CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Fire-controlling and the rescue of the victims is a risky task. Fire-controllers must face dangerous situations while extinguishing fire. Fire-controllers extinguish fires in large buildings, drag heavy hoses, climb high ladders, carry victims from one building to the next. In addition to long and irregular working hours, fire controllers also face an unfriendly environment such as high temperature, dust and low moisture. Moreover, they must also face life - threatening situations such as explosion and collapse.

According to IAFF 's 2000 report, 1,9 fire-controllers per 100,000 structure fires lost their lives per year in the United States. This rate, however, increased to 3 per 100,000 structure fires. Different causes of Line of Duty Deaths (LODD) include smoke inhalation, burning, injuries and related trauma. Statistics show that fire-quenchers die every year. This results in the need for fire breathing machines to help fire controllers avoid deaths by handling dangerous situations. So, if a robot is used instead, which can perform intelligent actions on its own, which will reduce the risk of this fire-controlling task. Robot is a mechanical device used to perform tasks that include high risk of fire-quenching.

A fire-breathing robot will reduce the need for fire controllers. The robot will further reduce the load of fire-controllers. It is impossible to extinguish fire and rescue many victims at a time of enormous catastrophe. In such cases, robot technology can be used very efficiently to rescue many more victims. Thus, robotics makes human life easier and safe, and save time. Rapid technology development improves fire-controlling tools and equipment. These advanced tools and so if a robot is used instead, which can be controlled from a distance or which can perform actions intelligently by itself, thereby reducing the risk of this fire-controlling task.

1.2 PROJECT OBJECTIVES

I. To study a robot that can detect and extinct burnt area and develop a program using Arduino.

II. To design the robot that includes the fire sensor, the obstacle sensor detects any obstacles in the robot path.

III. To analyse how the robot's performance detects the burnt area angle in front of the robot and detects burnt area in radius 0 cm~ 20 cm.

1.3 PROBLEM STATEMENT

Home, laboratory, office, factory and building safety is important for human life. We develop a fire protection robot security system with a sensor. The security system can detect and advise us of an abnormal and dangerous situation. First, we design a fire protection robot with an intelligent building extinguisher. Humans also had problems detecting the small burnt cause of electrical appliances. The late user takes the fire to extinguish. Users may take a while to extinguish fire like finding the source of water to extinguish fire when they want to extinguish fire. Fire difficulties detecting the small burnt area and location that the user is difficult to reach. Sometimes hard fire, for example, spaces are hard to see. The cost of the fire loss is slow to act.

1.4 EXPECTED RESULTS

The goals of this project are listed below:

- It needs to run automatically.
- Flames (match stick lights) must be tracked and found in the robot path and extinguished without direct contact.
- The entire project must not exceed a budget.

CHAPTER 2

LITERATURE REVIEW

A comprehensive study of up - to - date relevant literature and background material was the first step in this project. This was necessary to deepen our understanding of the subject and highlight any new or useful facts. For the purposes of this project, reports were read and consulted on fireBreathing robots. Few important ones are noted below from the extensive literature survey mentioned in the project report.

I. H. P.Singh, Akanshu Mahajan, N. Sukavanam, Veena Budhraja, Swarn Singh, Amit Kumar and Anadi Vashisht, "Control Of An Autonomous Industrial Fire Fighting Mobile Robot" , DU Journal of Undergraduate Research and Innovation.(Nov-2015)

This paper describes the construction and design of a firefighting mobile robot (FFMR). The system controls two optically isolated D.C. geared motors. The robot performs analogy to digital conversion on 5 infrared sensors: two to control the motion of robot and three for candle detection. The extinguishing system is comprised of a D.C. water pump and a water container. The experimental results are included to illustrate the detailed operational mode of the FFMR. This paper gives a detailed mechanism about the real time industrial fir fighting mobile robot that can move through a model structure, find a candle and then extinguish it with the help of pumping mechanism. The movement of the robot is controlled by the sensors which are fixed on the mobile platform. Experimental results are carried out for a four-wheel mobile robot to illustrate the proposed methodology. The results show that the proposed robot model is successfully implemented.

II. Swati A. Deshmukh, Karishma A. Matte and Rashmi A. Pandhare, "Wireless Fire Fighting Robot", International Journal for Research in Emerging Science and Technology, Volume-2, Special Issue-1, March-2015.

Wireless firefighting robot is developed by Swati Deshmukh et al. It comprises of machine which has ability to detect fire and extinguish it. The firefighting robot can move in both forward and reverse direction and can turned in left and right directions. Thus, fire fighter can operate the robot over a long distance and there is no need for human near the area on fire. Light dependent resistors are used for detection of fire. These resistors are highly sensitive devices and are capable of detecting very small fire. The robot provides security at home, buildings, factory and laboratory.

III. Manish Kumbhare, S.S.Kumbhalkar, Ratnesh Malik. "Fire Fighting Robot:An Approach" Vol.2,Issue.II,March 12,pp.1-4 ,Indian Streams Research Journal.(Jan2014)

This paper covers the design and construction of a robot that is able to extinguish a fire. This robot is fully autonomous and implements the following concepts: environmental sensing and awareness, proportional motor control. This robot processes information from its various sensors and key hardware elements via SMCL microcontroller. It uses Ultraviolet, Infrared and visible light to detect various components of its environment. A robot capable of fighting a simulated tunnel fire, industry fire and military applications are designed and built.

IV. Sahil S.Shah, Vaibhav K.Shah, Prithvish Mamtora And Mohit Hapani, "Fire Fighting Robot", International Journal Of Emerging Trends & Technology In Computer Science (IJETTCS), Volume 2, Issue 4, July – August 2013.

This paper has presented a unique vision of the concepts which are used in this particular field. It aims to promote technology innovation to achieve a reliable and efficient outcome from the various instruments. Experimental work has been carried out carefully. The result shows that higher efficiency is indeed achieved using the embedded system. With a common digitalized platform, these latest instruments will enable increased flexibility in control, operation, and expansion; allow for embedded intelligence, essentially foster the resilience of the instruments; and eventually benefit the customers with improved services, reliability and increased convenience. The day is not far when this technology will push its way into your house hold, making you lazier. This paper presents the major features and functions of the various concepts that could be used in this field in detail through various categories. Since this initial work cannot address everything within the proposed framework and vision, more research and development efforts are needed to fully implement the proposed framework through a joint effort of various entities.

CHAPTER 3

INTRODUCTION TO ROBOTICS AND EMBEDDED SYSTEMS

3.1 ROBOTICS BACKGROUND

Relax, enjoy arts and music and play sports; that could be our life in the coming decades with tremendous progress in robotics. According to the latest edition of world robotics, the world population of robots is currently over 8,6 million. And those 8,6 million do remarkable jobs to make people's lives easier and happier. Robots are a must in every industrial field in the world today. Can you imagine that the mysterious Titanic crash could never have been solved without robots?

