PROJECT REPORT

FIRE FIGHTING ROBOT WITH SMS AND CALL ALERT

Submitted to Bharathiar University in partial fulfillment of the requirement of the degree of Bachelor of Electronics and Communication Systems

Submitted by

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(2026B0009)

Under the Guidance of

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APRIL – 2023

CERTIFICATE

This is to certify that the project entitled **"FIRE FIGHTING ROBOT WITH SMS AND CALL ALERT"** submitted to Bharathiar University in partial fulfillment for the award of degree of Bachelor of Electronics and Communication Systems is a record of original work done by **M.ARUNKUMAR (2026B0009)** during the period of study in **KG COLLEGE OF ARTS AND SCIENCE** under the supervision of **Dr.S.KARTHIKEYEN,** Assistant Professor**,** Department of Electronics and Communication Systems.

Place: Coimbatore.

Date:

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Internal Examiner External Examiner

DECLARATION

I, hereby declare that the project entitled **"FIRE FIGHTING ROBOT WITH SMS AND CALL ALERT"** is done by me in partial fulfillment of requirement for the award of Degree of Bachelor of Electronics and Communication Systems at **KG COLLEGE OF ARTS AND SCIENCE** is an authentic record of my own work carried out under the supervision of **Dr.S.KARTHIKEYAN M.Sc., M.Phil., Ph.D.,** Assistant Professor**,** Department of Electronics and Communication Systems. The matter presented has not been submitted by me in any other university/institution for the award of Degree of Bachelor of Electronics and Communication Systems.

PLACE: COIMBATORE **M.ARUNKUMAR**

DATE: **(2026B0009)**

ACKNOWLEDGEMENT

I express my sincere thanks to **Dr.Ashok Bakthavathsalam, B.E, MS., Ph.D.** Managing Trustee for giving me an opportunity to do this course of study and to undertake this project work.

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CHAPTER I

INTRODUCTION

One of the most important parameters in life is fire disaster, that is lives lost in saving someone else life. It is sometimes impossible for fire-fighters personnel to access the site of a fire because of explosive materials, smoke, and high temperatures. A fast response to detect the fire can avoid many disastrous things. From the given statics (Fig.1.1), it is observed that fire can take place at domestic as well as at industrial level. A normal spark can generate a massive fire breakout. Not only lives of industrial people but also the lives of domestics people are at risk because of poor fire management system. Fire can take many lives to and can injure many people for their lifetime. But it can be avoided using proper fire controlling methods.

For such environments, fire-fighting robot is proposed. In today's generation a lot of robots are proposed and designed to remove the human factor from dangerous and deadly work. The use of robots is becoming very common that safely completes the labour intensive or deadly work for human beings. A Fire Extinguishing Robot is based on IoT Technology. In Fire Extinguishing robot, intend to build a system that could extinguish a small flame by sensing and moving to the location itself. It will automatically detect the fire with the help of flame sensors. Once it detects the fire location, it navigates itself accordingly to reach the fire source and extinguishes the fire by using built-in fire extinguishing system. For fire detection it is using three flame sensors. First one for the left direction, second one for the forward direction and third one for the right direction.

Arduino Uno is an open-source microcontroller board based on the Microchip Atmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.

Fire extinguishing system will get activated when fire detection system detects fire. It then reaches the breakout point and water pump will start ejecting the water when it detects fire. The key feature of this system is to provide surveillance of fire so that major fire accidents can be prevented and loss of human lives gets minimized.

The SIM800L GSM/GPRS module consists of four key components, which take important roles in the work of the module. These key components are SIM800L GSM cellular chip, LED Status Indicators, Antennas, and Micro-SIM socket.

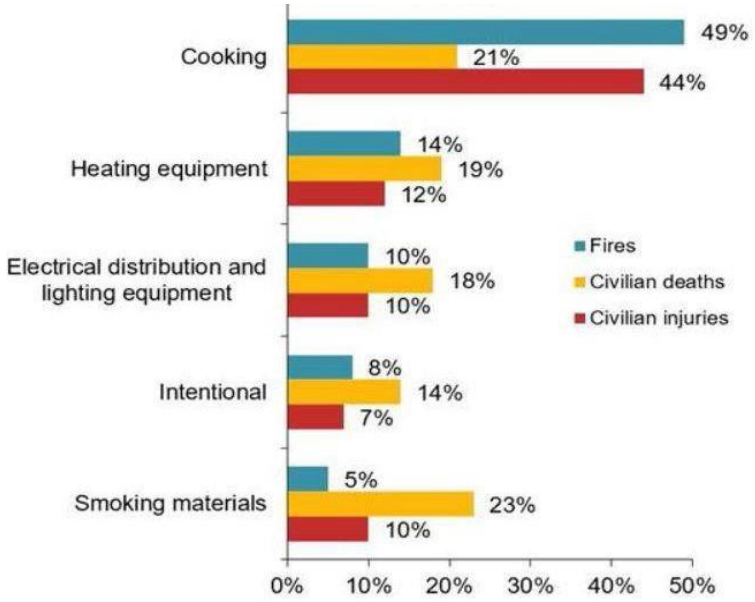

Fig 1.1 Causes of fire accident in 2022

CHAPTER II

REVIEW OF LITERATURE

2.1 GENERAL SURVEY

For many years robotics has become popular in many ways because of its variety of design and technological advancement. Our motivation to design a fire fighter robot is to help the community in effectively firefighting by sensing the fire and quickly acting without heavy losses of property or life. In some projects a tracking line is assigned for the robot to follow these paths to extinguish the fire. In some designs ultrasonic sensors are used. When it comes to simulation of this design it will make it difficult to implement it in real time situations. From the different projects reviewed, certain objectives helped us to choose a popular technique to fight fire efficiently by controlling it remotely by wireless technology application and using two main sensors on Temperature sensor, GAS sensor due to their ability to detect fire and fire extinguisher pump.

Motivation

Fire fighters try their best to respond quickly to cases of fires and even put their lives at risk as they endeavour to save human life and protect property from fires. The main objective of the project is to automatically or manually design and implement a fire fighter robot to extinguish fire. The robot is equipped with sensors that help us detect fire, smoke or any obstacles in its path.

- The areas will get benefitted from this project
- Home and Warehouse safety
- Assists firemen in fighting high-rise fires
- Server rooms and fire Sensitive places

2.2 Problem Description

The security of home, laboratory, office, factory and building is important to human life. We develop security system that contains a fire protection robot using sensor. The security system can detect abnormal and dangerous situation and notify us. First, we design a fire protection robot with extinguisher for the intelligent building. Besides, Human had difficulties to detect the small burnt cause by electrical appliances. The late time user takes to extinguish the fire. User may take a late time to extinguish fire like finding the water source to extinguish fire when want to extinguish the fire.

Objectives

The objectives of the project are:

- To study a robot which can search, detect and extinguish burnt area immediately and develop a program using Arduino UNO to control the movement of the robot. Besides, lean how to connect microcontroller and GSM modem.
- To design the robot that includes the flame sensor to detect the fire and then send notification by Short Message Service (SMS).
- To analyse how the robot performance to detect the burnt area in front of the robot and detecting burnt area in 0m - 2m in distance.

Methodology

- The theme of this paper is to automatically sense the environmental fire and extinguish it without human intervention.
- The methodology is divided into three parts. The first part is on the design structure, followed by hardware description and the finally on the programming design.
- The prototype of robotic system is presented, in which it consists of IR flame sensors, servo motors, submersible water pump, motor driver, mini breadboard, BO motors, rubber wheels, processor, and communication module for exchanging data between the fire-fighting robot and Arduino software.

Limitations

The system has restricted to the following limitation.

- Short distance of sensor's work. the fire could be recognized at the distance not more than 1.5m.
- Little period of working time and low storage of water provided.
- It is not used to put out in large fire.

2.3. Review of conclusion

The development of an autonomous firefighting system with SMS alert feature has been developed and implemented. This study has therefore provided a solution to problem of a sudden fire outbreak. The sensors used in this design can sense both gas leakages and fire with a high sensitivity. In the case of fire outbreak, the system is designed to work for three hours provided the lithium-ion battery is fully charged. The major drawback of the system from test is the dependence on the GSM module, in places with no network coverage the GSM module won't be able to send a SMS notification.

CHAPTER III

SYSTEM DESIGN

3.1 BLOCK DIAGRAM

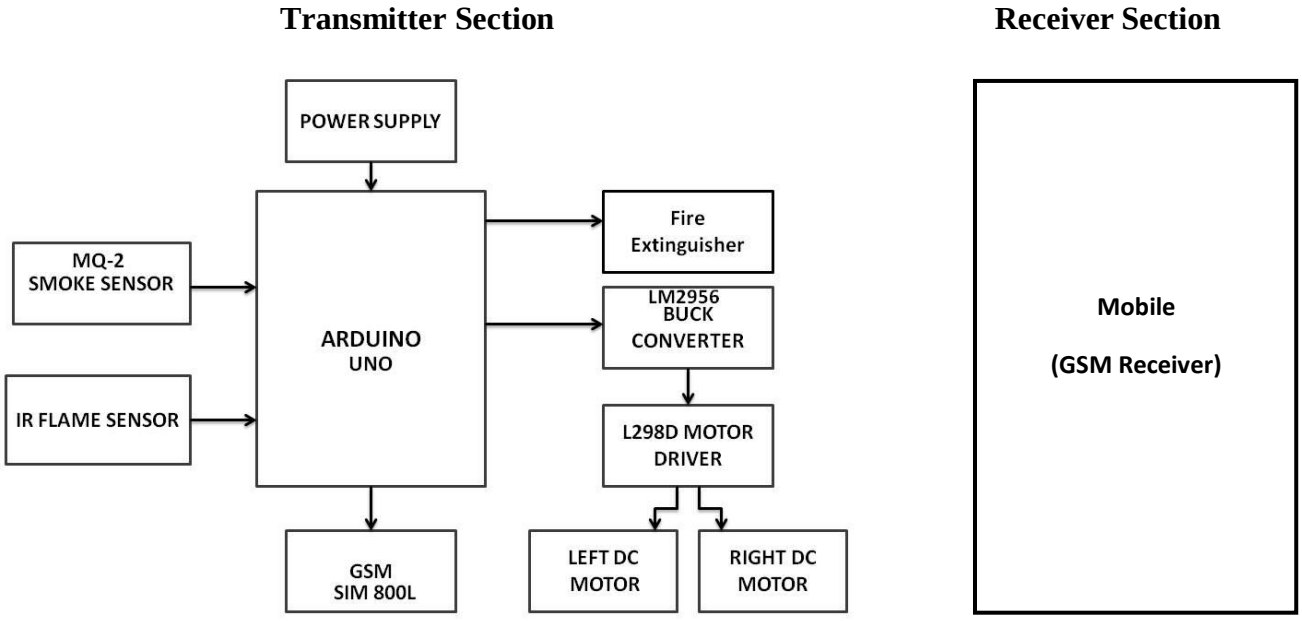

Fig 3.1 Block Diagram of Fire Fighting Robot

3.2 BLOCK DIAGRAM DESCRIPTION

The Fire Fighting Robot with SMS and call alert using Microcontroller (Arduino uno) comprises the following units, they are

- Arduino UNO
- DC motor
- L293 Motor driver
- Flame sensor
- LM2956 Buck converter
- GSM Sim 800L
- Battery
- Mini Water Pump
- MQ2 Gas sensor
- Servo Motor
- Relay Module

ARDUINO

- The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller.
- The Arduino UNO board has 14 digital I/O pins of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc.
- The board is equipped with sets of digital and analogue input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.
- Arduino allow structuring the programs in segments of code to do individual tasks. The usual case for creating a function is when one needs to perform the similar action multiple times in a program.
- Functions help the programmer stay controlled. Often this helps to conceptualize the program.
- Functions codify one exploit in one place so that the function only has to be thought about and debugged once.
- This also reduces chances for errors in change if the code needs to be changed.
- Functions make the whole sketch less important and more compact because sections of code are reused many times.
- They create it easier to reuse code in other programs by making it modular, and using functions often makes the code more readable.

MOTORS

These durable plastic gearbox motors (also known as 'TT' motors) are an easy, low-cost way to get your projects moving. This is a TT DC Gearbox Motor with a gear ratio of 1:48, and it comes with 2 x 200mm wires with breadboard-friendly 0.1" male connectors.

It can power these motors with 3V DC up to 6V DC, they'll of course go a little faster at the higher voltages.

L293D MOTOR DRIVER

The L293D is a 16-pin Motor Driver IC which can control a set of two DC motors simultaneously in any direction. The L293D is designed to provide bidirectional drive currents of up to 600 mA (per channel) at voltages from 4.5 V to 36 V. It can use it to control small dc motors - toy motors.

IR FLAME SENSOR

The IR flame sensor senses the environment and detects the presence of fire or flame. The module is based on the IR receiver and basically detects the presence of flammable and harmful gases like nitrogen, hydrogen, carbon mono oxide. The signal detection capacity is adjustable. The robot contains three flame sensors.

