DESIGN AND FABRICATION OF 360 DEGREE ROTATING WIRELESS FIRE PROTECTION SYSTEM.

A Project
By

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May 2024

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Submitted To The:

Department of Mechanical Engineering

SONARGAON UNIVERSITY (SU)

In partial fulfillment of the requirement for award of the degree

Of

Bachelor of Science in Mechanical Engineering

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LETTER OF TRANSMITTAL

May 2024

To

Nuruzzaman Rakib
Asst. Professor
Department of Mechanical Engineering.
Sonargaon University

Subject: Submission of Project Report**.**

Dear Sir,

We are pleased to submit the project report on "**Design and Fabrication of 360 Degree Rotating Wireless Fire Protection System".** It was a great pleasure to work on such an important topic. This project has been done as per instruction of your supervision and according to the requirements of the Sonargaon University.

We expect that the project will be accepted by the concerned authority we will remain happy to further explanation that you may feel necessary in this regard.

Thank You

Sincerely yours,

Md. Mukter Hossain	ID: ME2003022076
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DECLARATION

We do hereby solemnly declare that, the work presented here in this project report has been carried out by us and has not been previously submitted to any University/ Organization for award of any degree or certificate

We hereby ensure that the works that has been prevented here does not breach any existing copyright.

We further undertake to indemnify the university against any loss or damage arising from breach of the foregoing obligation.

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ABSTARCT

The 360 degree rotating wireless fire protection system is a cutting-edge innovation aimed at revolutionizing fire protection or suppression in diverse environments. Traditional fire protection systems often face limitations in coverage, response time and accessibility. In response, the employs a combination of advanced technologies to provide comprehensive fire protection or suppression capabilities with unparalleled flexibility and efficiency. At the core of the system is a network of wireless sensors strategically positioned to provide 360 degree coverage of the protected area. The wireless connectivity ensures rapid data transmission to the central control unit, enabling real-time monitoring and decision-making and enable fire protection capability in the adverse environment where fire fighter unable to reach due excessive heat or toxic smoke.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Fire hazards are a common phenomenon in developing countries like Bangladesh causing loss of lives and property every year. According to the Bangladesh fire service & Civil defense force report, fire outbreak is the third most serious threat to business continuity and operations. Accidents from fires are alarming and devastating.so, to minimize losses resulting from accidents and save lives, Fire extinguisher robots will play a vital role. Another aspect is related to the firemen involved in these accidents – they risk their lives while conducting firefighting& rescuing the victims. The location of the fire accident is important. Chemical mills, garment factories, gas and petrol stations, as it affects the target area including surroundings. This type of accident results in loss to lives and pollutes the environment. While the government and other regulatory agencies have prescribed fire safety standards and measures, execution and vigilance remain important issues.

Robotics: Robots are automated devices that are capable of performing tasks in an efficient, cost-effective and accurate manner compared to humans. It has grown in popularity as technology has advanced, minimizing human intervention.

Mechatronics: Robot development consists of hardware, electronics and programming to automate our daily tasks and to make or life easier using the concept of mechatronics. The Firefighting robot that is presented in this paper focuses on providing remote maneuvering capability using a programmable micro-controller ESP 8266 controlled through nrf. While any fire incident occurs then letting the user manually control the robot to douse the fire using a water pump connected to a water storage tank.

1.2 Problem Statement

Fire outbreaks are known to cause significant loss of life (victims and rescuers) and property. Due to high temperature and presence of potentially hazardous material fire-fighting robots will be useful for extinguishing fire, particularly in places where fire-men cannot reach and work. It can thus reduce human injury from a burning fire.

1.3 Objectives

The objectives of this project are:

- To study about **Design and Fabrication of** 3**60 Degree Rotating Wireless Fire Protection System.**
- To implement a Fire Protection System.
- To test the performance of the system.

1.4 Methodology

Our used methodology for the project:

- Creating an idea for the "**Design and Fabrication of 360 Degree Rotating Wireless Fire Protection System".** Designing a block diagram & circuit diagram to know which components we need to construct it.
- Collecting all the components and programming the micro-controller to control our desired system.
- Setting up all the components in a PCB board & soldering. Then assembling all the blocks in a board and finally running the system to check if it actually works or not.

1.5 Structure of the Project

This Project is organized as follows:

Chapter 1 Introduction**:** The 1st chapter contains the statement of the introduction, our background study for the project, problem statement, objectives of the study and the project outline.

Chapter 2 Literature Review**:** The 2nd chapter contains our literature review part.

Chapter 3 Hardware and Software Analysis**:** The 3rd chapter describes the theoretical model. Here we mainly discuss about proposed system Hardware and software development of our project etc.

Chapter 4 Methodology**:** The 4th chapter three describes the theoretical model. Here we mainly discuss about proposed system architecture in details with having block diagram, circuit diagram, structural diagram, project working principle, complete project image etc.

Chapter 5 Results and Discussion**:** The 5th chapter deals with the results and discussion and discuss about the project technical data, advantages, disadvantages and applications.