3.2 WHAT IS A ROBOT

There is no a particular definition on what exactly is a robot, but according to an industrial robotics group called the Robot Institute of America: " A robot is a re programmable, multi-functional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks " this definition is one of the most definitions used nowadays but unfortunately it could be only applied on Robots that perform manufacturing tasks. So, if we look at another definition, we might find Webster's definition that robot could be considered as any mechanical anthropomorphic being built to perform routine manual work for human beings or any mechanical device operated automatically, in particular by remote control, in an apparently human manner. We might also say that a robot is a programmable machine which imitates the actions or appearance of an intelligent creature-usually human. There are two types of robots; the remote-controlled robot is a robot that receives instructions from a human operator and the other is the autonomous robot that does not interfere with humans.

3.3 ORIGIN OF ROBOTS

The word " Robot " was first used by a Czech dramaturge named Karek Capek in his play Rossum's Universal Robots in the 1920s, where he used the word Robot to be the name of the artificial workers he had in his play. And that name came from a Czech word robot. The word ' robotics' was first used in Run-around, a short story published by Isaac Asimov in 1942. Robotics refers to the study and use of robots. Isaac also proposed robotics laws:

- Law One: A robot may not harm a human being or allow a human being to harm by inaction unless it violates a higher order law.
- Law Two: A robot must obey orders given by human beings, unless such orders conflict with a higher law.
- Law Three: A robot must protect its own existence without conflicting with higher order laws.

The first robot was a soldier in 1910 with automatic bellows blowing a trampette, see Figure 2.1. It was made by Fredrich Kaufman of Dresden, Germany and is now present in the Museum of Munich. Later, a robot was built in the United States in 1927 and it was a humanoid named Televox that operated via the telephone system. And robotics took the interest of scientists and engineers from that day and they began to think about how to make robots and what they could do. In the late 1950s, Joe Engel Berger and George Devol discussed the concept of robotics proposed by Isaac and the first industrial modern robot was released by Engel Berger 's universal automation manufacturing company in the name of ' Unimate.' And now Engel Berger was considered the father of robotics. While the Unimate (the first working robot) was installed with heated die-casting machines in a General Motors plant. The first artificial robotic arm was designed as a tool for people with disabilities in 1963 and had six joints that gave them the flexibility of a real weapon while being controlled by a computer. In addition, the population of robots increased gradually until it reached 8,7 million in 2009. And in the years to come this number will increase sharper as the earth is ready to be controlled by robots.

3.4 EMBEDDED SYSTEM

An embedded system is a special computer system designed to perform one or more dedicated functions, sometimes with computing constraints in real time. It is usually embedded in a complete device with hardware and mechanical parts. In contrast, a general computer, like a personal computer, can perform many different tasks depending on the programming. Embedded systems have become very important now that they control many of our common devices.

As the embedded system is dedicated to specific tasks, design engineers can optimize it, reduce product size and cost or increase reliability and performance. Some embedded systems are mass - produced and benefit from economies of scale.

Integrated systems range from portable devices such as digital watches and MP3 players to large stationary installations such as traffic lights, factory controllers or nuclear power plant control systems. Complexity varies from low to very high with multiple units, peripherals and networks installed in a large chassis or enclosure.

In general, the term ' embedded system ' is not exactly defined, since many systems have some programming element. For example, handheld computers share certain elements with embedded systems-such as operating systems and microprocessors that power them-but are not really embedded systems because they allow loading and connection of different applications.

An embedded system is a combination of computer hardware and software, whether fixed or programmable, specifically designed for a specific type of application device. Industrial machines, cars, medical equipment, cameras, household appliances, airplanes, sales machines and toys (as well as more obvious cell phones and PDAs) are among the many possible hosts of an embedded system. Embedded programable systems have a programming interface and embedded system programming is a specialized occupation.

Some operating systems or language platforms are suitable for embedded markets, such as Embedded Java and Windows XP Embedded. However, some low - end consumer products use very low - cost microprocessors and limited storage, both of which are part of a single program. The program is permanently written into the system memory instead of being loaded into RAM (random access memory) as programs on a personal computer are.

3.5 APPLICATIONS OF EMBEDDED SYSTEM

We live in the embedded world. You are surrounded by many embedded products and your everyday life depends largely on the functioning of these gadgets. TV, radio, CD player in your living room, washing machine or microwave oven in your kitchen, card readers, access controllers, palm devices in your work space allow you to do many of your tasks very effectively. Apart from all these, many controllers embedded in your car take care of car operations between the bumpers and you tend to ignore all these controllers most of the time.

You've been showered with various information on these embedded controllers in many places in recent days. All types of magazines and newspapers regularly disseminate details of the latest technologies, new devices; fast applications that make you believe that these embedded products control your basic survival. You can now agree that these embedded products have successfully entered our world. You have to ask about these embedded controllers or systems. What is the embedded system?

The computer you use to compose your mail, create a document or analyse the database is referred to as the standard desktop computer. These desktop computers are designed for many purposes and applications.

To obtain the required processing facility, you must install the relevant software. These desktop computers can do many things. In contrast, embedded controllers carry out their specific work. Engineers usually design these embedded controllers with a specific goal in mind. These controllers cannot therefore be used elsewhere.

Theoretically, an embedded controller is a combination of microprocessor-based hardware and appropriate software for a specific task.

Designers now have many choices in microprocessors / microcontrollers. In particular, the available variety can overwhelm an experienced designer in 8 bit and 32 bits. Selecting a right microprocessor may prove to be a very difficult first step and it becomes difficult as new devices continue to pop up very often.

3.6 MICROCONTROLLERS FOR EMBEDDED SYSTEM

In embedded systems products, microprocessors and microcontrollers are widely used. An embedded system product uses a microprocessor for one task only. A printer is an example of an embedded system because the processor within it performs only one task: to obtain the data and to print it. Contrast this to a PC based on Pentium. A PC can be used for any number of applications like word processor, print-server, bank account terminal, video game, network server or Internet terminal. Software may be loaded and run for a variety of applications. Of course, a pc can perform many tasks because it has a RAM memory and an operating system that loads the application software into the RAM memory and allows the CPU to run it.

In an embedded system, only one application software is usually burned to ROM. The x86 PC includes or is connected to various embedded products such as keyboard, printer, modem, disk controller, sound card, CD - ROM drives, mouse, etc. Each of these peripherals has within it a microcontroller that performs only one task. For example, a microcontroller is in each mouse to find and send the mouse to the PC.