LM2956 BUCK CONVERTER

DC-DC Buck Converter Step Down Module LM2956 Power Supply is a step-down(buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version.

GSM SIM 800L

SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls. Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range connectivity.

BATTERY

- The name derives from the battery's specific measurements: 18mm x 65mm. For scale, that's larger than an AA battery.
- The 18650 battery has a voltage of 3.6v and has between 2600mAh and 3500mAh (milli-amp-hours) These batteries are used in flashlights, laptops, electronics and even some electric cars because of their reliability, long run-times, and ability to be recharged hundreds of times over.
- 18650 batteries are considered as a "high drain battery."
- This means that the battery is designed to generate high output voltage and current to meet the power demands of the portable device in which it is being used.

MINI WATER PUMP

Submersible Water Pump DC 3V-5V, can be easily integrate to water system project. The water pump works using water suction method which drain the water through its inlet and released it through the outlet. You can use the water pump as exhaust system for aquarium and controlled water flow fountain.

GAS SENSOR

The MQ-2 is a smoke and combustible gas sensor from Winson. It can detect flammable gas in a range of 300 - 10000ppm. Its most common use is domestic gas leakage alarms and detectors with a high sensitivity to propane and smoke. The smoke detector used in this design is the MQ-2 gas sensor, they are used in detecting leakage of gas such as LPG, natural gas, town gas, cooking fumes and cigarette in homes and industries.

SERVO MOTOR

A servo motor is an electrical device that can push or rotate an object with great precision. If we want to rotate an object at some specific angles or distance, then we use a servo motor. It is made up of a simple motor that runs through a servo mechanism. The position of a servo motor is decided by an electrical pulse and its circuitry is placed beside the motor.

RELAY

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated the electromagnet pulls to either open or close an electrical circuit.

CHAPTER IV

4.1 CIRCUIT DIAGRAM

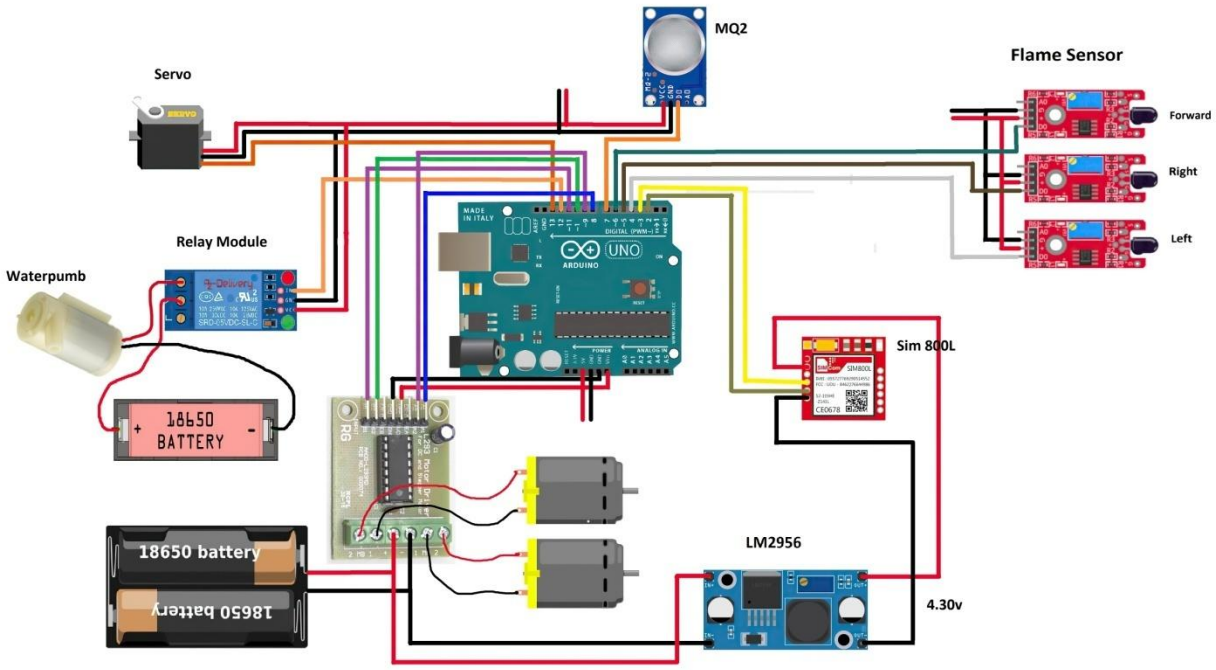

Fig 4.1 Circuit Diagram

4.2 Circuit Diagram Description

This circuit mainly consists of Arduino UNO, two Flame sensor, motors, motor driver, smoke detector, buck converter, water pump, servo motor, relay module and GSM. The Fire Fighting Robot needs mechanical chassis. The Three flame sensors are mounted Front, Right and Left of the chassis.

When robot is placed on a warehouse or in a server room it detects the fire and let us know the alert through SMS and Call. When the fire detected the robot move towards the fire and stops at safer distance and extinguish the fire.

- The output pins of Flame sensor to be connected to 6,5,4 on Arduino.
- The A1, A2, B1, B2 pins of L293D motor driver module to be connected to 8,9,10,11.
- Battery is connected to Vin and Ground pins of Arduino, Buck converter, GSM and L293D motor driver.
- Motors have to be connected to OUT 1,2,3,4 pins of L293 Motor driver.
- Pump is connected to the Relay module.
- Servo and Smoke detector is connected to the 6 and 13 pin of Arduino.

CHAPTER V

HARDWARE DESCRIPTION

The Fire Fighting Robot with SMS and call alert using Microcontroller (Arduino UNO) comprises the following units, they are

- Battery
- Arduino UNO
- DC motor
- L293D Motor driver
- Flame Sensor
- LM2956 Buck Converter
- GSM SIM 800L
- Mini Water Pump
- MQ-2 Gas sensor
- Servo Motor
- Relay Module

5.1 POWER SUPPLY

5.1.1 DEFINITION

A lithium-ion battery or Li-ion battery is a type of rechargeable battery composed of cells in which lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge and back when charging. Li-ion cells use an intercalated lithium compound as the material at the positive electrode and typically graphite at the negative electrode. Li-ion batteries have a high energy density, no memory effect (other than LFP cells) and low self-discharge. Cells can be manufactured to either prioritize energy or power density. They can however be a safety hazard since they contain flammable electrolytes and if damaged or incorrectly charged can lead to explosions and fires.

A prototype Li-ion battery was developed by Akira Yoshino in 1985, based on earlier research by John Goodenough, M. Stanley Whittingham, Rachid Azami and Koichi Mizushima during the 1970s–1980s, and then a commercial Li-ion battery was developed by a Sony and Asahi Kasei team led by Yoshio Nishi in 1991. Lithium-ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications.

5.1.2 DESIGN

Generally, the negative electrode of a conventional lithium-ion cell is made from carbon. The positive electrode is typically a metal oxide. The electrolyte is a lithium salt in an organic solvent. The electrochemical roles of the electrodes reverse between anode and cathode, depending on the direction of current flow through the cell. The most common commercially used anode (negative electrode) is graphite, which in its fully lithiated state of LiC6 correlates to a maximal capacity of 1339 C/g (372 mAh/g). The positive electrode is generally one of three materials. Lithium reacts vigorously with water to form lithium hydroxide (LiOH) and hydrogen gas. Thus, a non-aqueous electrolyte is typically used, and a sealed container rigidly excludes moisture from the battery pack.

The non-aqueous electrolyte is typically a mixture of organic carbonates such as ethylene carbonate or diethyl carbonate containing complexes of lithium ions. The salt is almost always lithium hexafluorophosphate (LiPF6), which combines good ionic conductivity with chemical and electrochemical stability. Other salts like lithium perchlorate (LiClO4), lithium tetrafluoroborate (LiBF4), and lithium tetrafluoroborate (LiC2F6NO4S2) are frequently used in research for reasons of cost or convenience but are not usable in commercial cells. The increasing demand for batteries has led vendors and academics to focus on improving the energy density, operating temperature, safety, durability, charging time, output power, elimination of cobalt requirements, and cost of lithium-ion battery technology.

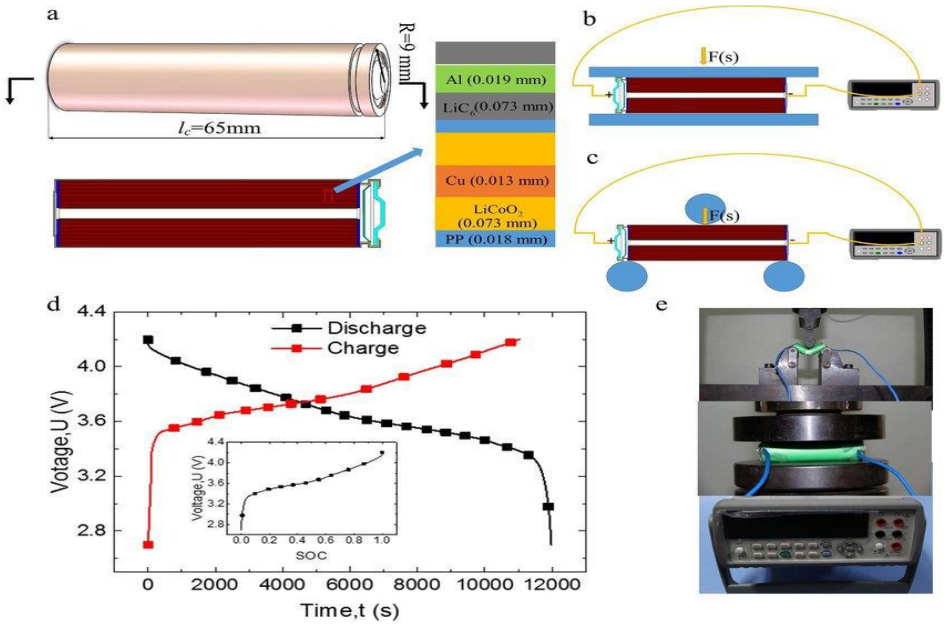

Fig 5.1.1 li-ion battery

5.2 ARDUINO

Arduino Uno is an open-source microcontroller board based on the Microchip Atmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.

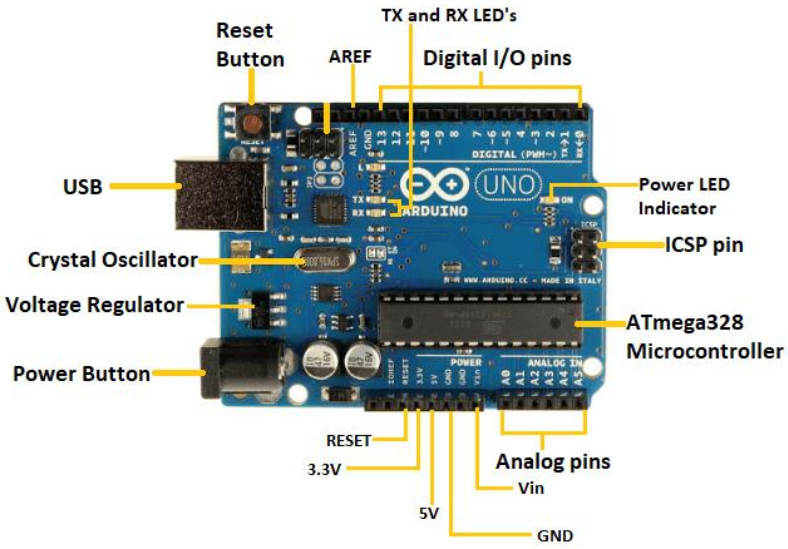

Fig 5.2.1 Arduino UNO

Arduino UNO has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller. This board includes digital I/O pins-14, a power jack, analog i/ps-6, ceramic resonator-A16 MHz, a USB connection, an RST button, and an ICSP header. All these can support the microcontroller for further operation by connecting this board to the computer. The power supply of this board can be done with the help of an AC to DC adapter, a USB cable, otherwise a battery.

Atmega-328

Atmega-328 is the largest part micro-controller that is used while designing. Atmega 328is the largest part important part of Arduino. The program is uploaded on the AVR micro-controller close on Arduino.Atmega32 is an eight 8- bit Microcontroller. It can hold the data sized of up to eight 8-bits. It is an AVR (Atmega328) based microcontroller.

• Internal memory is around 32KB.

• Operates ranging from 3.3V to 5V.

The data even when the electrical supply is removed from its biasing terminals.