Chapter 6 Conclusion**:** The 6th chapter is all about our project conclusion and future scope.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review

In today's era firefighting in hazardous locations is a difficult in real-life problem. Many researchers are working on Mechatronics, Internet of Things (IoT) driven techniques for firefighting robots and have developed innovative solutions.

Tawfiqur Rakib, M. A. Rashid Sarkar proposed a firefighting robot model which consists of a base platform made up of 'Kerosene wood', LM35 sensor for temperature detection, flame sensors to detect the fire and a water container of 1 liter capacity which is made up of a strong cardboard that makes it water resistant. The robot has two wheels for its movement. [1]

Saravanan P , Soni Ishawarya proposed a model which uses Atmega2560 micro-controller and in which the robot is divided into three basic units according to their functions which are as locomotive unit, fire detecting unit and extinguishing unit. Each unit performs their task in order to achieve the desired output of extinguishing fire. The locomotive unit is used for the movement of the robot and to avoid the obstacles with the help of four IR and four ultrasonic sensors. The fire detecting unit is used to detect fire using LDR and temperature sensor. The extinguishing unit is used to extinguish the fire using water container and BLDC motor. The robot also has a Bluetooth module that is connected with the smartphones in order to navigate it in the proper direction. [2]

Boo Siew Khoo demonstrates the Fire Droid, an automated fire extinguisher robot that can detect and extinguish flames. When a fire breaks out in a home, the fire-fighting robot will be able to detect the flame and proceed to the source of the fire. Water is pumped out of the water tank after the fire position is secured and the flame distance is calculated, hence dousing the fire. [3]

H.P. Singh developed the control system for a mobile autonomous industrial firefighting robot. The paper demonstrates the creation and design of firefighting robots with a wide range of capabilities. Two optically separated D.C. engines are housed within the structure. The robot transforms data from infrared sensors in a variety of ways, from simple to

complex. There are five infrared sensors in use. Two sensors control the robots' movement, while the other three are used to detect fire. A D.C water syphon and a water compartment are included in the douser. The primary goal of the paper is to identify and suffocate fire flare-ups. This infrared sensor serves as an information sensor, detecting infrared beams emitted by the fire. The extinguishing mechanism is controlled by the microcontroller. [4]

This project entitled “Design and Fabrication of Fire Fighting Autonomous Robotic System Equipped with Sensitive Sensors for Fire Alarm and Detection, Avoidance Behavior Mechanism and SMS Messaging Capability”. The title was based on the functions and objectives of the study. However, this project was similarly alike to other robots but this innovative robot was the researchers own idea. The features were pondered by the researchers technically focusing on the components contributions when assembled as one robot. The Design and Fabrication of Fire Fighting

Autonomous Robotic System Equipped with Sensitive Sensors for Fire Alarm and Detection, Avoidance Behavior Mechanism and SMS Messaging Capability has additional features that make it unique to others. It was installed with an alarm system that notifies the owner that flame has occurred. Moreover, it has an auxiliary function like ultrasonic sensor, flame sensor and a smoke sensor that detects the flame combustion. Robot is a machine that resembles a human being and mimics various complex tasks. Now, let us have a good look at existing firefighting robots. The following robots below are the characteristic of the previous robot that have been similar with this robot project and used in the literature review

2.2 Summary

We try to do this project by reading the above literature and we have been able to make our project successful by reducing the mistakes of earlier project.

CHAPTER 3

METHODOLOGY

3.1 Hardware & Software

This Project has worked on two things, Hardware and Software. Here we will discuss about our project hardware and software details.

Hardware Components

- Node MCU
- Servo Motor
- Motor Driver
- Battery(12V)
- Relay
- High Speed Pump Motor
- Nozzle
- Step down transformer
- Hose pipe

3.2 Node MCU

Node MCU is an open source firmware for which open source prototyping board designs are available. The name "Node MCU" combines "node" and "MCU" (micro-controller unit). The term "Node MCU" strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source.

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

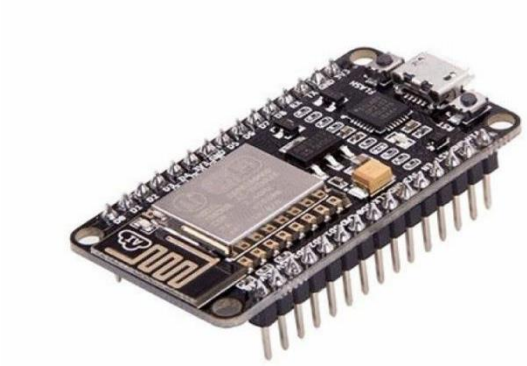


Figure 3.1: Node MCU

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications. This an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Express if Systems, and hardware which is based on the ESP-12 module. The term "Node MCU" by default refers to the firmware rather than the development kits. The firmware uses the Luascripting language. It is based on the eLua project, and built on the Es press if Non-OS SDK for ESP8266. Node MCU was created shortly after the ESP8266 came out.