CHAPTER 4

PROJECT DEVELOPMENT

4.1 BLOCK DIAGRAM

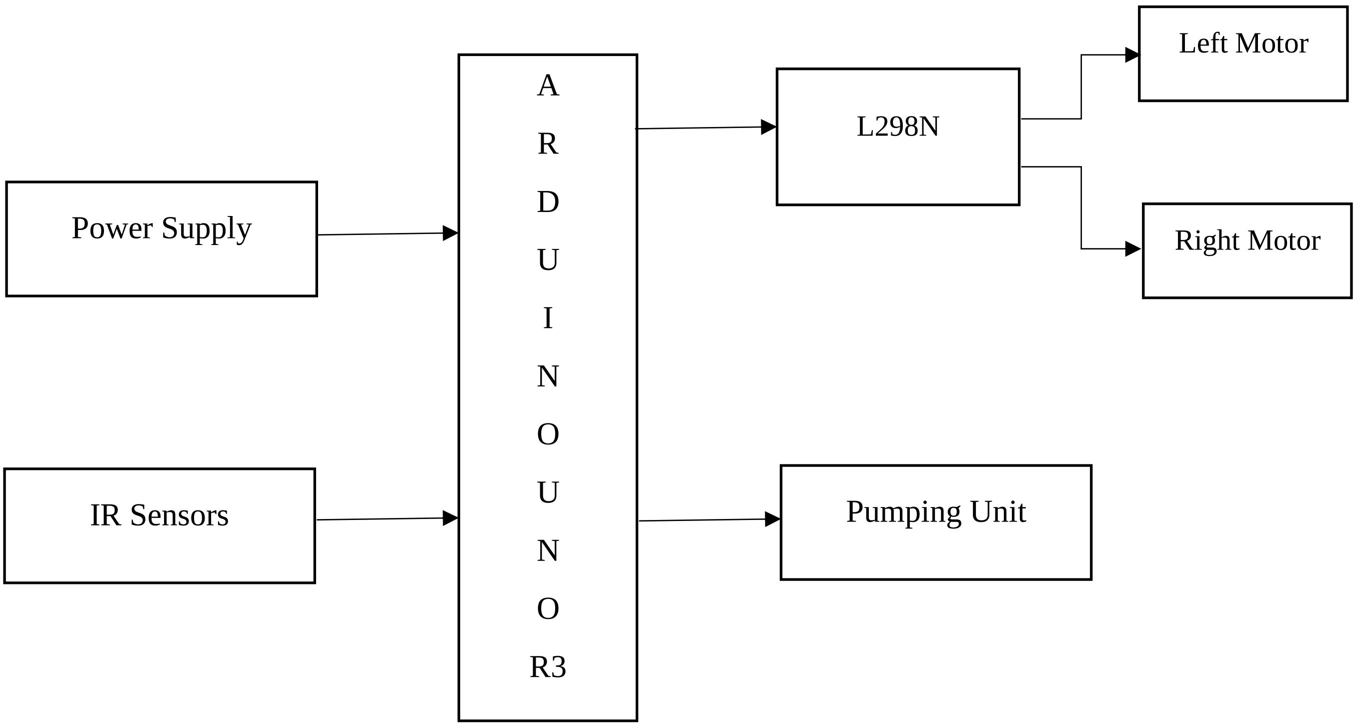


Fig.4.1 Block Diagram

The block diagram and its brief description of the project work are explained in block wise and this block diagram consists the following blocks

1.Arduino Uno R3.

2.L298N Motor Driver.

3. DC Motors.

4. IR Fire Sensor.

5.Pumping Unit.

6.Power Supply.

4.2 MICROCONTROLLER (Arduino Uno R3):

4.2.1 PIN CONFIGURATION

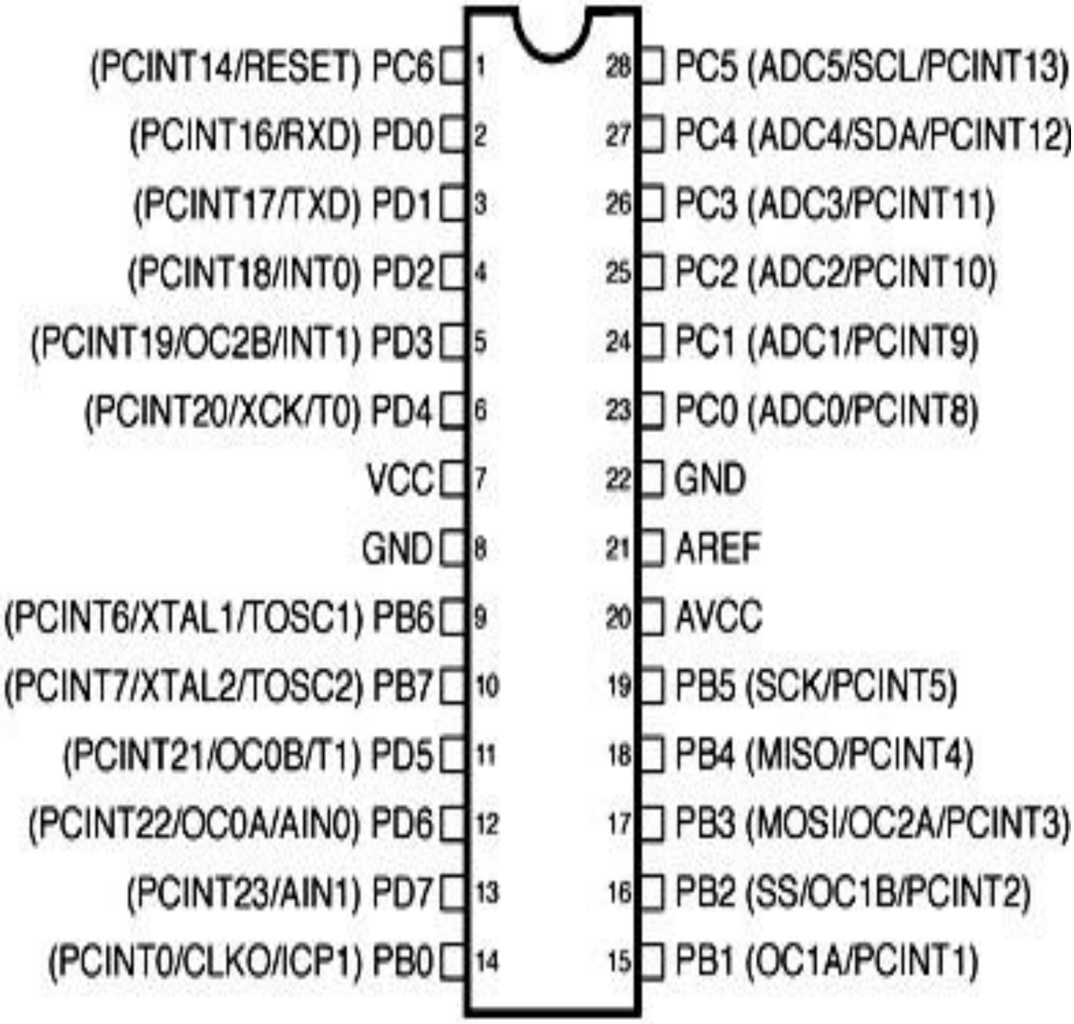


Fig.4.2 Pin Diagram of Arduino Uno R3(ATMEGA 328P)

4.2.2 FEATURES OF ARDUINO R3:

4.2.2.1 ADVACNED RISC ARCHITECTURE

- 131 Powerful Instructions
- Most Single Clock Cycle Execution
- 32 x 8 General Purpose Working Registers
- Fully Static Operation
- Up to 20 MIPS Throughput at 20MHz
- On-chip 2-cycle Multiplier