Fig 5.2.2 Atmega328

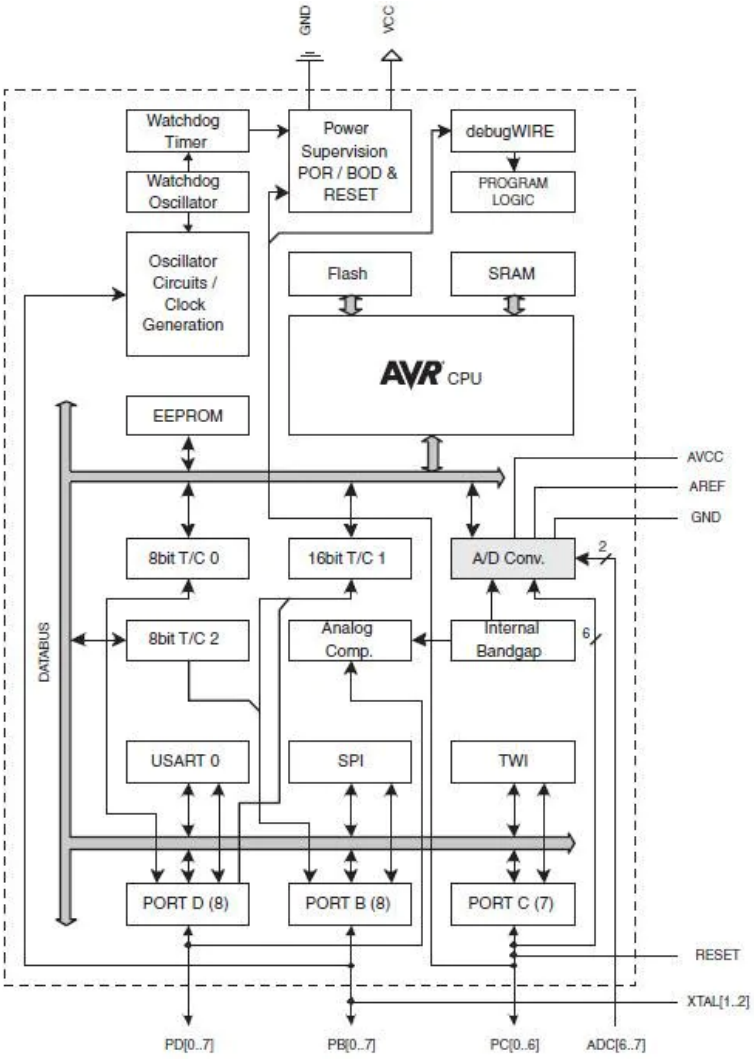

Fig 5.2.3 Architecture of Atmega328

BLOCK DIAGRAM

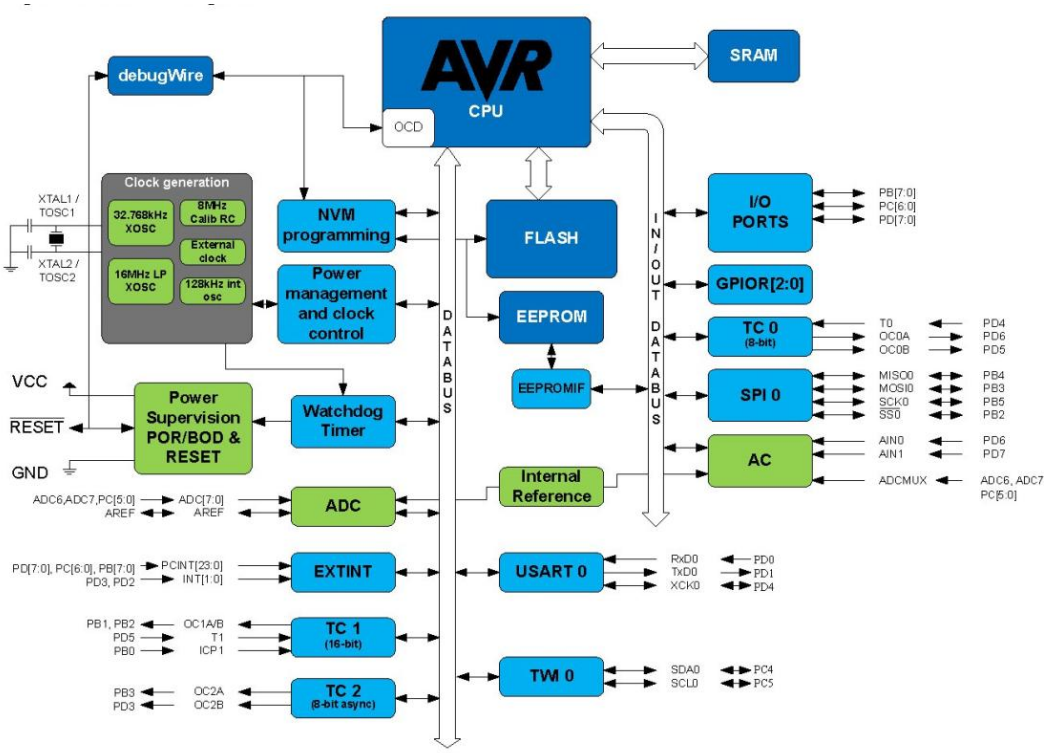

Fig 5.2.4 Block Diagram of Atmega 328

AVR microcontrollers are available in three different categories such as Tiny AVR, Mega AVR, and X mega AVR

- The Tiny AVR microcontroller is very small in size and used in many simple applications
- Mega AVR microcontroller is very famous due to many integrated components, good memory, and used in modern to multiple applications
- The X mega AVR microcontroller is applied in difficult applications, which require high speed and huge program memory.

These Microcontrollers were very fast, and they utilize low power to work in different power saving modes. There are different configurations of AVR microcontrollers are available to perform various operations like 8-bit, 16-bit, and 32-bit.

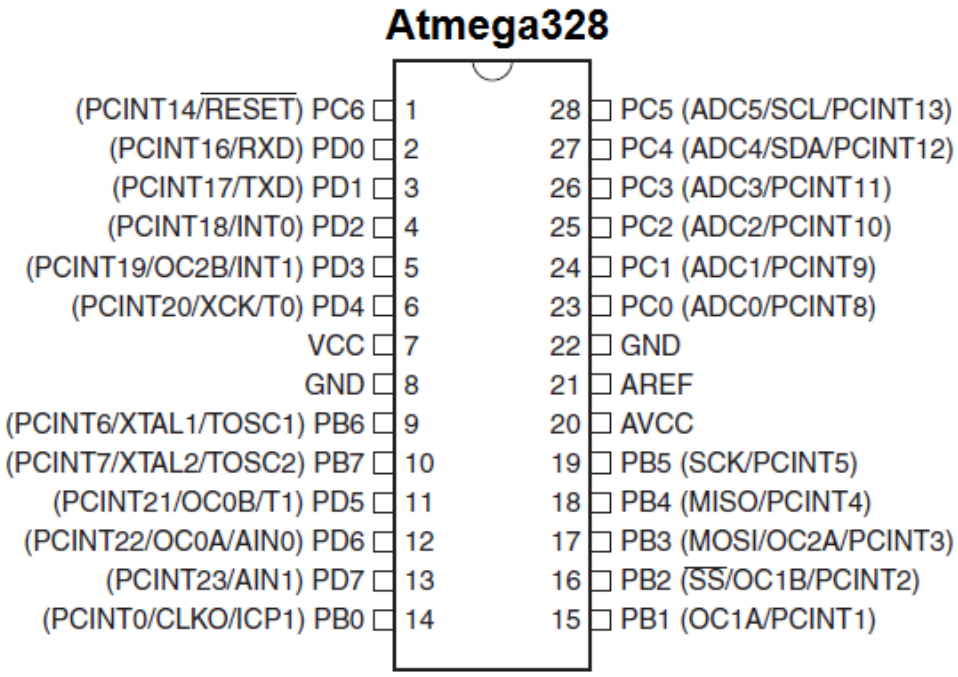

Fig 5.2.5 Pin Diagram of Atmega328

PIN DESCRIPTION OF ATMEGA328

- Pin -1 is the RST (Reset) pin and applying a low-level signal for a time longer than the minimum pulse length will produce a RESET.
- Pin-2 and pin-3 are used in serial communication.
- Pin-4 and pin-5 are used as an external interrupt. One of them will activate when an interrupt flag bit of the status register is set and the other will activate as long as the intrude condition succeeds.
- Pin-9 & pin-10 are used as a timer-counters oscillators as well as an external oscillator where the crystal is associated directly with the two pins. Pin-10 is used for low-frequency crystal oscillator or crystal oscillator. If the internal adjusted RC oscillator is used as the CLK source & the asynchronous timer is allowed, these pins can be utilized as a timer oscillator pin.
- Pin-19 is used as a Master CLK o/p, slave CLK i/p for the SPI-channel.
- Pin-18 is used as Master CLK i/p, slave CLK o/p.
- Pin-17 is used as Master data o/p, slave data i/p for the SPI-channel. It is used as an i/p when empowered by a slave & is bidirectional when allowed by the master. This pin can also be utilized as an o/p compare with match o/p, which helps as an external o/p for the timer/counter. Pin-16 is used as a slave choice i/p. It can also be used as a timer or counter1 comparatively by arranging the PB2-pin as an o/p.

- Pin-15 can be used as an external o/p of the timer or counter compare match A.
- Pin-23 to Pins28 have used for ADC (digital value of analog input) channels. Pin-27 can also be used as a serial interface CLK & pin-28 can be used as a serial interface data.
- Pin-12 and pin-13 are used as an Analog Comparator i/ps.
- Pin-6 and pin-11 are used as timer/counter sources.

5.2.3 PIN DESCRIPTIONS

1.VCC

VCC- Digital supply voltage.

2.GND

GND- Ground.

Port B (PB [7:0]) XTAL1/XTAL2/TOSC1/TOSC2

Port B -8-bit

Bi-directional I/O port

5.2.4 Atmega328 FEATURES

Port B pins that are externally pulled low will source current if the pull-up resistors are activated.

Port C (PC [5:0])

Port C is a 7-bit

Bi-directional I/O

PC6/RESET

Fuse is programmed
Fuse is unprogrammed
PC6 -Reset input
PC6 -I/O pin

Port D (PD [7:0])

Port D is an 8-bit, Bi-directional I/O

The Port D output buffers have symmetrical drive characteristics with both high sink and source capability

AVCC

AVCC –supply voltage pin for the A/D Converter.

AREF

AREF -A/D Converter.

ADC [7:6] (TQFP and VFQFN Package Only)

TQFP and VFQFN – analog inputs to the A/D converter.

These pins are powered from the analog supply and serve as 10-bit ADC channels.

ATmega328 Features	
Sr. No	**Features**
1	Non programmable data and program memory
2	High performance
3	Low power consumption
4	Fully static operation
5	On chip analog comparator
6	Advance RISC architecture
7	32KB flash memory
8	2KB SRAM

Fig 5.2.6 features of Atmega

Features of Arduino Uno Board

The features of Arduino Uno Atmega328 includes the following,

- The operating voltage is 5V
- The recommended input voltage will range from 7v to 12v
- The input voltage ranges from 6v to 20V
- Digital input/output pins are 14
- Analog i/p pins are 6
- DC Current for each input/output pin is 40 mA
- DC Current for 3.3V Pin is 50 mA
- Flash Memory is 32 KB
- SRAM is 2 KB
- EEPROM is 1 KB
- CLK Speed is 16 MHz

Arduino Uno Pin Diagram

The Arduino Uno board can be built with power pins, analog pins, Atmegs328, ICSP header, reset button, power LED, digital pins, test led 13, TX/RX pins, USB interface, an external power supply. The Arduino UNO board description is discussed below.

Power Supply

The Arduino Uno power supply can be done with the help of a USB cable or an external power supply. The external power supplies mainly include AC to DC adapter otherwise a battery. The adapter can be connected to the Arduino Uno by plugging into the power jack of the Arduino board. Similarly, the battery leads can be connected to the Vin pin and the GND pin of the POWER connector. The suggested voltage range will be 7 volts to 12 volts.

Input & Output

The 14 digital pins on the Arduino Uno can be used as input & output with the help of the functions like pinMode(), digitalWrite(), & Digital Read (). Pin1 (TX) & Pin0 (RX) (Serial): This pin is used to transmit & receive TTL serial data, and these are connected to the Atmega8U2 USB to TTL Serial chip equivalent pins.

Arduino Uno Pin Diagram

- Pin 2 & Pin 3 (External Interrupts): External pins can be connected to activate an interrupt over a low value, change in value. Pins 3, 5, 6, 9, 10, & 11 (PWM): This pin gives 8-bit PWM o/p by the function of analogWrite().
- SPI Pins (Pin-10 (SS), Pin-11 (MOSI), Pin-12 (MISO), Pin-13 (SCK): These pins maintain SPI-communication, even though offered by the fundamental hardware, is not presently included within the Arduino language.
- Pin-13(LED): The inbuilt LED can be connected to pin-13 (digital pin). As the HIGH-value pin, the light emitting diode is activated, whenever the pin is LOW.
- Pin-4 (SDA) & Pin-5 (SCL) (I2C): It supports TWI-communication with the help of the Wire library.
- AREF (Reference Voltage): The reference voltage is for the analog i/ps with analogReference(), Reset Pin: This pin is used for resetting (RST) the microcontroller.