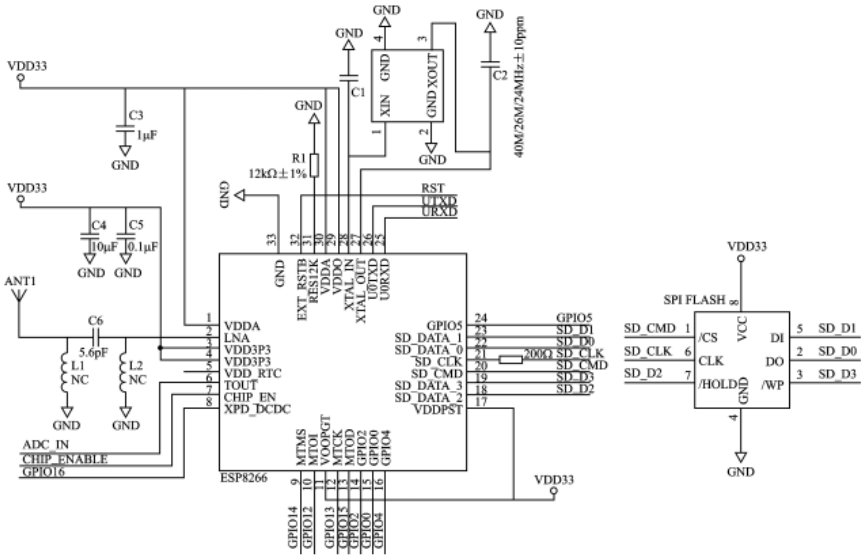


Figure 3.2: Node MCU Schematic Diagram

Another important update was made on 30 Jan 2015, when Devsaurus ported the u8glibto Node MCU project, enabling Node MCU to easily drive LCD, Screen, OLED, even VGA displays. In summer 2015 the creators abandoned the firmware project and a group of independent contributors took over. By summer 2016 the Node MCU included more than 40 different modules. Due to resource constraints users need to select the modules relevant for their project and build a firmware tailored to their needs.

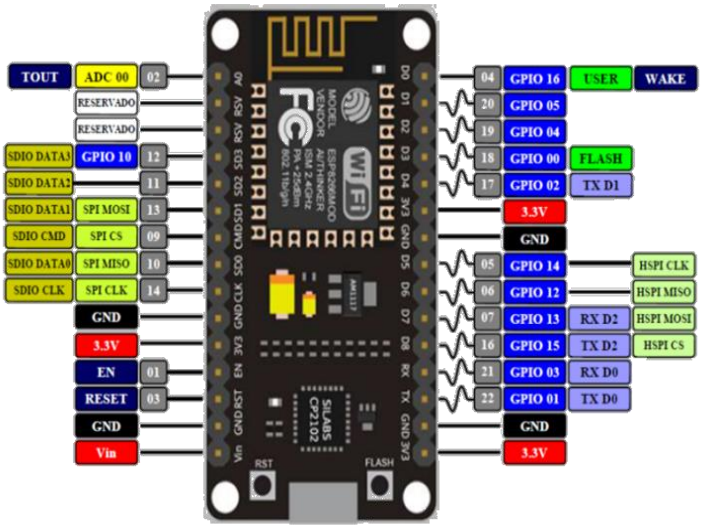


Figure 3.3: Node MCU Pin Out

Node MCU V3 ESP8266 ESP-12E is Wi-Fi development board that helps you to prototype your IoT product with few Lua script linesor through Arduino IDE. The board is based on ESP8266 ESP-12E variant, unlike other ESP-12E, you won't need to buy a separate breakout board, USB to serial adapter, or even solder it to a PCB to get startedand you will only need a USB cable (Micro USB).

Features

1. Communication interface voltage: 3.3V.
2. Antenna type: Built-in PCB antenna is available.
3. Wireless 802.11 b/g/n standard
4. Wi-Fi at 2.4GHz, support WPA / WPA2 security mode
5. Support STA/AP/STA + AP three operating modes

6. Built-in TCP/IP protocol stack to support multiple TCP Client connections (5 MAX)
7. D0 ~ D8, SD1 ~ SD3: used as GPIO, PWM, IIC, etc., port driver capability 15mA
8. AD0: 1 channel ADC
9. Power input: 4.5V ~ 9V (10VMAX)
10. Current: continuous transmission: ≈70mA (200mA MAX), Standby: <200uA
11. Transfer rate: 110-460800bps
12. Support UART / GPIO data communication interface

Remote firmware upgrade (OTA)

3.3 Battery (12V)

A twelve-volt battery has six single cells in series producing a fully charged output voltage of 12.6 volts. A battery cell consists of two lead plates a positive plate covered with a paste of lead dioxide and a negative made of sponge lead, with an insulating material (separator) in between.

Quick Details

- Nominal Capacity: 7AH
- Rechargeable 12V DC Battery.
- Maintenance Type: Free
- Voltage: 12V



Figure 3.4: 12V Battery

3.4 Servo Motor

A servo motor is an electrical device that can push or rotate an object with great precision. If you want to rotate and object at certain angles or distances, you can use a servo motor. It is made by a simple motor which is driven by a servo mechanism. If the motor is DC driven then it is called DC servo motor and if it is AC driven motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight package. These are being used in various applications like toy cars, RC helicopters and planes, robotics, machines etc.



