)

[31] Z. G. Lu, J. R. Liu, C. Y. Song, J. Weber, Y. Mao, S. D. Chang, H. P. Ding, P. J. Poole, P. J. Barrios, D. Poitras, S. Janz, and M. O'Sullivan, "High performance InAs/InP quantum dot 34.462-GHz C-band coherent comb laser module," Opt. Express 26, 2160-2167 (2018)

[32] Fauzi Fauzi, Mahyuddin Mahyuddin, Kurnia Lahna, " Utilization of GSM Module (Sim 900) Based Arduino-Uno for Alarm System and Remote Automatic Door Locking", unsyiah, Volume 7 Number 1, January 2018

[33] Al-Kadhimi, A. M., Marhoon, H. M., & Karam, Z. A. (2018). Implementation of Cell Phone Detection Mobile Robot for Restricted Areas Using NodeMCU. *Iraqi Journal of Information & Communications Technology*, *1*(1), 27-35.

[34]. Andrej Škraba, Andrej Kološvari, Davorin Kofjač, Radovan Stojanović and Vladimir Stanovov ; Eugene Semenkin, " Prototype of group heart rate monitoring with NODEMCU ESP8266", MECO, 13 July 2017

[34] S. M. Ahmed, H. M. Marhoon, and O. Nuri, "Implementation of smart anti-theft car security system based on GSM," *Int. J. Eng. Technol.*, vol. 7, no. 4, pp. 5368–5372, 2018.//doi: 10.14419/ijet.v7i4.27765.

APPENDIX A

CODE

The NodeMCU code:

```
#include <ESP8266WiFi.h>

#include <ESP8266WebServer.h>

/* Put your SSID & Password */

const char* ssid = "AndroidAP";  // Enter SSID here

const char* password = "omaromar";  //Enter Password here

/* Put IP Address details */

IPAddress local_ip(192,168,1,1);

IPAddress gateway(192,168,1,1);

IPAddress subnet(255,255,255,0);

ESP8266WebServer server(80);

uint8_t LED1pin = D7;

bool LED1status = LOW;

uint8_t LED2pin = D6;

bool LED2status = LOW;

void setup() {

  Serial.begin(115200);

  pinMode(LED1pin, OUTPUT);

  pinMode(LED2pin, OUTPUT);

  pinMode(5,INPUT_PULLUP);//pir
```

```
  pinMode(4,INPUT_PULLUP);//gas
   pinMode(12,INPUT_PULLUP);//flame
  WiFi.softAP(ssid, password);
  WiFi.softAPConfig(local_ip, gateway, subnet);
  delay(100);
  server.on("/", handle_OnConnect);
  server.on("/led1on", handle_led1on);
  server.on("/led1off", handle_led1off);
  server.onNotFound(handle_NotFound);
  server.begin();
  Serial.println("HTTP server started");
}
void loop() {
  server.handleClient();
  if(LED1status)
  {digitalWrite(LED1pin, HIGH);}
  else
  {digitalWrite(LED1pin, LOW);}
  if(LED2status)
  {digitalWrite(LED2pin, HIGH);}
  else
```

```
  {digitalWrite(LED2pin, LOW);}
// if(pir==0)
}
void handle_OnConnect() {
  LED1status = LOW;
  LED2status = LOW;
  Serial.println("GPIO7 Status: OFF | GPIO6 Status: OFF");
  server.send(200, "text/html", SendHTML(LED1status,LED2status));
}
void handle_led1on() {
  LED1status = HIGH;
  Serial.println("GPIO7 Status: ON");
  server.send(200, "text/html", SendHTML(true,LED2status));
}
void handle_led1off() {
  LED1status = LOW;
  Serial.println("GPIO7 Status: OFF");
  server.send(200, "text/html", SendHTML(false,LED2status));
}
void handle_led2on() {
  LED2status = HIGH;
```

```
  Serial.println("GPIO6 Status: Open");
  server.send(200, "text/html", SendHTML(LED1status,true));
}
void handle_led2off() {
  LED2status = LOW;
  Serial.println("GPIO6 Status: Close");
  server.send(200, "text/html", SendHTML(LED1status,false));
}
void handle_NotFound(){
  server.send(404, "text/plain", "Not found");}
String SendHTML(uint8_t led1stat,uint8_t led2stat){
  int pir=digitalRead(5);
  int gas=digitalRead(4);
  int flame=digitalRead(12);
  String ptr = "<!DOCTYPE html> <html>\n";
  ptr +="<head><meta name=\"viewport\" content=\"width=device-width, initial-scale=1.0, user-scalable=no\">\n";
  ptr +="<title>LED Control</title>\n";
  ptr +="<style>html { font-family: Helvetica; display: inline-block; margin: 0px auto; text-align: center;}\n";
  ptr +="body{margin-top: 50px;} h1 {color: #444444;margin: 50px auto 30px;} h3 {color: #444444;margin-bottom: 50px;}\n";
```

```
 ptr +=".button {display: block;width: 80px;background-color: #1abc9c;border: none;color: white;padding: 13px 30px;text-decoration: none;font-size: 25px;margin: 0px auto 35px;cursor: pointer;border-radius: 4px;}\n";

 ptr +=".button-on {background-color: #1abc9c;}\n";

 ptr +=".button-on:active {background-color: #16a085;}\n";

 ptr +=".button-off {background-color: #34495e;}\n";

 ptr +=".button-off:active {background-color: #2c3e50;}\n";

 ptr +="p {font-size: 14px;color: #888;margin-bottom: 10px;}\n";

 ptr +="</style>\n";

 ptr +="</head>\n";

 ptr +="<body>\n";

 ptr +="<h1>Omar's Smart System</h1>\n";

 ptr +="<h3>Using IoT</h3>\n";

  if(led1stat)

 {ptr +="<p>Outdoor Lamp Status: ON</p><a class=\"button button-off\" href=\"/led1off\">OFF</a>\n";}

 else

 {ptr +="<p>Outdoor Lamp: OFF</p><a class=\"button button-on\" href=\"/led1on\">ON</a>\n";}

if(pir==0)

 ptr +="<h1>Alarm! Motion Detected</h1>\n";

else if(gas==0)
```

```
ptr +="<h1>Alarm ! Gas Leak Detected!</h1>\n";

else if(flame==0)

ptr +="<h1>Alarm ! Fire Detected!</h1>\n";

else if(pir!=0&&flame!=0&&gas!=0)

ptr +="<h1>Omer's Home in Safe Mode</h1>\n";

  ptr +="</body>\n";

  ptr +="</html>\n";

  return ptr;

}
```