Memory

The memory of this Atmega328 Arduino microcontroller includes flash memory-32 KB for storing code, SRAM-2 KB EEPROM-1 KB.

Communication

The Arduino Uno Atmega328 offers UART TTL-serial communication, and it is accessible on digital pins like TX (1) and RX (0). The software of an Arduino has a serial monitor that permits easy data. There are two LEDs on the board like RX & TX which will blink whenever data is being broadcasted through the USB.

A Software Serial library permits for serial communication on Arduino Uno digital pins and the Atmega328P supports TWI (I2C) as well as SPI-communication. The Arduino software contains a wired library for simplifying the utilization of the I2C bus.

How to Use an Arduino Uno?

Arduino Uno can detect the surroundings from the input. Here the input is a variety of sensors, and these can affect its surroundings through controlling motors, lights, other actuators, etc. The Atmega328 microcontroller on the Arduino board can be programmed with the help of an Arduino programming language and the IDE (Integrated Development Environment). Arduino projects can communicate by software while running on a PC.

Arduino Programming

- Once the Arduino IDE tool is installed in the PC, attach the Arduino board to the computer with the help of USB cable. Open the Arduino IDE & select the right board by choosing Tools–>Board.>Arduino Uno and select the right Port by choosing Tools–>Port. This board can be programmed with the help of an Arduino programming language depends on Wiring.
- To activate the Arduino board & flash the LED on the board, dump the program code with the selection of Files–> Examples.>Basics.>Flash. When the programming codes are dumped into the IDE, and then click the button 'upload' on the top bar. Once this process is completed, check the LED flash on the board.

High Voltage Protection of USB

The Arduino Uno board has a rearrangeable poly fuse that defends the USB port of the PC from the over-voltage. Though most of the PCs have their own inner protection, the fuse gives an additional coating of safety. If above 500mA is given to the USB port, then the fuse will routinely crack the connection until the over-voltage is removed.

Physical Characteristics

The physical characteristics of an Arduino board mainly include length and width. The printed circuit board of the Arduino Uno length and width are 2.7 X 2.1 inches, but the power jack and the USB connector will extend beyond the previous measurement. The board can be attached on the surface otherwise case with the screw holes.

Applications of Arduino Uno Atmega328

The applications of Arduino Uno include the following.

• Arduino Uno is used in Do-it-Yourself projects prototyping.

• In developing projects based on code-based control

• Development of Automation System

• Designing of basic circuit designs.

Thus, this is all about Arduino Uno datasheet. From the above information finally, we can conclude that this is an 8-bit Atmega328P microcontroller. It has different components like serial communication, crystal oscillator, the voltage regulator for supporting the microcontroller.

This board includes a USB connection, digital I/O pins-14, analogue I/p pins-6, a power-barrel jack, a reset button, and an ICSP header. Thus, Arduino UNO is a Main microcontroller. Each Arduino board has its own microcontroller, the brain of the board. The main IC (integrated circuit) on the Arduino is slightly different from board to board.

5.3 FLAME SENSOR

5.3.1 DEFINITION

A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting. It includes an alarm system, a natural gas line, propane & a fire suppression system. This sensor is used in industrial boilers. The main function of this is to give authentication whether the boiler is properly working or not. The response of these sensors is faster as well as more accurate compare with a heat/smoke detector because of its mechanism while detecting the flame.

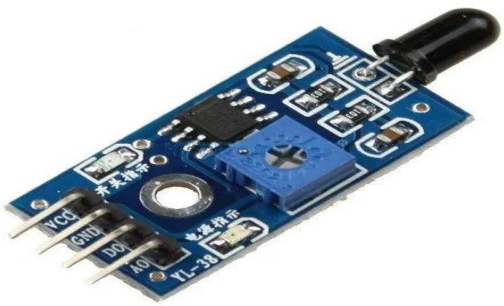

Fig 5.3.1Flame Sensor

5.3.2 WORKING PRINCIPLE

Most fire detection technology focuses on detecting heat, smoke (particle matter) or flame (light) – the three major characteristics of fire. All of these characteristics also have benign sources other than fire, such as heat from steam pipes, particle matter from aerosols, and light from the sun. Other factors further confound the process of fire detection by masking the characteristic of interest, such as air temperature, and air movement.

In addition, smoke and heat from fires can dissipate too rapidly or accumulate too slowly for effective detection. In contrast, because flame detectors are optical devices, they can respond to flames in less than a second. This optical quality also limits the flame detector as not all fires have a flame. As with any type of detection method its use must match the environment and the risk within the environment.

5.3.3 TYPES OF FLAME SENSORS

There are different types of flame sensors like ultraviolet, infrared, Ultraviolet, Multi-Spectrum Infrared, IR3 flame.

UV Flame Sensors

UV frame or ultraviolet frame sensors are used to detect ultraviolet radiation because most fires emit ultraviolet radiation. These sensors are particularly helpful for services that are prone to particular hazards like halogen, metal fires & hydrocarbon. So, these types of sensors provide great sensitivity at small distances approximately 0 to 50 feet but, their performance will decrease at any length. These sensors respond to electrical discharges such as lightning.

Infrared Flame Sensors

Infrared flame sensors monitor IR radiation. These sensors also detect & analyze the IR spectral band to discover particular predefined prototypes given off through hot gases. These prototypes are detected with thermal imaging or thermographic cameras. The technology used by these sensors is flame recognition technology which detects the near-infrared radiation with a Charge-coupled device (CCD). The IR radiation sensors will affect significantly by the vapor of water as water simply absorbs a main part of the received infrared radiation. Because of this main reason, these sensors are not able to provide precise results in an outside environment.

Ultraviolet/Infrared Flame Detectors

Ultraviolet/infrared flame detectors add sensors for both UV & IR radiation. These two sensors simply work separately. But some included circuitry & wiring to assist the detector procedure & evaluate both UV and IR signals. So, this helps dispel any fake alarms that a single signal or the other may provoke. This improved immunity to fake alarms permits ultraviolet or infrared flame detectors to be utilized in both indoor as well as outdoor applications. But it limits fire detection to comprise fires that simply produce both UV & IR radiation.

Multi-Spectrum Infrared Flame Detectors

MSIR sensors utilize many IR wavelengths to differentiate flame-producing radiation from the sources of non-flame-production radiation. MSIR sensors respond to fires very quickly up to a distance of 200 feet both indoors & outdoors. These sensors are capable of detecting flames even between the smokiest of fires and also not causes fake alarms because of sunlight, lighting, otherwise other hot objects within the surrounding area.

IR3 Flame Detector

IR3 flame sensors compare the emission patterns among three various infrared spectral bands & the radiation bands ratio. Usually, these types of flame sensors are programmed to notice one radiation band in the 4.4-micrometer range & the remaining two bands range below & above the 4.4-micrometer spectrum. So, this sensor is capable of separating the actual flames & the non-flame radiations that affect the results. Thus, these sensors provide superior flame detection results by simply avoiding the background radiations.

5.3.4 CIRCUIT DIAGRAM

The circuit diagram of the flame sensor is shown below. This sensor module circuit can be designed with different components like LM393, YG1006 Phototransistor, two 1K Resistors like R1& R3, R2 -10K Resistor, VR1 – 10K Potentiometer, two 0.1 uF C1, C2 Ceramic Capacitors & D1, D2 RED LEDs.

The working of the flame sensor module is simple. The theory behind it is that a hot body will emit infrared radiation. And for a flame or fire, this radiation will be high. We will detect this IR radiation using an infrared photodiode. The conductivity of the photodiode will vary depending on the IR radiation it detects. We use an LM393 to compare this radiation and when a threshold value is reached the digital output is changed.

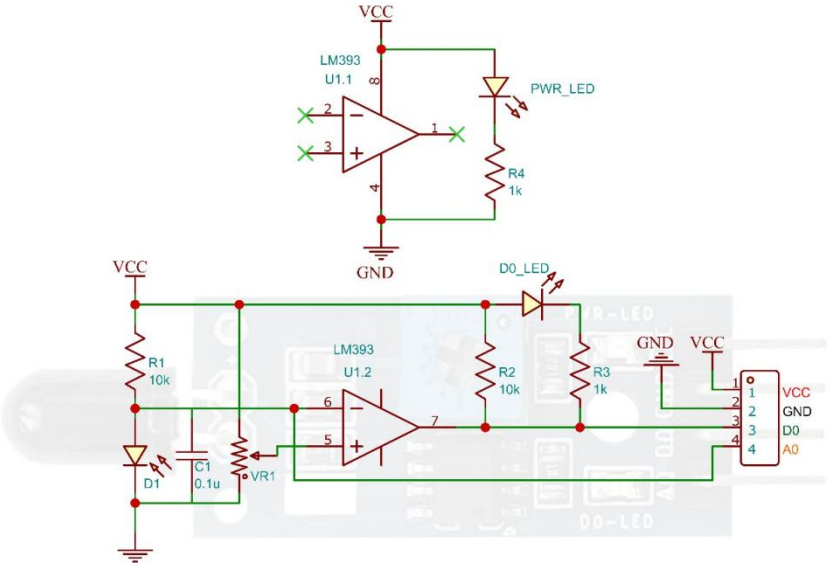

Fig 5.3.2 Flame Sensor Circuit Diagram

We can also use the analog output to measure the IR radiation intensity. The analog output is directly taken from the terminal of the photodiode. The onboard D0 LED will show the presence of fire when detected. The sensitivity can be changed by adjusting the variable resistor on board. This can be used to eliminate false triggering.

5.3.5 FLAME SENSOR CIRCUIT USING TRANSISTOR

Fire sensor circuits are very useful in detecting any smoke or fire in a mall or building. This tutorial helps us to design a simple Fire Sensor Circuit using a BC547 transistor.

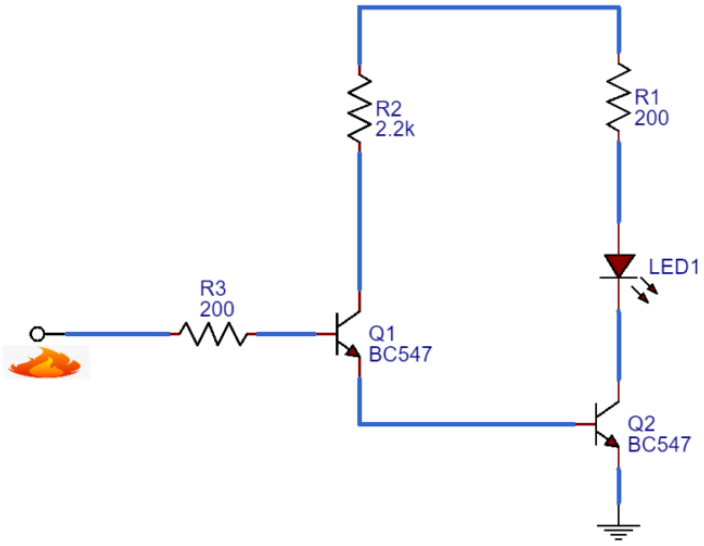

Fig 5.3.3 Flame Sensor Circuit using Transistors

It doesn't require any microcontroller to detect a fire. As the circuit detects any smoke or fire, it triggers the buzzer or glows a Led to indicate an alert so that safety measures can be taken. The above circuit includes IR LED, resistors 2-200ohms, 2.2k ohms, 2-BC547 transistors. The step-by-step process of making the flame sensor with transistor in the following steps.

- Connect the components as per the circuit diagram using required components.
- Connect the 200ohm resistor to the Q1 BC547 transistor's base terminal.
- Connect a 2.2k ohm & 200ohm resistor serial connect to LED and to the Q2 transistor's collector terminal.
- Connect the Q1 transistor's emitter toward the Q2's base terminal.
- Once the connection of the circuit is done then gives the power supply to the circuit for testing.

5.3.6 CIRCUIT WORKING

A BC547 NPN transistor drives a buzzer or a Led at the output as it detects a fire. The working of a fire sensor is quite easy and simple. The transistor turns on whenever it gets the base voltage of 0.7V through the resistor. As the circuit senses the fire it decreases the resistance at the base. Due to this the voltage across the base terminal increases or becomes equal to 0.7V which turns the transistor ON. The Led starts glowing to indicate the fire. When there is no fire, the lead turns Off as the voltage across the base terminal falls below 0.7V so the transistor turns off.