Figure 3.5: Servo Motor

Servo motors are rated at kg / cm (Kilogram per centimeters). Most hobby servo motors are rated at 3 kg / cm or 6 kg / cm or 12 kg / cm. This kg / centimeter tells you how much weight your servo motor can lift at a certain distance. For example: A 6 kg / cm servo motor should be able to lift 6 kg if the load is suspended 1 cm away from the motor shaft, to be less than the carrying capacity. The position of the servo motor is determined by the electric pulse and its circuitry is placed next to the motor.

Servo Mechanism

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

All motors have three wires. Of which two will be used for the supply (positive and negative) and one will be used for the signal transmitted from the MCU. The servo motor is controlled by PWM (Pulse with Modulation) which provides the control wires. Has minimum pulse, maximum pulse and repetition rate. The servo motor can rotate 90 degrees in two directions, creating its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the pulse length will determine how far the motor rotates. For example, a 1.5 mm pulse will turn the motor to 90 °, for example, if the branch is less than 1.5 mm shaft, it will move to 0 to, and if it is longer than 1.5 mm, the servo will turn to 180 to.

The servo motor operates on the PWM (pulse width modulation) principle, meaning that the angle of rotation is controlled by the duration of the pulse applied to its control pin. Basically, the servo motor is made up of a DC motor which is controlled by a variable resistor (potentiometer) and some gears. The high-speed force of the DC motor is converted to torque by the gears. We know that work = force x DISTANCE, less in DC motor force and more in distance (speed) and in servo, forces are higher and distance is less. The potentiometer server is connected to the output trench to calculate the angle and stop the DC motor at the required angle.

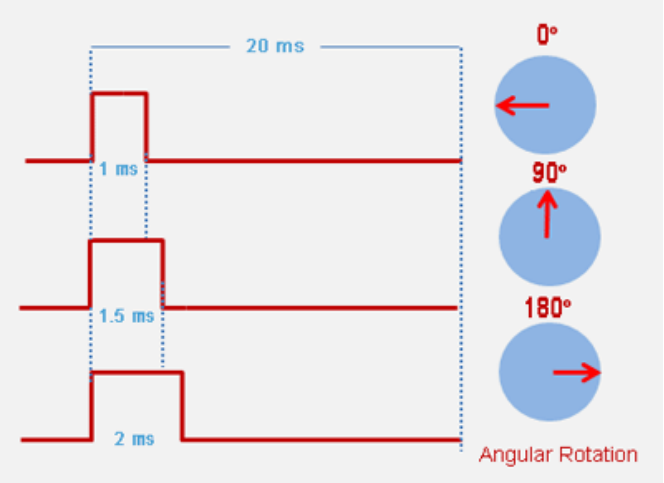


Figure 3.6: Schematic Diagram of servo motor

The servo motor can be rotated from 0 to 180 degrees but depending on the output it can go up to 210 degrees. This degree of rotation can be controlled by applying an electric pulse of appropriate width to its control pin. Servo examines pulses every 20 milliseconds. The 1 ms (1 millisecond) width pulse servo can rotate 0 degrees, 1.5 mm 90 degrees (neutral position) and 2 ms pulse it can rotate 180 degrees. All servo motors work directly with your + 5V supply rails but we need to be careful about how much current the motor will use. If you plan to use more than two servo motors, you should design a suitable servo solder.

3.5 L293D Motor Driver IC

The **L293D** is a popular 16-Pin **Motor Driver** IC. As the name suggests it is mainly used to drive **motors**. A single **L293D** IC is capable of running two DC **motors** at the same time; also the direction of these two **motors** can be controlled independently.