4.2.2.2 PERIPHERAL FEATURS

- Two 8-bit Timer/Counters with Separate Pre-scaler and Compare Mode
- One 16-bit Timer/Counter with Separate Pre-scaler, Compare Mode, and Capture Mode
- Real Time Counter with Separate Oscillator
- Six PWM Channels
- 8-channel 10-bit ADC in TQFP and QFN/MLF package
  - Temperature Measurement
- 6-channel 10-bit ADC in PDIP Package
  - Temperature Measurement
- Two Master/Slave SPI Serial Interface
- One Programmable Serial USART
- One Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
- Programmable Watchdog Timer with Separate On-chip Oscillator
- One On-chip Analog Comparator
- Interrupt and Wake-up on Pin Change

4.2.2.3 Special Microcontroller Features:

- Power-on Reset and Programmable Brown-out Detection
- Internal Calibrated Oscillator
- External and Internal Interrupt Sources
- Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby

4.2.2.4 I/O and Packages:

- 23 Programmable I/O Lines
- 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF

4.2.2.5 Operating Voltage:

- 1.8 - 5.5V

4.2.2.6 Speed Grade:

- 0 - 4MHz @ 1.8 - 5.5V
- 0 - 10MHz @ 2.7 - 5.5V
- 0 - 20MHz @ 4.5 - 5.5V

4.2.2.7 Power Consumption at 1MHz, 1.8V, 25°C:

- Active Mode: 0.2mA
- Power-down Mode: 0.1µA
- Power-save Mode: 0.75µA (Including 32kHz RTC)

4.2.2.8 Temperature Range:

- -40°C to 105°C

4.2.2.9 Atmel® Q-Touch® Library Support:

- Capacitive Touch Buttons, Sliders and Wheels
- Q-Touch and Q-Matrix® Acquisition
- Up to 64 sense channels

4.2.2.10 Crystal oscillator:

The clock circuit is an important element that is required in the system board. This is because the microcontroller works digitally based on generated clock. The rate of the clock is determined by a crystal oscillator that is connected to the clock logic pins. A high-speed crystal of 12 MHz is used in this project in order to avoid any delay in terms of relay tripping ON and OFF, and monitoring of the transformer parameters through the ADC of the microcontroller. Because the monitoring of transformer parameters and tripping off the relay has to be very fast to avoid failure of the entire protection system. Crystal is inscribed into the microcontroller, with two 33 pF capacitors used to filter out external noise.

4.2.11 Pin Description of Arduino Uno R3:

Table 4.1 Pin Description of Arduino Uno R3

Pin Number	Description	Function
1	PC6	Reset
2	PD0	Digital Pin (RX)
3	PD1	Digital Pin (TX)
4	PD2	Digital Pin
5	PD3	Digital Pin (PWM)
6	PD4	Digital Pin
7	Vcc	Positive Voltage (Power)
8	GND	Ground
9	XTAL 1	Crystal Oscillator
10	XTAL 2	Crystal Oscillator
11	PD5	Digital Pin (PWM)
12	PD6	Digital Pin (PWM)
13	PD7	Digital Pin
14	PB0	Digital Pin
15	PB1	Digital Pin (PWM)
16	PB2	Digital Pin (PWM)
17	PB3	Digital Pin (PWM)
18	PB4	Digital Pin
19	PB5	Digital Pin
20	AVCC	Positive voltage for ADC (power)
21	AREF	Reference Voltage
22	GND	Ground
23	PC0	Analog Input
24	PC1	Analog Input
25	PC2	Analog Input
26	PC3	Analog Input
27	PC4	Analog Input
28	PC5	Analog Input

4.3 Motor Driver (L298N):

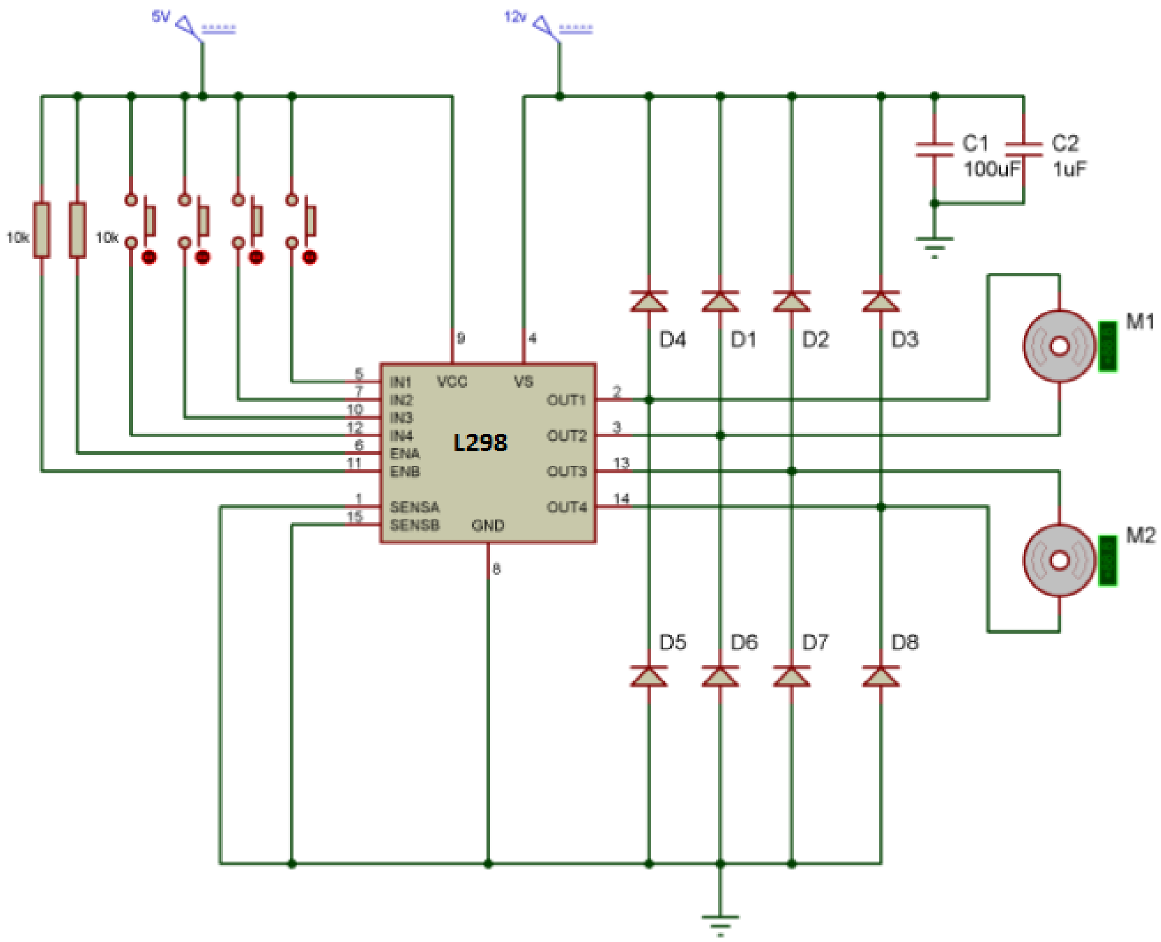


Fig 4.3 Motor Driver Circuit

L298N Motor Driver Dual H-Bridge. The L298N Motor Driver Module is a high voltage Dual H-Bridge manufactured by ST Company. H-bridge drivers are used to drive inductive loads that requires forward and reverse function with speed control such as DC Motors, and Stepper Motors An internal sensor senses its internal temperature and stops driving the motor the motor if the temperature crosses a set point which implies that the over temperature protection also built into the IC. A diode is used to protect the driver IC from the voltage spikes that occur when the motor is turned on and/or off.