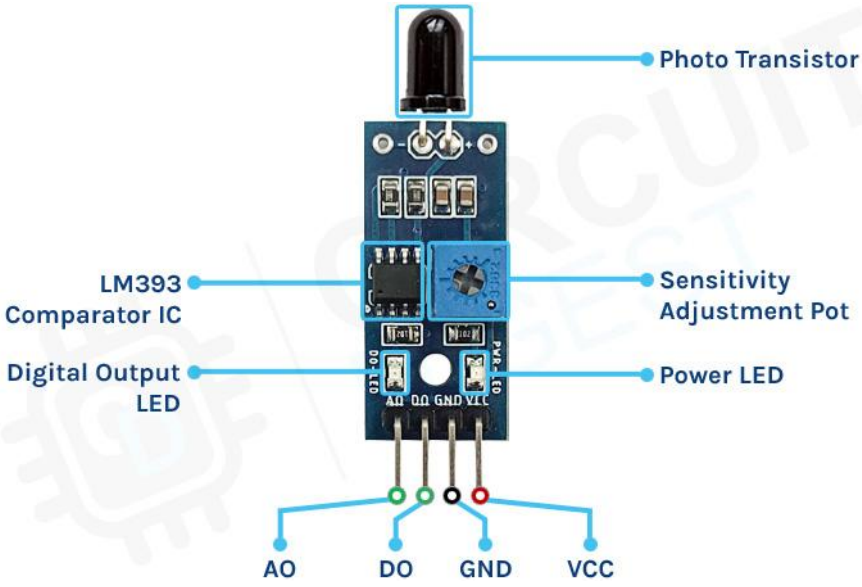

Fig 5.3.4 Flame sensor module

INTERFACING WITH ARDUINO

The flame sensor is connected to digital pin 2 of Arduino. Variable “flame detected” is used for storing the digital value read out from the flame sensor. Based on this value we will detect the presence of flame.

As soon as the flame sensor detects fire or flame, it gets triggered. This sensing is based on parameters like humidity, temperature, smoke, Etc. These signals can be in the form of analog or digital. In this project, we have used the digital output of the flame sensor. When Arduino receives this signal, it performs the resultant action in response.

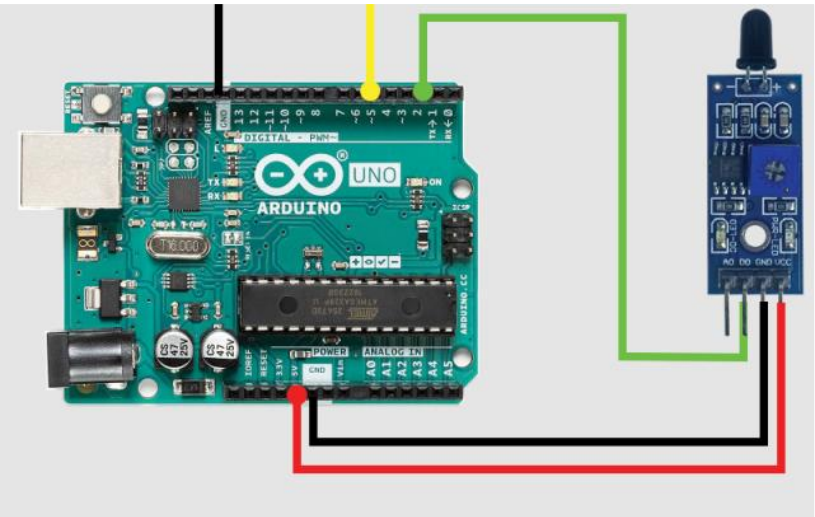

Fig 5.3.5 Interfacing Flame sensor with Arduino

5.4 L293D Motor Driver

L293D is a motor driver or motor driver IC which is responsible for the movement of DC motor on either direction. L293D is a 16 pin IC through which we are able to run two DC motors simultaneously in any direction.

The L293D motor driver IC is used to control the rotation direction and speed of two DC motors. The L293d is a dual-channel H-Bridge motor driver IC. This module uses two techniques for the control speed and rotation direction of the DC motors. These are PWM – For controlling the speed and H-Bridge – For controlling rotation direction. These modules can control two DC motor or one stepper motor at the same time.

Fig 5.4.1 L293D Motor Driver

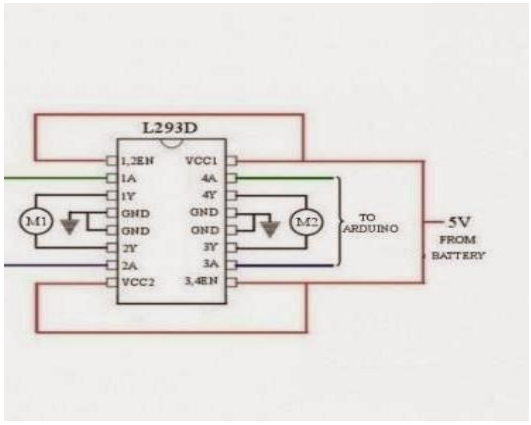

Fig 5.4.2 L293D Block Diagram

Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo- Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. L293 and L293D are characterized for operation from 0°C to 70°C.

5.4.1 Working Principle

The circuit diagram of the L293D Driver Motor IC designed for soldering on PCB with the connectors. Here, four inputs such as Input 1, Input 2, Input 3, and Input 4 are given at input pins 2,7,10, and 14 respectively. Two Enables such as Enable 1,2 and Enable 3,4 are given at enabling pins 1 and 9 respectively. The connection of all pins of IC and other components is shown in the above circuit diagram.

Depending on the value of Inputs and Enables, the motor will rotate either in a clockwise direction or anticlockwise direction with full speed or less speed. The direction of rotation of the motor depends on the value of Inputs and the speed of rotation depends on the value of Enables. The motor is said to be in full speed when Enable is High and is said to be in less speed when enable is provided with PWM.

Input 1	**Input 2**	**Enable 1,2**	**Result**
0	0	1	Stop
0	1	1	Anti-clockwise rotation
1	0	1	Clockwise rotation
1	1	1	Stop
0	1	50% duty cycle	Anti-clockwise rotation with half speed
1	0	50% duty cycle	Clockwise rotation with half speed

Table 5.4.1 control mode and state of motor

Let us take Left Motor and assume the conditions when Enable is HIGH and Input 1 and Input 2 are HIGH and LOW respectively then the motor will move in a clockwise direction.The behaviour of the motor depending on the input conditions such as Inputs and it Enables logical 1 is referred to as HIGH and Logical 0 is referred to as LOW.

5.4.2 Block Diagram & Circuit Diagram

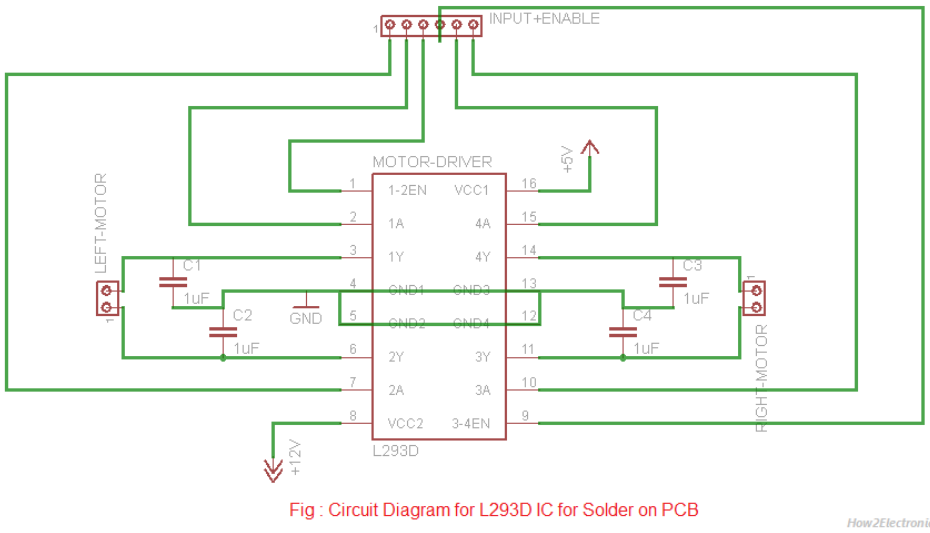

Fig : Circuit Diagram for L293D IC for Solder on PCB

Fig 5.4.2 circuit diagram for L293D motor driver

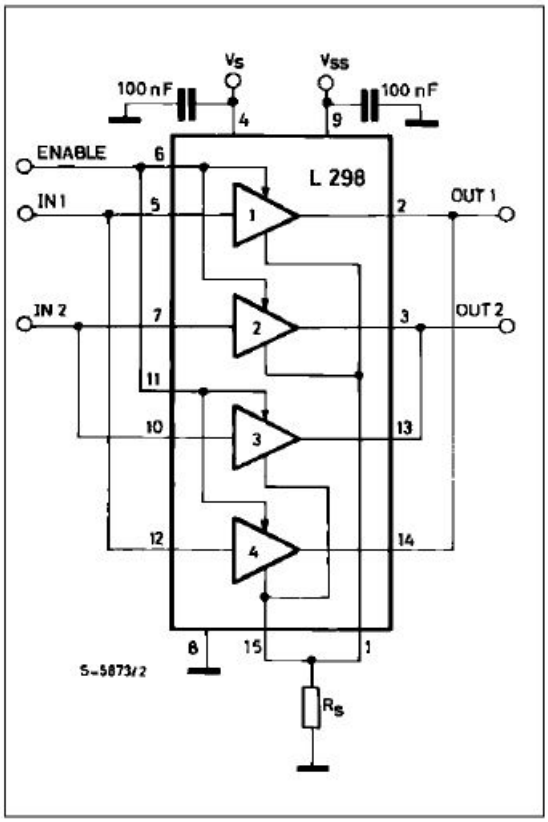

Fig 5.4.3 Block Diagram of L293D Motor

5.4.3 Features

- Wide Supply-Voltage Range: 4.5 V to 36 V.
- Separate Input-Logic Supply.
- Internal ESD Protection.
- High-Noise-Immunity Inputs.
- Output Current 1 A Per Channel (600 mA for. L293D)
- Peak Output Current 2 A Per Channel (1.2 A for. L293D)
- Output Clamp Diodes for Inductive Transient. Suppression (L293D)

5.5 DC MOTOR AND WHEELS

A Direct Current (DC) motor is a rotating electrical device that converts direct current, of electrical energy, into mechanical energy. An Inductor (coil) inside the DC motor produces a magnetic field that creates rotary motion as DC voltage is applied to its terminal. Inside the motor is an iron shaft, wrapped in a coil of wire. This shaft contains two fixed, North and South, magnets on both sides which causes both a repulsive and attractive force, in turn, producing torque. ISL Products designs and manufactures both brushed DC motors and brushless DC motors. We tailor our DC motors size and performance to meet your desired specs.

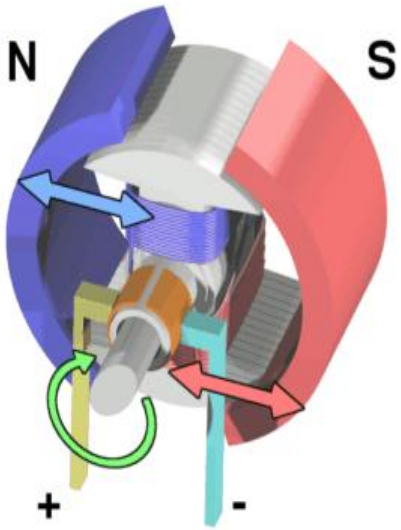

Figure 1 - Inside the DC Motor


Figure 2 - DC Motor

Fig 5.5.1 DC Motor

A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters in regard to gear motors are speed (rpm), torque (lb-in) and efficiency (%). To select the most suitable gear motor for your application you must first compute the load, speed and torque requirements for your application.

ISL Products offers a variety of Spur Gear Motors, Planetary Gear Motors and Worm Gear Motors to meet all application requirements. Most of our DC motors can be complemented with one of our unique gearheads, providing you with a highly efficient gear motor solution.

Fig 5.5.2 TT Gear motor with Wheel

5.5.1 Electrical Characteristics

• Operating Voltage Range: 3~7.5V

• Rated Voltage: 6V

• Max. No-load Current(3V): 140 mA

• Max. No-load Current(6V): 170 mA

• No-load Speed(3V): 90 rpm

• No-load Speed(6V): 160 rpm

• Max. Output Torque: 0.8 kgf.cm

• Max. Stall Current: 2.8 A

5.6 LM2956 BUCK CONVERTER

- LM2596 is a voltage regulator mainly used to step down the voltage or to drive load under 3A.
- It is also known as DC-to-DC power converter or buck converter which is used to step down the voltage from its input supply to the output load. The current goes up during this voltage step down process.