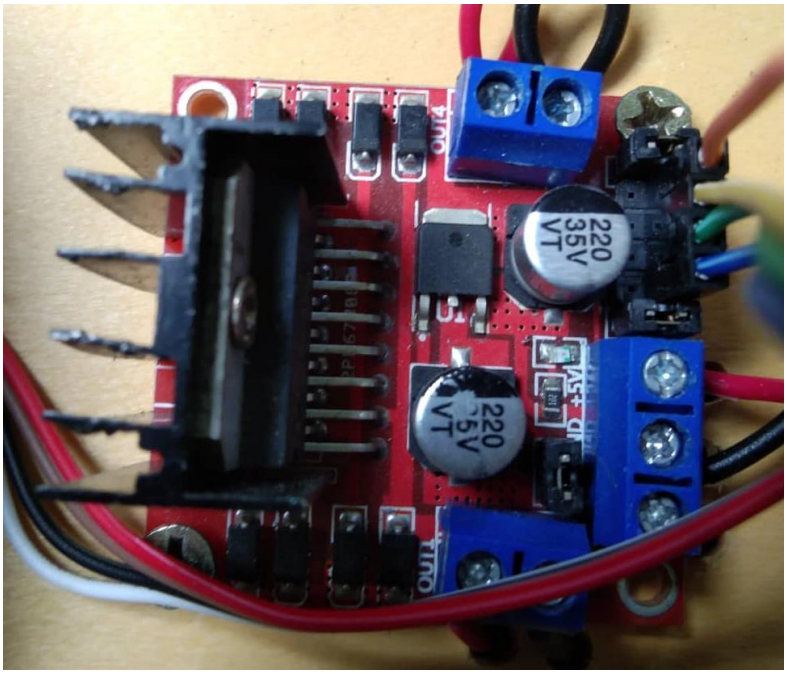


Figure 3.7: Motor driver IC L293D

Working Process

L293D IC is a typical **Motor Driver** IC which allows the DC **motor** to drive on any direction. This IC consists of 16-pins which are used to control a set of two DC **motors** instantaneously in any direction. It means, by using a **L293D** IC we can control two DC **motors**.

Features

- Can be used to run Two DC motors with the same IC.
- Speed and Direction control is possible
- Motor voltage Vcc2 (Vs): 4.5V to 36V
- Maximum Peak motor current: 1.2A
- Maximum Continuous Motor Current: 600mA

L293D Pin Configuration

Table 2.1: Motor Driver Pin out

Pin Number	**Pin Name**	**Description**
1	Enable 1,2	This pin enables the input pin Input 1(2) and Input 2(7)

2	Input 1	Directly controls the Output 1 pin. Controlled by digital circuits
3	Output 1	Connected to one end of Motor 1
4	Ground	Ground pins are connected to ground of circuit (0V)
5	Ground	Ground pins are connected to ground of circuit (0V)
6	Output 2	Connected to another end of Motor 1
7	Input 2	Directly controls the Output 2 pin. Controlled by digital circuits
8	Vcc2 (Vs)	Connected to Voltage pin for running motors (4.5V to 36V)
9	Enable 3,4	This pin enables the input pin Input 3(10) and Input 4(15)
10	Input 3	Directly controls the Output 3 pin. Controlled by digital circuits
11	Output 3	Connected to one end of Motor 2
12	Ground	Ground pins are connected to ground of circuit (0V)
13	Ground	Ground pins are connected to ground of circuit (0V)
14	Output 4	Connected to another end of Motor 2

Use of a L293D Motor Driver IC

Using this L293D motor driver IC is very simple. The IC works on the principle of **Half H-Bridge**, let us not go too deep into what H-Bridge means, but for now just know that H bridge is a set-up which is used to run motors both in clock wise and anti-clockwise direction. As said earlier this IC is capable of running two motors at the any direction at the same time, the circuit to achieve the same is shown below.

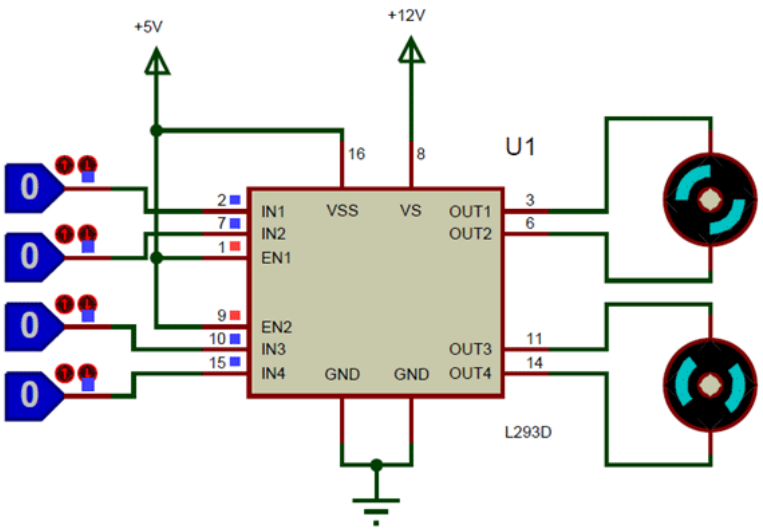


Figure 3.8: L293D circuit Diagram

All the Ground pins should be grounded. There are two power pins for this IC, one is the Vss(Vcc1) which provides the voltage for the IC to work, this must be connected to +5V. The other is Vs(Vcc2) which provides voltage for the motors to run, based on the specification of your motor you can connect this pin to anywhere between 4.5V to 36V, here I have connected to +12V.

The Enable pins (Enable 1,2 and Enable 3,4) are used to Enable Input pins for Motor 1 and Motor 2 respectively. Since in most cases we will be using both the motors both the pins are held high by default by connecting to +5V supply. The input pins Input 1,2 are used to control the motor 1 and Input pins 3,4 are used to control the Motor 2. The input pins are connected to the any Digital circuit or micro-controller to control the speed and direction of the motor.