4.3.1 Pin Configuration Diagram:

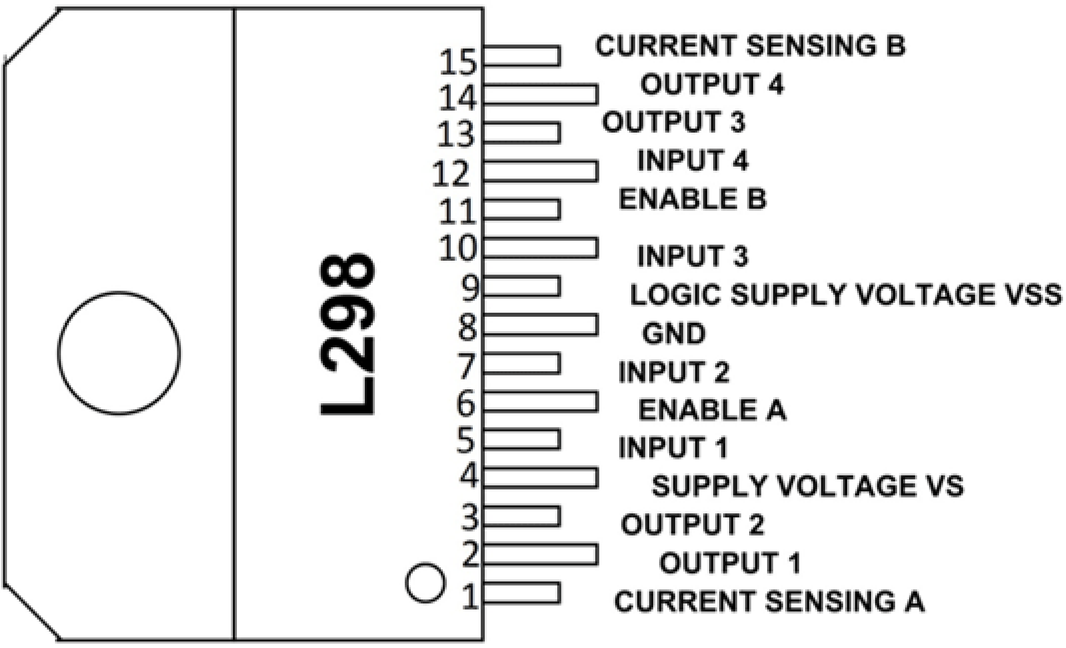


Fig 4.4 IC input output pin configuration

4.4 DC MOTORS

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

Fig 4.5 Dc Motor

We had used 30 Rpm motor for this project. This gives high torque for this motor.30 RPM Side Shaft 37mm Diameter Compact DC Gear Motor is suitable for small robots / automation systems. It has sturdy construction with gearbox built to handle stall torque produced by the motor. Drive shaft is supported from both sides with metal bushes. Motor runs smoothly from 4V to 12V and gives 30 RPM at 12V. Motor has 6mm diameter, 22mm length drive shaft with D shape for excellent coupling. We had used brushed DC motor. The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary magnets (permanent or electromagnets), and rotating electrical magnets. Advantages of a brushed DC motor include low initial cost, high reliability, and simple control of motor speed. Disadvantages are high maintenance and low life-span for high intensity uses. Maintenance involves regularly replacing the carbon brushes and springs which carry the electric current, as well as cleaning or replacing the commutator. These components are necessary for transferring electrical power from outside the motor to the spinning wire windings of the rotor inside the motor. Brushes consist of conductors. We used two DC motors to drive the vehicle.

4.4.1 Specifications:

- RPM: 30 at 12V
- Voltage: 4V to 12V
- Shaft diameter: 6mm
- Shaft length: 22mm
- Gear assembly: Spur
- Brush type: Carbon
- Motor weight: 143gms

4.4.2 Robot Movement:

Table 4.2 Robot Movement

Left Motor	Right Motor	Robot Movement
Straight	Straight	Straight
Stop	Straight	Left
Reverse	Straight	Sharp left
Straight	Stop	Right
Straight	Reverse	Sharp Right
Reverse	Reverse	Reverse

4.5 IR FIRE SENSORS

The Fire sensor, as the name suggests, is used as a simple and compact device for protection against fire. The module makes use of IR sensor and comparator to detect fire up to a range of 1 - 2 meters depending on fire density.

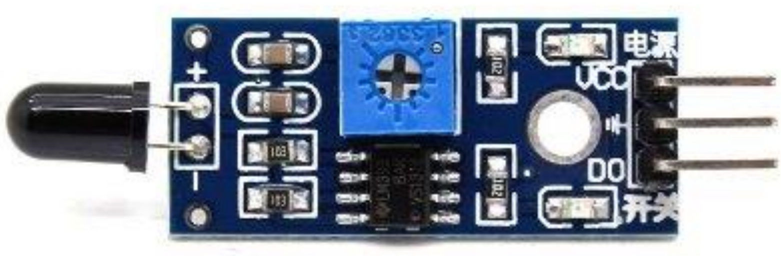


FIG. 4.6 IR SENSOR

4.5.1 Features:

- Wavelength range -760 : nm-1100 nm
- Detection distance-20 cm (4.8V)-100 cm (1V)
- Operating voltage -3.3V :-5V
- Detection angle- 15°
- Dimensions-3x1.5x0.5 cm
- Weight -8g

4.5.2 Application:

- Industrial heating and drying systems.
- Domestic heating systems.
- Industrial gas turbines.

4.5.3 Specification:

- Operating Voltage:+5V
- Range:2m

4.5.4 Pin Details:

Table 4.3 IR sensor Pin configuration

PIN	Name	Details
1	Detected output	Active High Output
2	Vcc	Power supply input
3	Gnd	Power supply ground

4.5.5 Using the Sensor:

- Connect ground and VCC pin to +5V and GND.
- Connect out pin to port pin of controller for interfacing with applications.

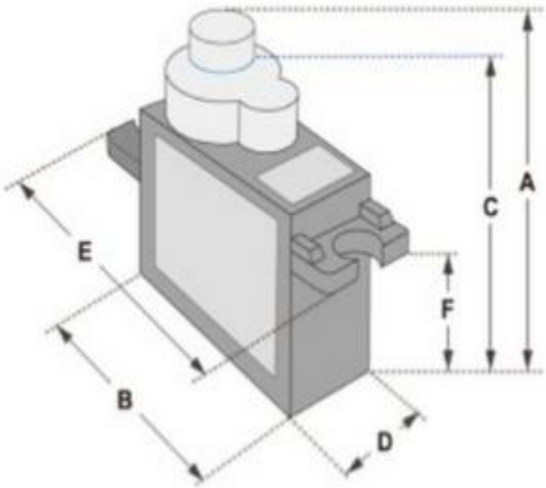
4.5.6 Working:

The fire sensor circuit is too sensitive and can detect a rise in temperature in its vicinity. The fire sensor module consists of IR sensor, comparator and LED. It has got three pins GND, VCC and out. Whenever fire is detected by IR sensor LED glows, and out pin is set high. The out pin can be given as input to the microcontroller and can be used for any fire detection applications. Whenever the LED is ON it indicates that fire is detected. For example, you can connect it to a buzzer via microcontroller and when out pin of fire sensor module is set high the buzzer is ON and the range of the sensor is 50 cms.