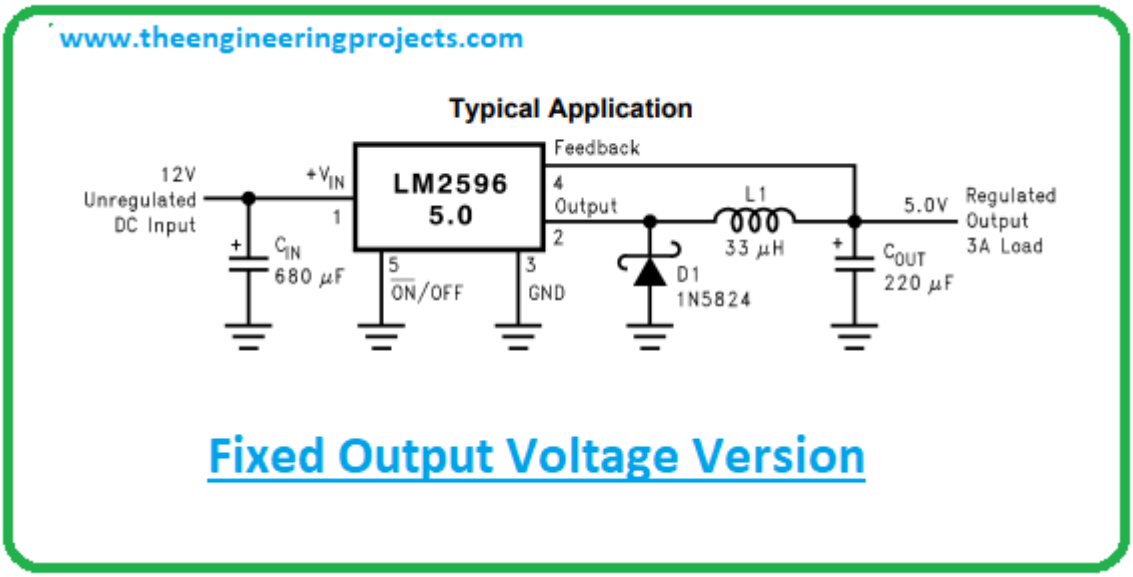

Fig 5.6 LM2596 Buck Converter

- LM2596 comes with a remarkable load and line regulation. It is available in both versions: fixed output voltage version with 3.3V, 5V, 12V, and customized output version where you can choose the output as per your requirement.
- This regulator is incorporated with a fixed-frequency oscillator and an internal frequency compensation method.
- Introduction to LM2596, LM2596 pinout, LM2596 power ratings, LM2596 applications
- Frequency compensation is applied by adjusting both phase and gain characteristics of the open-loop output to avoid oscillation and vibration in the circuit. This is achieved with the help of resistance-capacitance networks.
- A minimum number of external components are required for this regulator that works at a fixed frequency of 150 kHz.

5.7 SERVO MOTOR

A servo motor is a linear or rotary actuator that enables precise position control in closed-loop applications. Servo motors are not suitable for continuous energy conversion when compared to huge industrial electric motors. Because of the inertia, these motors have a high-speed reaction and are constructed with tiny diameters and large rotor lengths.

FIG 5.7.1 Servo Motor

The speed and ultimate position of servo motors are controlled by a mechanism that uses position feedback. A servo motor is made up of a motor, a feedback circuit, a controller, and another electrical circuit on the inside. Smaller applications are best suited for these motors. Because of their high precise control, AC servo motors are becoming more popular as microprocessors and power transistors progress.

5.8 GSM SIM800L

SIM800L GSM/GPRS module is a miniature cellular GSM modem from Simcom, which can easily interface with any microcontroller to give the microcontroller GSM functionality, and allows for GPRS transmission. This module connects the microcontroller to the mobile network to make or receive phone calls, send or receive SMS (text messages), and connect to the internet using GPRS, TCP, or IP. Another advantage is It supports quad-band GSM/GPRS network, which means it can work anywhere in the world. These important functionalities as well as the low cost and small footprint make this module more perfect for any project where long-range connectivity is required and also it can be integrated into a great number of IoT projects.

SIM800L GSM/GPRS Module Hardware Overview

The SIM800L GSM/GPRS module consists of four key components, which take important roles in the work of the module. These key components are SIM800L GSM cellular chip, LED Status Indicators, Antennas, and Micro-SIM socket.

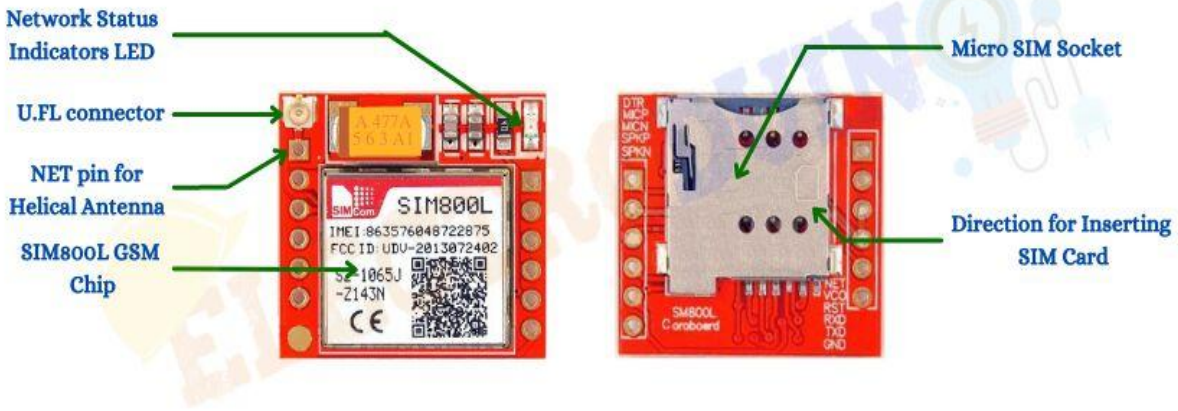

FIG 5.8.1 SIM800L GSM GPRS Module Hardware Overview

SIM800L GSM cellular chip

On the top surface of the GSM module, we can see a chip is mounted on the module board. This is a Quad-band SIM800L GSM/GPRS cellular chip from SimCom in SMT type. SIM800L supports Quad-band frequency its works on frequencies 850MHz, 900MHz, 1800MHz, and 1900MHz, it can transmit and receive voice, SMS, and data information with low power consumption. The operating voltage of this chip is from 3.4V to 4.4V which makes it ideal to operate by a LiPo battery supply. This chip supports a baud rate from 1200bps to 115200bps with Auto-Baud detection.

LED Status Indicators

On the topmost right corner side of the SIM800L Module, we can see an LED that indicates the status of your cellular network. After applying the power supply to the module the LED will blink at three different ratios, which shows three different statuses of your cellular network.

Antennas

An antenna is a vital part of the module, it is used for voice or data communications as well as some SIM commands. SIM800l GSM/GPRS module provides two ways to connect Antennas. There are two types of antennas that can connect to the module one is a Helical GSM antenna and another one is PCB Antenna.

Helical GSM Antenna

The Helical GSM antenna is made of wire, which usually comes with the module. It can be soldered directly to the NET pin on PCB. This type of antenna is very useful in narrow space projects.

PCB Antenna

It can see a U.FL male connector present at the top-left corner of the module, which is used to connect the PCB antenna. This antenna has better performance and allows you to put your module inside a metal case – as long the antenna is outside.

Micro-SIM socket

On the backside of the module, a SIM socket is available, where It can insert an activated 2G micro-SIM card that would work perfectly. When we insert a SIM card into the socket we must ensure that the notch point will upwards. Normally the symbol of the SIM card is engraved on the surface of the SIM socket that helps us to identify the correct direction of SIM inserting.

Pinout/Pin Diagram of SIM800L GSM/GPRS Module

The SIM800L GSM module has 12 pins that are used to connect the module to any microcontroller. The Pinout configuration is explained below:

FIG 5.8.2 SIM800L GSM-GPRS Module Pinout, Pin Diagram

NET: The NET pin is used to attach an external antenna. Where we can solder Helical Antenna which comes along with the module.

VCC: The VCC pin is used to supply the positive (+) voltage to the module. Power supply 3.4V to 4.4V with min 2 Amp required to work the module finely. Remember, never connect it to a 5V power supply, which can destroy your module. Also, It doesn't work on a 3.3 V power supply.

RST: This pin is a hard reset pin. Pulling this pin low for 100 ms to perform hard reset of the module.

RXD(Receiver): RX pin is used for Serial communication

TXD(Transmitter): TX pin is used for Serial communication

GND: This is the Ground Pin of the module that needs to be connected to the GND pin on the microcontroller.

SPK±: SPK + and SPK – is a differential speaker interface. The two pins of a speaker can be connected to these two pins. The positive pin of the speaker is connected to the SPK+ pin and the negative Pin to the SPK-.

MIC±: MIC+ and MIC- pins are differential microphone inputs. The two pins of the microphone can be connected to these pins. The positive pin of the microphone is connected to the MIC+ pin and the negative Pin to the MIC-.

DTR: Pulling this pin HIGH to activate sleep mode. In sleep mode, the module disables serial communication. Pulling it LOW to deactivate sleep mode, means the module wakes up.

RING: The RING pin acts as a Ring Indicator, which is used in detecting calls and SMS. Basically, this is the 'interrupt' out pin from the module. It is by-default high, but when a call is received it gives a LOW pulse for 120ms. Also, it can be configured to pulse when an SMS is received.

5.9 RELAY

A Relay is an electromechanical device that can be used to make or break an electrical connection. It consists of a flexible moving mechanical part which can be controlled electronically through an electromagnet, basically, a relay is just like a mechanical switch but you can control it with an electronic signal instead of manually turning it on or off. Again this working principle of relay fits only for the electromechanical relay.

There are many types of relay and each relay has its own application, a standard, and generally used relay is made up of electromagnets which in general used as a switch. Dictionary says that relay means the act of passing something from one thing to another, the same meaning can be applied to this device because the signal received from one side of the device controls the switching operation on the other side. So relay is a switch which controls (open and close) circuits electromechanically. The main operation of this device is to make or break contact with the help of a signal without any human involvement in order to switch it ON or OFF. It is mainly used to control a high powered circuit using a low power signal. Generally, a DC signal is used to control the circuit which is driven by high voltage like controlling AC home appliances with DC signals from microcontrollers.

Construction of Relay and its operation:

The following figure shows how a Relay looks internally and how it can be constructed,

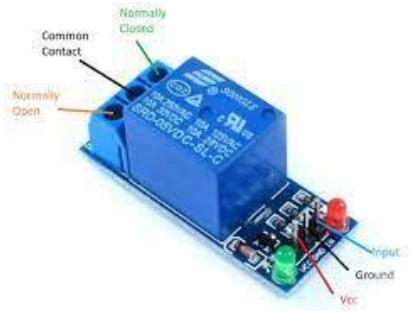

FIG 5.9 Electromagnetic Relay

On a casing, a core with copper windings (forms a coil) winded on it is placed. A movable armature consists of a spring support or stand like structure connected to one end, and a metal contact connected to another side, all these arrangements are placed over the core such that, when the coil is energized, it attracts the armature. The movable armature is generally considered as a common terminal which is to be connected to the external circuitry.

The relay also has two pins namely normally closed and normally opened (NC and NO), the normally closed pin is connected to the armature or the common terminal whereas the normally opened pin is left free (when the coil is not energized). When the coil is energized the armature moves and is get connected to the normally opened contact till there exists flow of current through the coil. When it is de-energized it goes to its initial position.

5.10 MQ-2GAS SENSOR

MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.

FIG 5.10 MQ-2 Gas Sensor

MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas. MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.

5.10.1 Working Principle

This sensor contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless steel mesh. Sensing element has six connecting legs attached to it. Two leads are responsible for heating the sensing element, the other four are used for output signals.

Oxygen gets adsorbed on the surface of sensing material when it is heated in air at high temperature. Then donor electrons present in tin oxide are attracted towards this oxygen, thus preventing the current flow.

When reducing gases are present, these oxygen atoms react with the reducing gases thereby decreasing the surface density of the adsorbed oxygen. Now current can flow through the sensor, which generated analog voltage values.

These voltage values are measured to know the concentration of gas. Voltage values are higher when the concentration of gas is high.

5.10.2 Applications

- These sensors are used to detect the presence of gases in the air such as methane, butane, LPG and smoke but they are unable to distinguish between gases. Thus, they cannot tell which gas it is.
- Module version of this sensor can be used without interfacing to any microcontroller and is useful when detecting only one particular gas. This can only detect the gas. But if ppm has to be calculated then the sensor should be used without module.
- This sensor is also used for Air quality monitoring, Gas leak alarm and for maintaining environmental standards in hospitals. In industries, these are used to detect the leakage of harmful gases.

CHAPTER VI

SOFTWARE DESCRIPTION

ARDUINO SOFTWARE

The Uno is programmed using the Arduino Software, our Integrated Development Environment (IDE) common to all our boards. Before you can move on, you must have installed the Arduino Software (IDE) on your PC, as explained in the home page of our receiving Started.

The USB link with the PC is required to program the board and not just to power it up. The Uno automatically sketch power from either the USB or an external power supply. Attach the board to your computer using the USB cable. The green power LED should go on.

Fig 6.1.1 Arduino IDE

6.1 INSTALL THE BOARD DRIVERS

- Windows beginning XP up to 10 will install drivers by design as soon as you connect your board. If you downloaded and delayed the Zip package or for some reason, the board was not properly acknowledged, please follow the system below.
- Get on the Start Menu, and open -Control Panel.
- While in the Control Panel, find the way to System and Security. Next, click on System. Previously the System window is up, open the Device Manager.
- Look under Ports (COM & LPT). You should notice an open port named “Arduino UNO (COMxx)”. If there is no COM & LPT part, look below “Other Devices” for “Unknown Device”.
- Next- “Browse my computer for Driver software” option.
- Windows will end up the driver installation from there.