Applications

- Used to drive high current Motors using Digital Circuits
- Can be used to drive Stepper motors
- High current LED's can be driven
- Relay Driver module (Latching Relay is possible)

3.6 High Speed Pump

A pump is a device that moves fluids (liquids or gases), or sometimes slurries by mechanical action, typically converted from electrical energy into hydraulic energy. Mechanical pumps serve in a wide range of applications such as pumping water from wells, aquarium filtering, pond filtering and aeration, in the car industry for water-cooling and fuel injection, in the energy industry for pumping oil and natural gas or for operating cooling towers and other components of heating, ventilation and air conditioning systems. In the medical industry, pumps are used for biochemical processes in developing and manufacturing medicine, and as artificial replacements for body parts, in particular the artificial heart and penile prosthesis.

Feature:

- Pump Operating Voltage: 9V-14V
- Power: 120W Max
- Working Pressure: 100 PSI (6.88 Bar) Cutoff
- Cutoff Automatic Switch
- Flow (MAX): 4.5L/min
- Pressure Adjustable Copper Head Water Spray
- Water Pressure Limit : Adjustable
- Sprayers Size : 20 mm
- Spray Distance: 9 m
- Thread Diameter: 1.5cm
- Main Material: Copper, Plastic
- Power supply Voltage: 12V DC
- Power supply Current: 5A



Figure 3.9: High Speed Pump

3.7 The Smoothing Capacitor

When there is a potential difference across the conductors (e.g., when a capacitor is attached across a battery), an electric field develops across the dielectric, causing positive charge (+Q) to collect on one plate and negative charge (-Q) to collect on the other plate. If a battery has been attached to a capacitor for a sufficient amount of time, no current can flow through the capacitor. However, if an accelerating or alternating voltage is applied across the leads of the capacitor, a displacement current can flow.



Figure 3.10: Capacitor

An ideal capacitor is characterized by a single constant value for its capacitance. Capacitance is expressed as the ratio of the electric charge (Q) on each conductor to the potential Difference (V). The SI unit of capacitance is the farad (F), which is equal to one coulomb per volt (1 C/V). Typical capacitance values range from about 1 pF (10−12 F) to about 1 mF (10−3 F). The capacitance is greater when there is a narrower separation between conductors and when the conductors have a larger surface area.

In practice, the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, known as the breakdown voltage. The conductors and leads introduce an undesired inductance and resistance. Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems, they stabilize voltage and power flow.

The full-wave bridge rectifier however, gives us a greater mean DC value (0.637 Vmax) with less superimposed ripple while the output waveform is twice that of the frequency of the input supply frequency. We can improve the average DC output of the rectifier while at the same time reducing the AC variation of the rectified output by using smoothing capacitors to filter the output waveform. Smoothing or reservoir capacitors connected in parallel with the load across the output of the full wave bridge rectifier circuit increases the average DC output level even higher as the capacitor acts like a storage device as shown below. Too low a capacitance value and the capacitor has little effect on the output waveform. But if the smoothing capacitor is sufficiently large enough (parallel capacitors can be used) and the load current is not too large, the output voltage will be almost as smooth as pure DC.

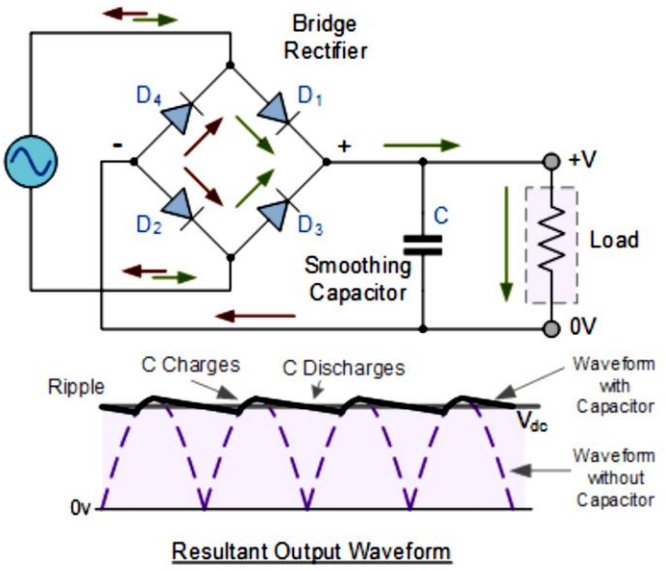


Figure 3.11: The Smoothing Capacitor with Full Bridge Rectifier

3.8 Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the sometime, act to lower voltage levels within circuits. Resistors may have fixed resistances or variable resistances, such as those founding thermostats, visitors, trimmers, photo resistors, hamsters and potentiometers. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. This relationship is represented by Ohm's law.



Figure 3.12: Resistor

Theory of operation**:**

The behavior of an ideal resistor is dictated by the relationship specified by Ohm ‘slaw:

$$V = I.R$$

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I), where the constant of proportionality is the resistance (R).

Equivalently, Ohm's law can be stated:

$$I = V/R$$

This formulation states that the current (I) is proportional to the voltage (V) and inversely proportional to the resistance (R). This is directly used in practical computations. For example, if a 300 ohm resistor is attached across the terminals of a12 volt battery, then a current of12 / 300 = 0.04 amperes flows through that resistor.