4.6 SERVO MOTOR

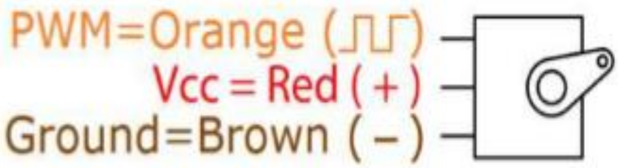
Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware.

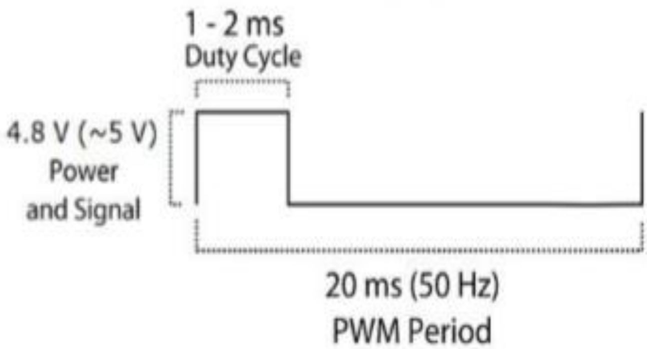
Figure:4.6 Servo Motor



Dimensions & Specifications
A (mm) : 32
B (mm) : 23
C (mm) : 28.5
D (mm) : 12
E (mm) : 32
F (mm) : 19.5
Speed (sec) : 0.1
Torque (kg-cm) : 2.5
Weight (g) : 14.7
Voltage : 4.8 - 6

Position "0" (1.5 ms pulse) is middle, "90" (~2ms pulse) is middle, is all the way to the right, "-90" (~1ms pulse) is all the way to the left.





4.7 WATER PUMP

Micro dc 3-6v micro submersible pump mini water pump for fountain garden mini water circulation system project dc 3v to 6v submersible pump micro mini submersible water pump 3v to 6v dc water pump for dc pump for hobby kit mini submersible pump motor this is a low cost, small size submersible pump motor which can be operated from a 2.5 ~ 6V power supply. It can take up to 120 litres per hour with very low current consumption of 220ma.

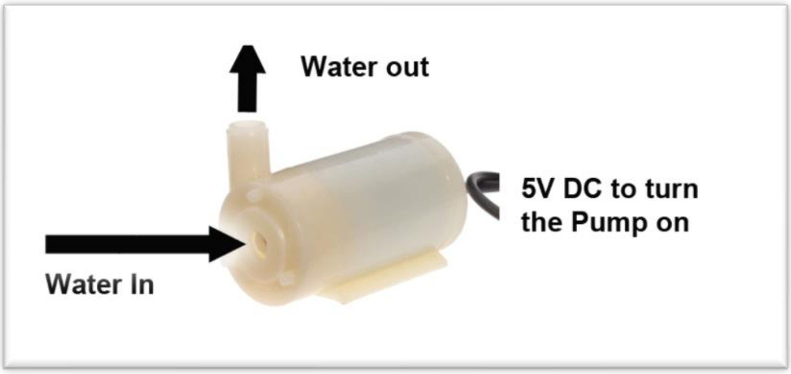


Figure: 4.7 Water Pump

4.7.1 FEATURES

- Voltage: 2.5-6V
- Maximum lift: 40-110cm / 15.75"-43.4"
- Flow rate: 80-120L/H
- Outside diameter: 7.5mm / 0.3"
- Inside diameter: 5mm / 0.2"
- Diameter: Approx. 24mm / 0.95"
- Length: Approx. 45mm / 1.8"
- Height: Approx. 30mm / 1.2"
- Material: Engineering plastic
- Driving mode: DC design, magnetic driving

4.7.2 APPLICATIONS

- Controlled fountain water flow
- Controlled Garden watering systems
- Hydroponic Systems
- Fresh water intake

CHAPTER 5

OPERATING PRINCIPLE

5.1 WORKING PRINCIPLE

The primary mind of this project is the Arduino, yet with the end goal to detect fire we utilize the Fire sensor module. As you can see these sensors have an IR Receiver (Photodiode) which is used to detect the fire. How is this possible When fire burns it emits a small amount of Infra-red light, this light will be received by the IR receiver on the sensor module. Then we use an Op-Amp to check for change in voltage across the IR Receiver, so that if a fire is detected the output pin (DO) will give 0V(LOW) and if the is no fire the output pin will be 5V(HIGH)So, we place three such sensors in three directions of the robot to sense on which direction the fire is present. We detect the direction of the fire we can use the motors to move near the fire by driving our motors through the L298N module. When near a fire we have to put it out using water. Using a small container, we can carry water, a 5V pump is also placed in the container and the whole container is placed on top of a servo motor so that we can control the direction in which the water has to be sprayed.

5.2 WHEEL MOVEMENT

TABLE: 5.2 Wheel Movement

SENSOR	LEFT MOTOR	RIGHT MOTOR	WHEEL MOVEMENT
Forward	Active	Active	Forward
Left	In-Active	Active	Left
Right	Active	In-Active	Right

5.3 DETECTION DISTANCE

Sensitivity and range are related to fire size. The detectable fire size varies according to the inverse square law. If detection distance is doubled, % 25 of the flame lights can reach the detector. Conversely; system needs four times larger area of fire for the same response time. For example, if a standard detector with capable of detecting 1 m2 fire at 10 m distance is located at 20 m distance from fire source; the required minimum fire size will be 4 m2. The flame detection distance according to the inverse square law (Anonymous, 2009) as shown.

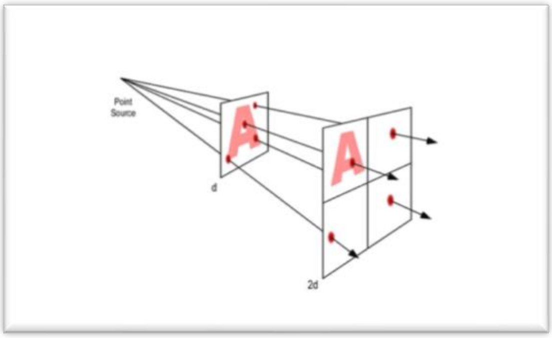


Figure:5.1 Flame detection distance (Inverse square law)

5.4 TORQUE REQUIREMENT CALCULATON

The torque requirement is another important parameter to select the proper motors. Total weight and diameter of the wheels must be known to calculate torque requirement.