6.2 OPEN YOUR FIRST SKETCH

Open the LED blink sketch: File > Examples >01.Basics > Blink

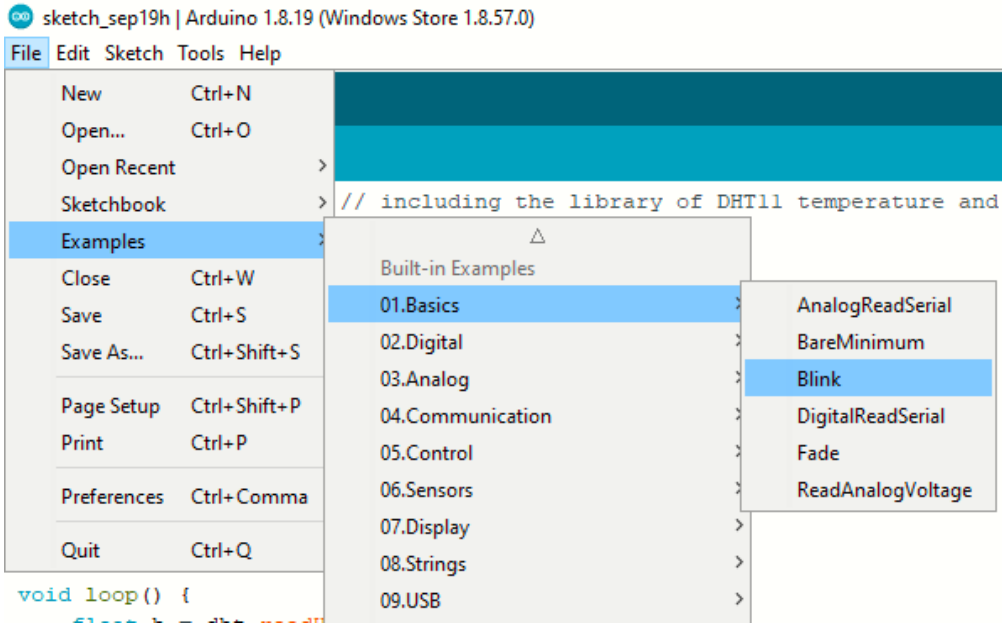

Fig 6.2.1 Open your first sketch

6.3 CHOOSE YOUR BOARD TYPE AND PORT

To choose the entry in the Tools > Board menu that corresponds to your Arduino. Choose the serial device of the board from the Tools serial port menu.This is possible to be COM3 or higher (COM1 and COM2 -usually reserved for hardware serial ports).

To detect, you can disconnect your board and re-open the menu the entry that disappears should be the Arduino. Reconnect the board and choose that serial port.

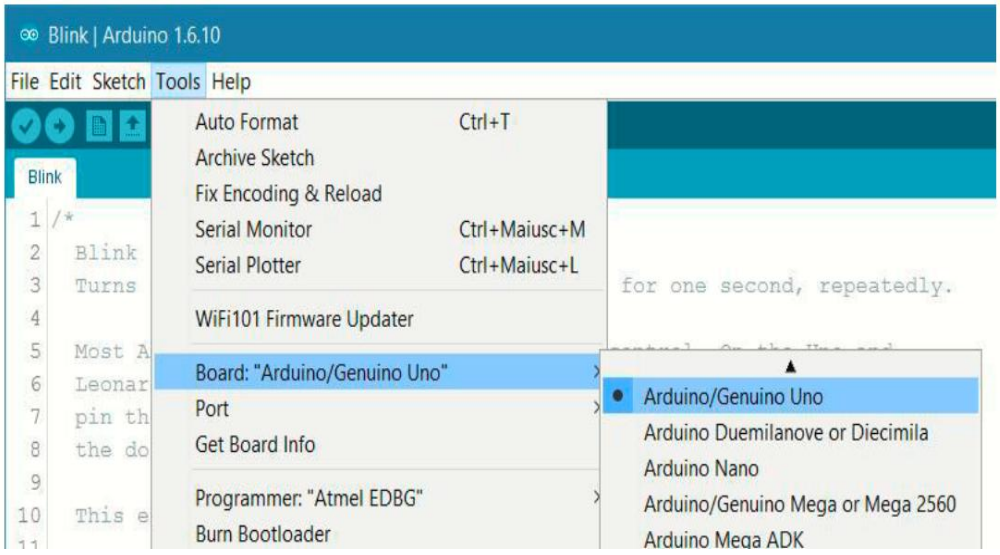

Fig 6.3.1 Choose your board type

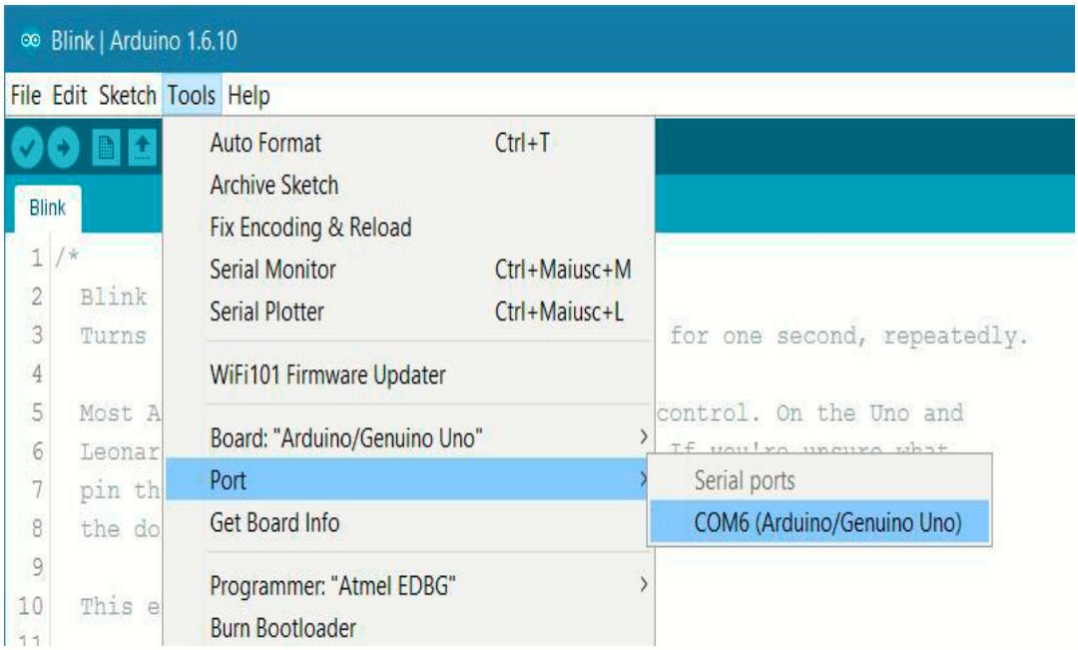

Fig 6.3.2 Choose your board port

6.4 UPLOAD THE PROGRAM

- Now, simply click the "Upload" pin in the environment. Stay a few seconds – you should see the RX and TX leds on the board flashing. If the upload is thriving, the message "Done uploading." Will show in the status bar.
- A number of seconds after the upload finishes, you should see the pin 13 (L) LED on the board start to blink (in orange). If it does, congratulations! You've gotten Arduino up-and-running.

1. Select the board which you are using to program by going Tools > Board (In my case UNO).

2. Open the Arduino ISP code which ca be found by going to File > Examples > Arduino ISP.

3. Upload the sketch.

4. After Uploading the sketch, again go to Tools > Board and now select the board which is to be programmed.

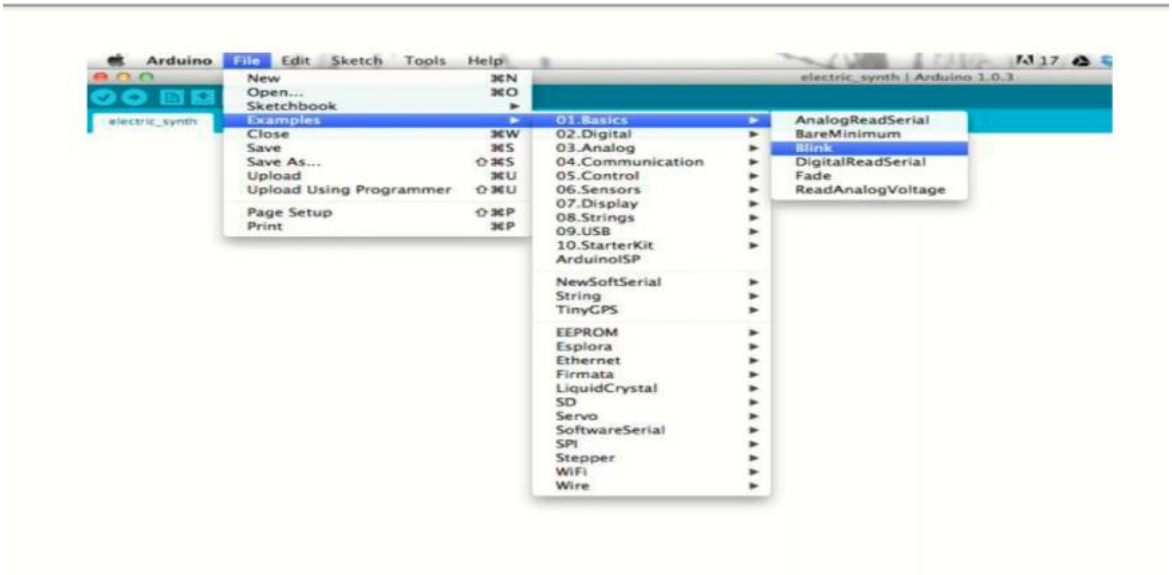

Fig 6.4.1 Upload the program

Choose the type of Arduino board you're using: Tools > Board > your board type.

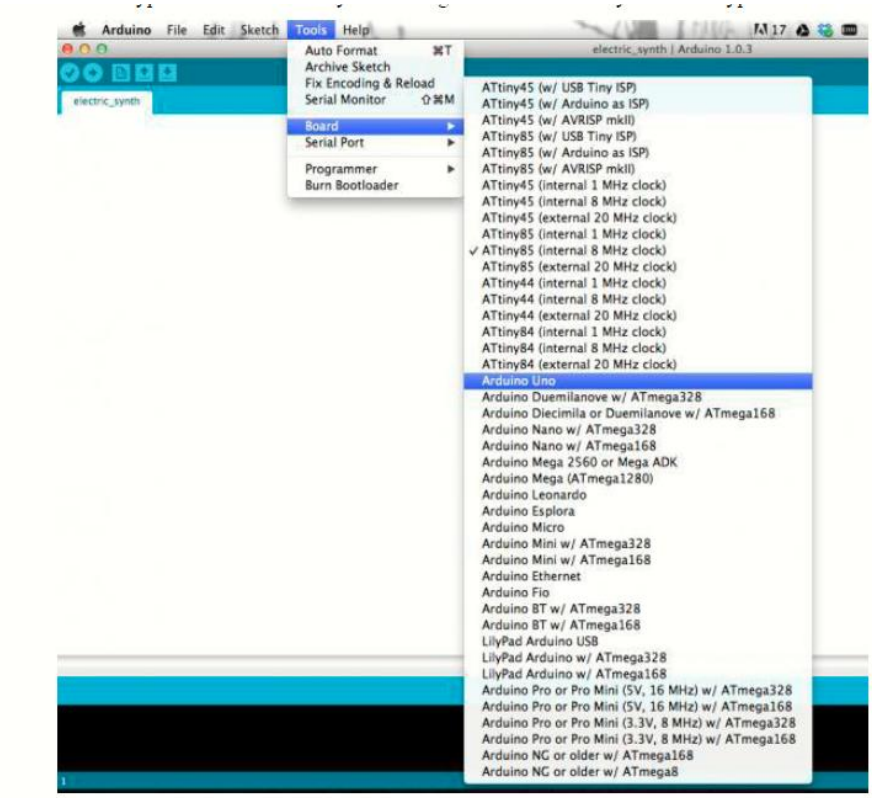

Fig 6.4.2 Board selection

choose the serial port that your Arduino is attached to: Tools > Port > xxx.

INSTALLATION OF CODE TO ARDUINO UNO

1. Connect your Arduino using the USB cable.
2. Choose Tools→ Board→ Arduino Uno to find your board in the Arduino menu.
3. Choose the correct serial port for your board.
4. Click the Upload button.