3.9 Arduino Software

The digital microcontroller unit named as Arduino Nano can be programmed with the Arduino software IDE. There is no any requirement for installing other software rather than Arduino. Firstly, Select "Arduino Nano from the Tools, Board menu (according to the microcontroller on our board). The IC used named as ATmega328 on the Arduino Nano comes pre burned with a boot loader that allows us to upload new code to it without the use of an external hardware programmer.

Communication is using the original STK500 protocol (reference, C header files). We can also bypass the boot loader and programs the microcontroller through the ICSP (In Circuit Serial Programming) header. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by:

On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2. On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

The Arduino Nano is one of the latest digital microcontroller units and has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL at (5V) with serial communication, which is available on digital pins 0 -(RX) for receive the data and pin no.1 (TX) for transmit the

data. An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an .in file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board.

The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial Communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Nano's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus. Arduino programs are written in C or C++ and the program code written for Arduino is called sketch. The Arduino IDE uses the GNU tool chain and AVR Lab to compile programs, and for uploading the programs it uses argued.

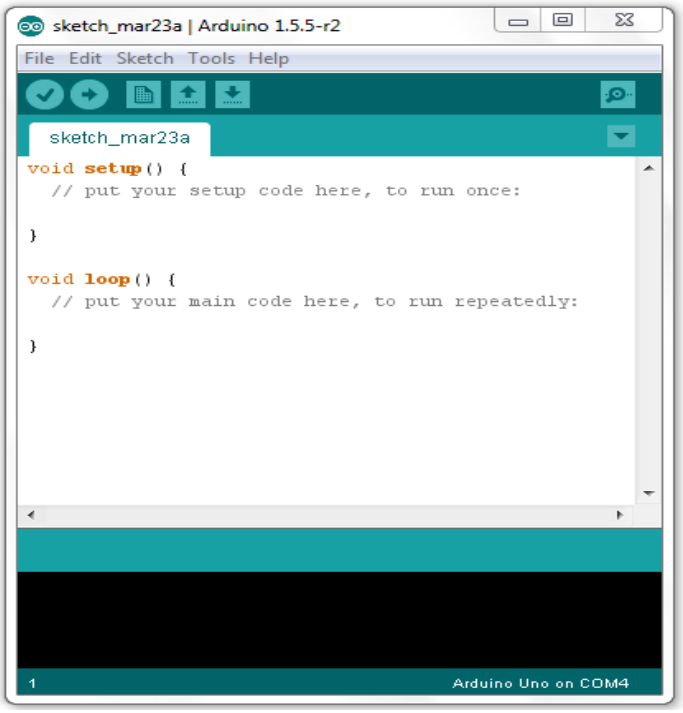


Figure 3.13: Arduino Software Interface IDE

Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. Into. The editor has features

for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

Burn Bootloader

The items in this menu allow you to burn a boot loader onto the microcontroller on an Arduino board. This is not required for normal use of an Arduino or Genuino board but is useful if you purchase a new ATmega microcontroller (which normally come without a boot loader). Ensure that you've selected the correct board from the Boards menu before burning the boot loader on the target board. This command also set the right fuses.

Uploading

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager.

On Linux, it should be /dev/ttyACMx , /dev/ttyUSBx or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a

message when the upload is complete, or show an error.

Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete it's #include statements from the top of your code.

Serial Monitor

This displays serial sent from the Arduino or Genuino board over USB or serial connector. To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down menu that matches the rate passed to Serial. Begin in your sketch. Note that on Windows, Mac or Linux the board will reset (it will rerun your sketch) when you connect with the serial monitor. Please note that the Serial Monitor does not process control characters; if your sketch needs a complete management of the serial communication with control characters, you can use an external terminal program and connect it to the COM port assigned to your Arduino board. You can also talk to the board from Processing, Flash, MaxMSP, etc (see the interfacing page for details).

3.10 Proteus Software

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronics design engineers and technicians to create schematics and electronics prints for manufacturing printed circuit boards. The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990 with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and

micro-controller simulation then arrived in Proteus in 1998. Shape based auto routing was added in 2002 and 2006 saw another major product update with 3D Board Visualization. More recently, a dedicated IDE for simulation was added in 2011 and MCAD import/export was included in 2015. Support for high speed design was added in 2017. Feature led product releases are typically biannual, while maintenance-based service packs are released as required.