The formula of the torque requirement is; T = [Mm x g x (sin a + fr) x d] / 2

Where: T

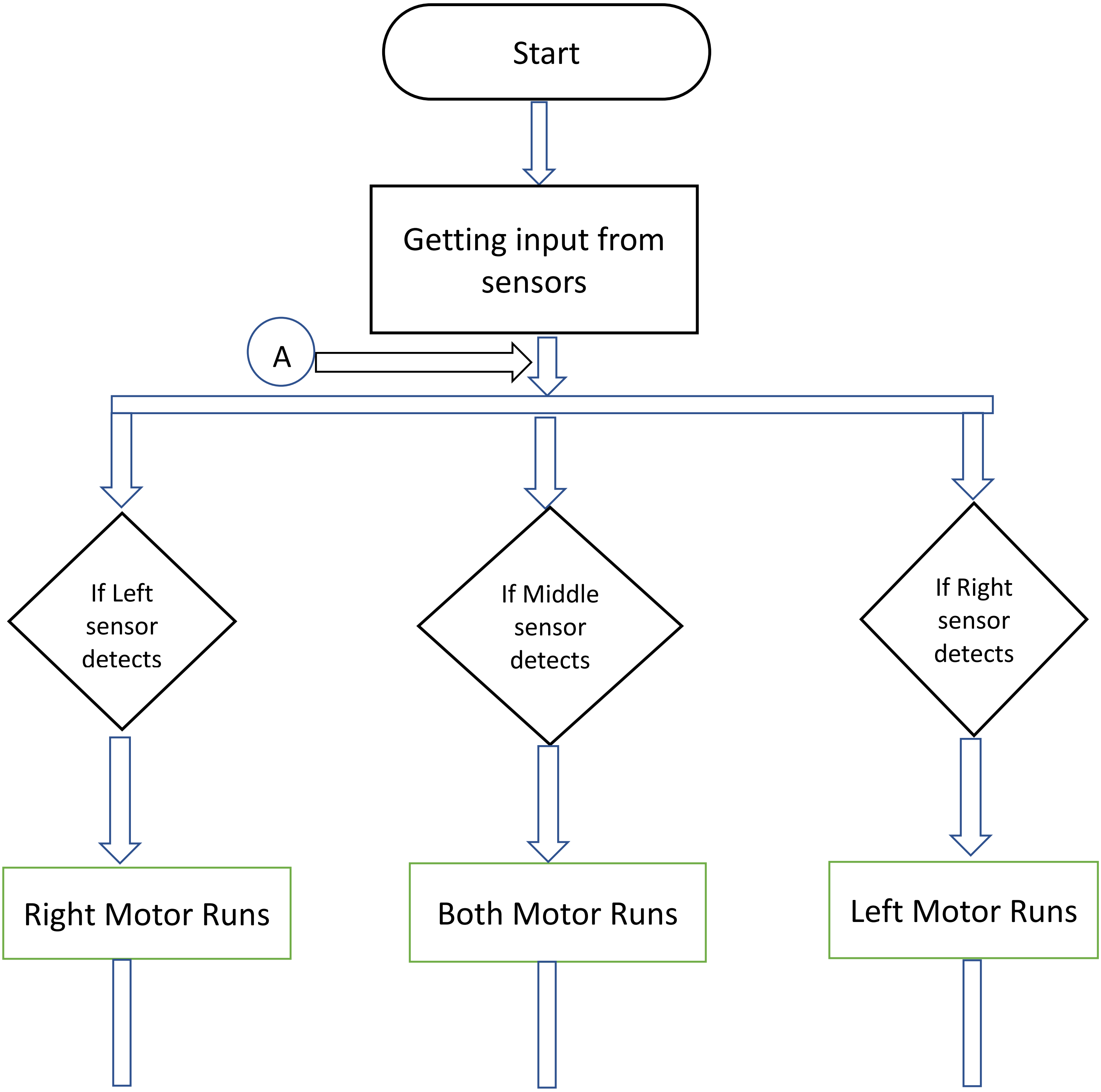
d The torque of the axis The wheel diameter, in meter The result of the (3.11) for 2.5 kilograms estimated robot weight and 10˚ slope is.

T = [Mm x g x (sin a + fr) x d] / 2 = [2.5 x 9.81 x (sin 10˚ + 0.020) x 0.09] / 2 ≈ 0.21 Nm

As a result, the torque requirement for a single motor is about 0.053 Nm.

To calculate the power and torque requirements of the system a “Force-Torque Calculator” was developed using C#