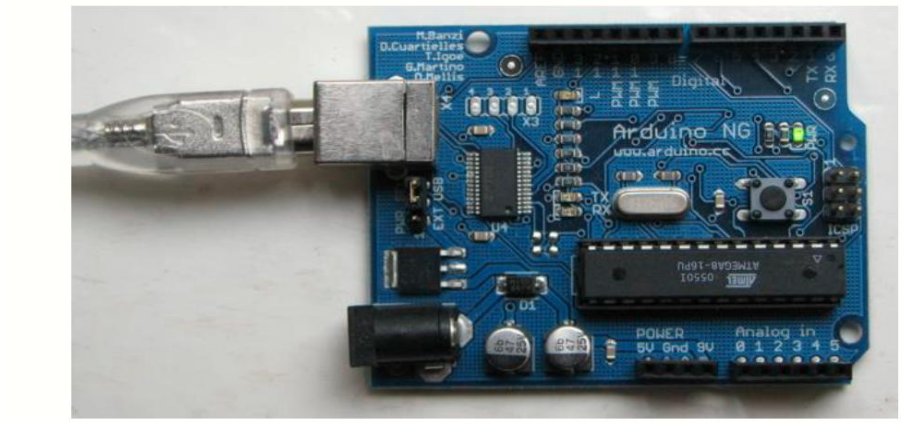

Fig 6.4.3 Upload the program to Arduino

6.5 SOURCE CODE

```
#include <Servo.h>            //include servo.h library
#include <SoftwareSerial.h> //include SoftwareSerial.h library

Servo myservo;

int pos = 0;

boolean fire = false;

const String PHONE = "+918610261273"; //use your number with country code

#define rxPin 2

#define txPin 3

SoftwareSerial sim800L(rxPin,txPin);

#define Left 4          // left sensor

#define Right 5         // right sensor

#define Forward 6       //front sensor
```

```
#define GAS_SENSOR 7    //Gas sensor
#define LM1 8          // left motor
#define LM2 9          // left motor
#define RM1 10          // right motor
#define RM2 11          // right motor
#define pump 12         //water pumb
void setup ()
{
  Serial.begin(115200);
  sim800L.begin(9600);
  sim800L.println("AT");
  delay (1000);
  sim800L.println("AT+CMGF=1");
  delay (1000);
  pinMode(Left, INPUT);
  pinMode(Right, INPUT);
  pinMode(Forward, INPUT);
  pinMode(GAS_SENSOR, INPUT);
  pinMode(LM1, OUTPUT);
  pinMode(LM2, OUTPUT);
  pinMode(RM1, OUTPUT);
  pinMode(RM2, OUTPUT);
  PinMode (pump, OUTPUT);
  myservo.attach(13);
```

```
  myservo.write(90);
   while (sim800L.available()) {
  Serial.println(sim800L.readString());
  }
}
void put_off_fire()
{
   digitalWrite(LM1, HIGH);
   digitalWrite(LM2, HIGH);
   digitalWrite(RM1, HIGH);
   digitalWrite(RM2, HIGH);
   digitalWrite(pump,HIGH);
   delay (500);
   for (pos = 50; pos <= 110; pos += 1) {
   myservo.write(pos);
   delay (10);
  }
  for (pos = 110; pos >= 50; pos -= 1) {
   myservo.write(pos);
   delay (10);
  }
  digitalWrite(pump,LOW);
  myservo.write(90);
  fire=false;
```

```
}
void loop ()
{
 myservo.write(90); //Sweep_Servo();
 if (digitalRead(Left) ==1 && digitalRead(Right)==1 && digitalRead(Forward) ==1)
   {
   delay (500);
   digitalWrite(LM1, HIGH);
   digitalWrite(LM2, HIGH);
   digitalWrite(RM1, HIGH);
   digitalWrite(RM2, HIGH);
   }
   else if (digitalRead(Forward) ==0)
   {
   digitalWrite(LM1, HIGH);
   digitalWrite(LM2, LOW);
   digitalWrite(RM1, HIGH);
   digitalWrite(RM2, LOW);
   fire = true;
   }
   else if (digitalRead(Left) ==0)
   {
   digitalWrite(LM1, HIGH);
   digitalWrite(LM2, LOW);
```

```
digitalWrite(RM1, HIGH);
digitalWrite(RM2, HIGH);
}
else if (digitalRead(Right) ==0)
{
digitalWrite(LM1, HIGH);
digitalWrite(LM2, HIGH);
digitalWrite(RM1, HIGH);
digitalWrite(RM2, LOW);
}
delay (400) ;//change this value to change the distance
 if(digitalRead(GAS_SENSOR) == 0)
{
 Serial.println("Gas is Detected.");
  send_sms();
}
 while (fire == true)
 {
  put_off_fire();
  Serial.println("Fire Detected.");
  make_call();
 }
}
 void make_call()
```

```
{
    Serial.println("calling....");
    sim800L.println("ATD"+PHONE+";");
    delay (20000); //20 sec delay
    sim800L.println("ATH");
    delay (1000); //1 sec delay
}
void send_sms()
{
    Serial.println("sending SMS....");
    delay (50);
    sim800L.print("AT+CMGF=1\r");
    delay (1000);
    sim800L.print("AT+CMGS=\""+PHONE+"\"\r");
    delay (1000);
    sim800L.print("Gas Detected");
    delay (100);
    sim800L.write(0x1A);
    delay (5000);
}
```

CHAPTER VII

RESULT AND DISCUSSION

In this chapter, deals with results and discussions related to the developed application. In section 7.1 the project results of the thesis are screened out by charts.

7.1 RESULTS IN SCREENSHOTS

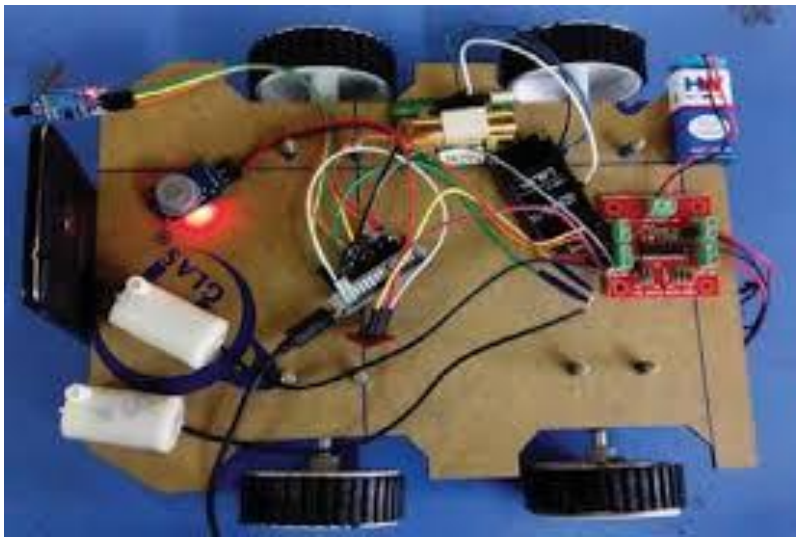

Fig 7.1 Screenshot of assembling

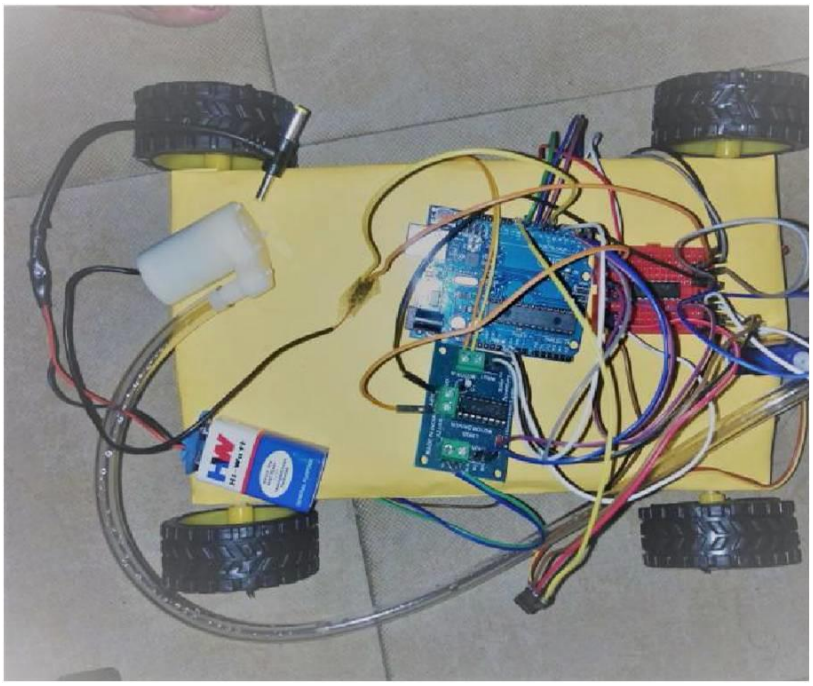

Fig 7.2 Screenshot of assembling

HARDWARE RESULT

The Flame sensors are working towards the fire. It passes light on the fire. If fire occurs the sensor gets high and send signal to Arduino. According to the data transmitted by the sensor, Arduino controls the L293D motor driver. Accurately it works without any un-stability.

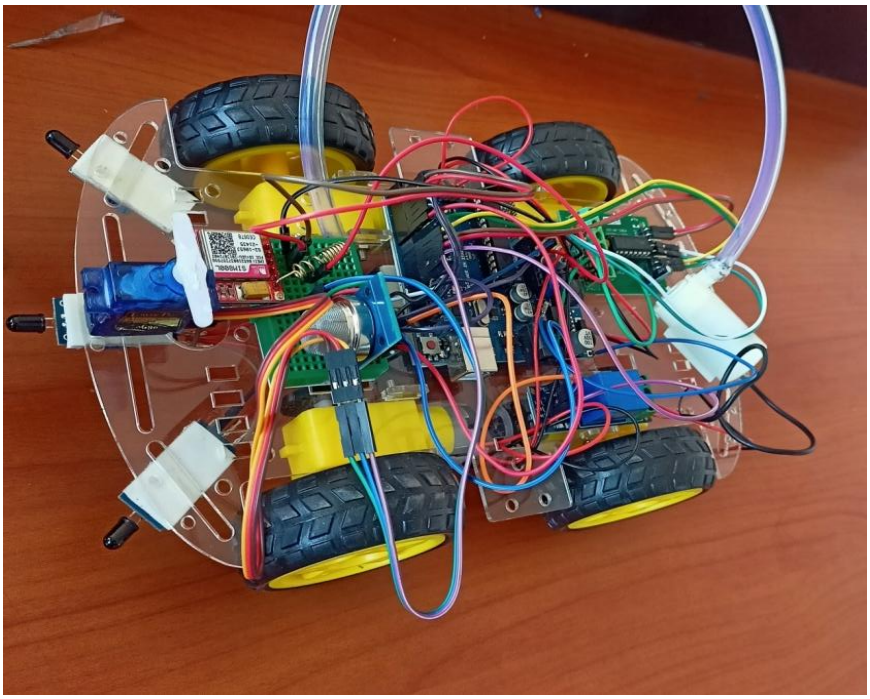

Fig 7.3 Screenshot of assembling

CHAPTER VIII

CONCLUSION AND FUTURE SCOPE

8.1 CONCLUSION

This model of Fire Extinguishing Robot aids to share out the burden of fire fighters in firefighting task. Our project aims to build a real time firefighting robot which moves in a constant speed, identify the fire and then extinguish it with the help of pumping mechanism. The detection and extinguishing were done with the help basic hardware components attached with the robot. Firstly, IR Flame sensors are used for the detection of fire. Secondly, BO Motors and Rubber wheels are used to navigate the robot to reach the fireplace. Finally, the robot extinguishes the fire with the help of submersible water pump and servo motors. The development of an autonomous firefighting system with an SMS alert feature has been developed and implemented. This study has therefore provided a solution to the problem of a sudden fire outbreak by developing an extinguishing robot for a fire outbreak. The sensors used in this design can sense both gas leakages and fire with high sensitivity. In the case of a fire outbreak, the system is designed to work for three hours provided the lithium-ion battery is fully charged.

ADVANTAGES

- ✓ Fire Fighting robots can fully play their role in various dangerous and complex environments.
- ✓ Detect the exact direction of the fire source.
- ✓ Capability of sensing accurately with increased flexibility. Reduce human effort.
- ✓ Reliable and economical.

DISADVANTAGES

- No monitoring system for the vehicle.
- No remote control for the robotic movement.
- Our system used only for less than 3.5Kg application.
- It is not used to put out large fires.

8.2 FUTURE SCOPE

An advanced autonomous fire extinguishing system can combat fire accidents and minimize damage to both human lives and property without exposing fire fighters to additional risks. The proposed robot can autonomously detect and extinguish fire before it spreads.

8.3APPLICATIONS

This can be extended with more ideas as:

- Deploying technologies like the Internet of Things (IoT), mobile data and cloud computing.
- It must be able to autonomously navigate through a modelled floor plan while actively scanning for a flame.
- By replace the Flame sensor with Camera and Arduino with Raspberry pi to make this project more advanced.
- In future we can incorporate lot of image processing techniques to efficient restoration of corrupted images of fire with high accuracy and advanced level.

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