5.5 FLOW CAHRT



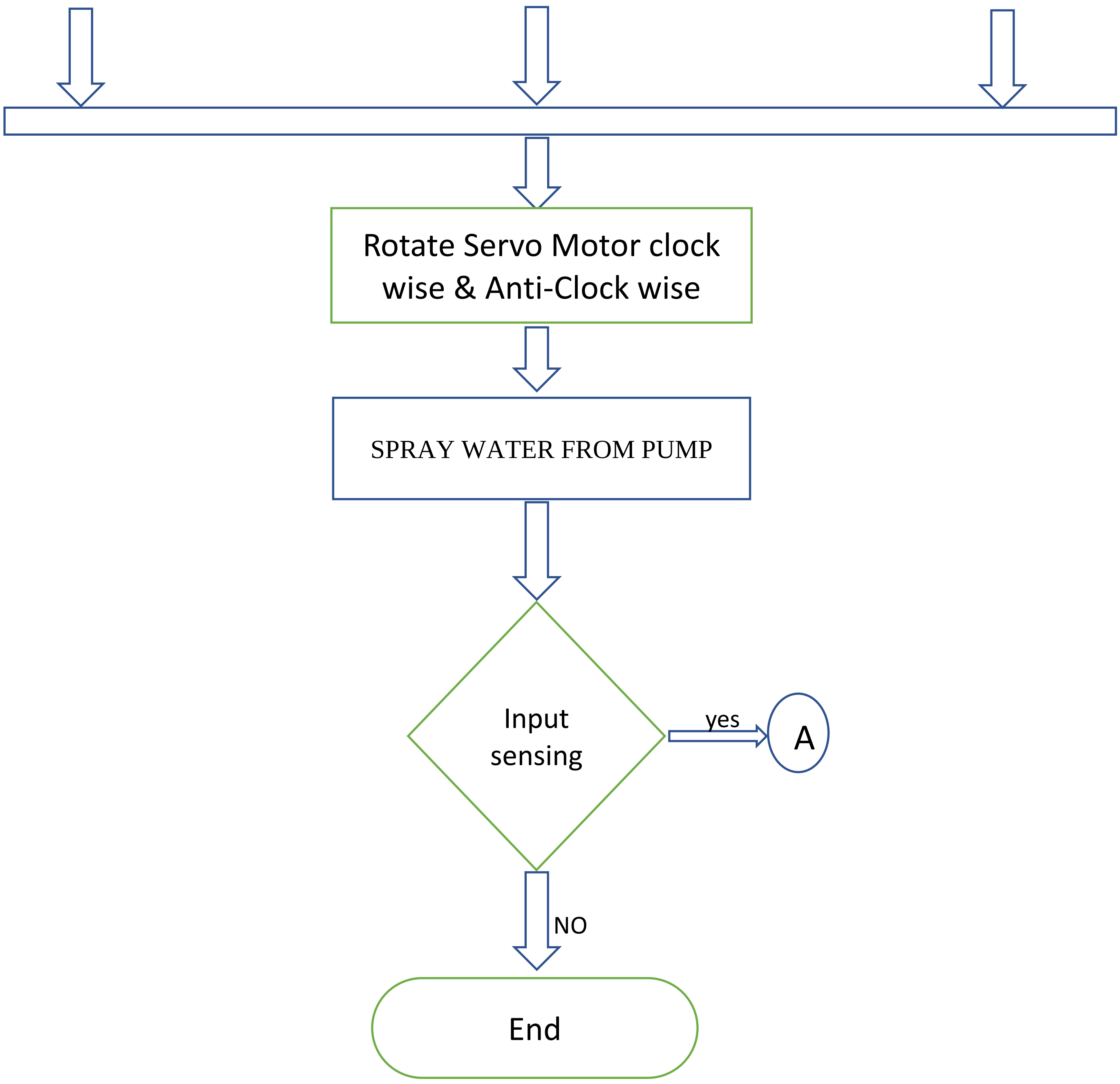


Figure:5.2 Flow Chart

5.6 Motor Selection

After the calculations of power and torque requirement, a brushed DC motor set was selected for robot motion. It is a proper and affordable motor when the criteria such as size, weight, price, power, torque and velocity outputs are taken into consideration. It is also easy to find this type of motor in any industrial place.

The motor rotates at 120 rev / min and powered with 12V DC. The rated power is 32 W with a torque of 2.6 Nm. Maximum power requirement of single motor was calculated about 0.66 W and torque requirement was about 0.053 Nm. The technical properties of the motor can easily satisfy the robot's power and torque requirements.

As mentioned before, our maximum speed expectation is 0.5 m/s. The relation between the angular velocity and linear velocity can be calculated as;

The formula of the relation is: $V_{max} = R \times W \times 0.10472$

Where:

R is The radius of the wheel

W is Angular velocity of the motor, in RPM

(Rounds per minute)

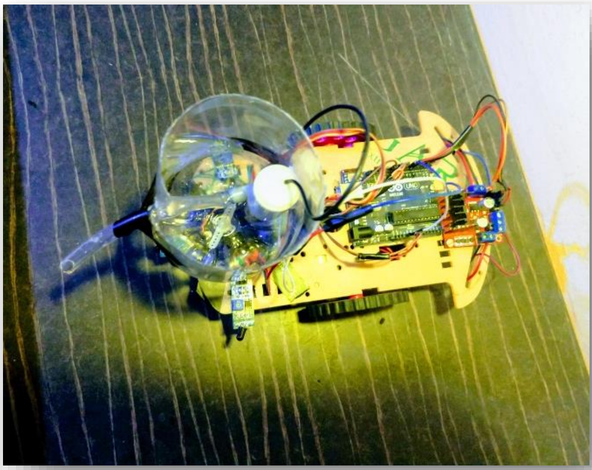
5.7 APPLICATIONS

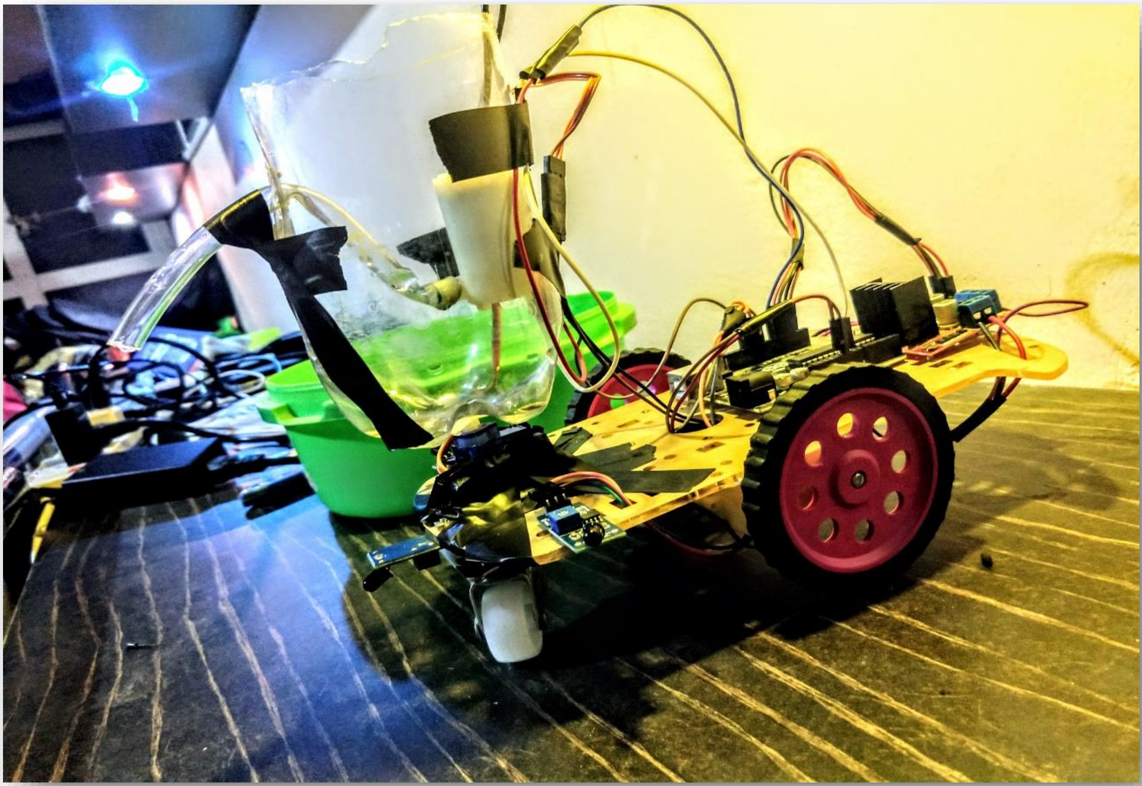
- Can be used in record maintaining rooms where fire can cause loss of valuable data.
- Can be used in Server rooms for immediate action in case of fire.
- Can be used in extinguishing fire where probability of explosion is high.
  - For e.g. Hotel kitchens, LPG/CNG gas stores, etc.
- Every working environment requiring permanent operator's attention.
  - At power plant control rooms.
  - At captain bridges.
  - At flight control centres.
- This Type of Robots are Suitable For:
  - Fire department.
  - Factories.

CHAPTER 6

RESULTS &FUTURE WORK

6.1 RESULTS





6.2 FUTURE WORK

In Phase-I we have designed the chassis of the robotic vehicle with two DC motors mounted on the chassis. We have designed the driving circuit for DC Motor using L298N Motor Driver. We implemented pumping unit in order to quench the fire using servo motor and dc pump.

In phase- I I we have to do this work:

- Affixing more sensors.
- Affixing a GSM module and control the robot from distant places.
- Controlling the robot using Application from distant places.
- Developing industrial prototype using industry graded IR sensors.
- Increasing the speed of the Robot.
- Increasing the sensitivity of IR sensors.

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