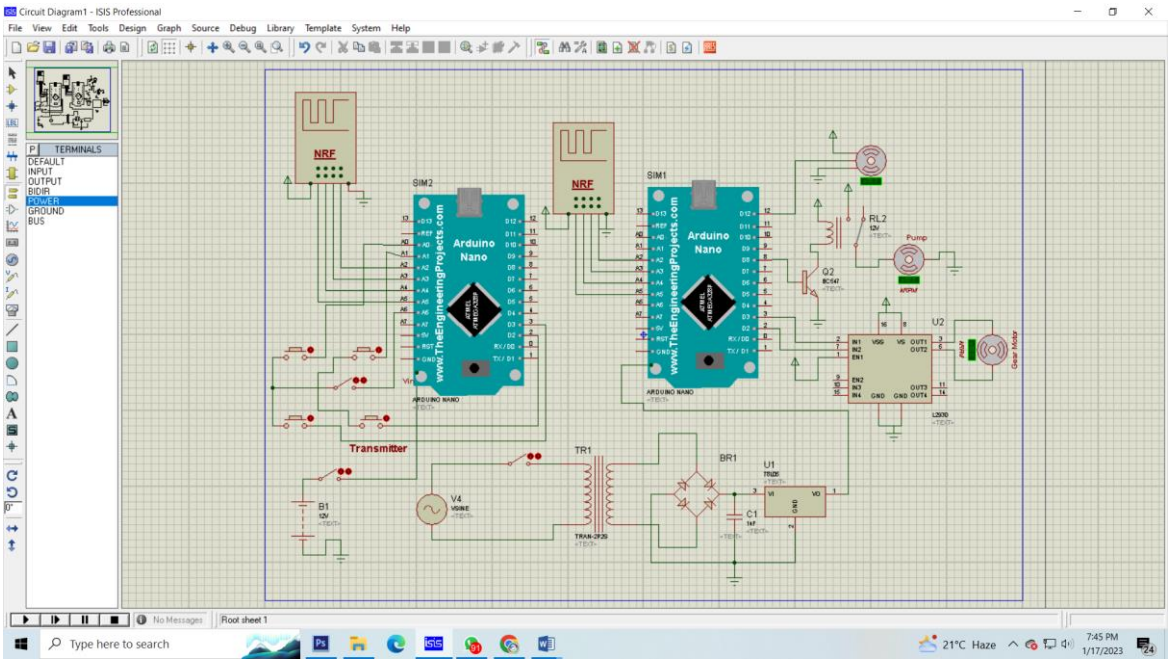


Figure 3.14: Proteus Software Interface

CHAPTER 4

DESIGN AND WORKING PRINCIPLE

4.1 Design and Architecture

The Robot Hardware (Chassis) should be designed such that:

- It should have low weight for a single person to carry during emergencies.
- It should move fast and maneuver the entire fire area, at the same time being stable without losing balance.
- The robot chassis and its structure must accommodate for all the sensors and micro-controller and should have it suitably covered for protection against fire or water. We fabricated the chassis using Mild Steel. We decided to use Mild Steel because of the following reasons:
- **Ductile** – Mild steel is particularly ductile due to the minimal quantity of carbon utilized in its production and the lack of any alloying components. Low carbon steel can be deformed and shaped without losing its hardness, making it an extremely malleable steel that may be utilized for a variety of applications.
- **Machinable and Weldable** – Mild steel's ductility makes it particularly well suited to a variety of steel fabrication techniques, including welding. The smaller the proportion of carbon in the steel, the more bendable the steel becomes.
- **Affordable** – Mild steel is a cost-effective type of steel that many steel fabrication customers utilize to finish their industrial projects because it takes minimal resources and ingredients.

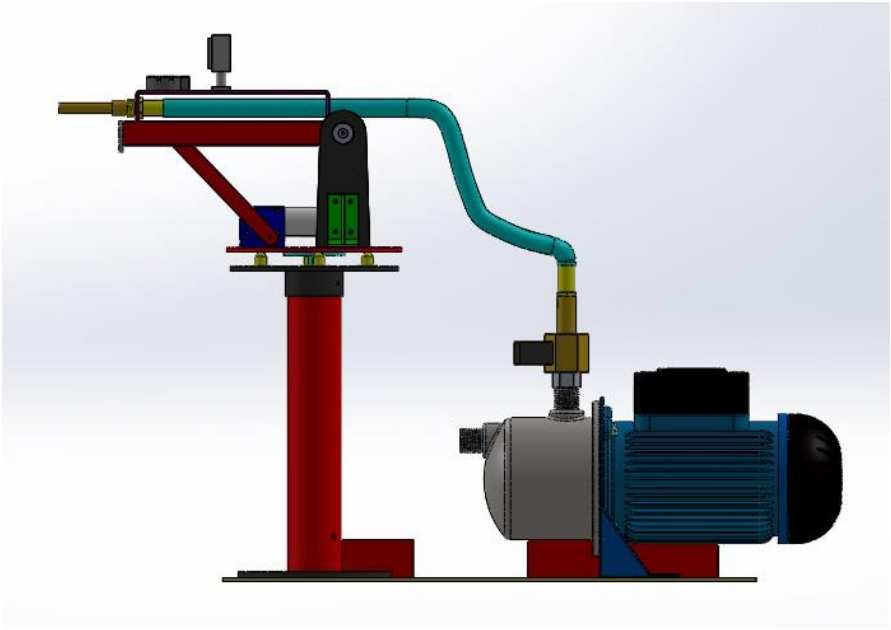


Figure 4.1: Structural View (Side View)

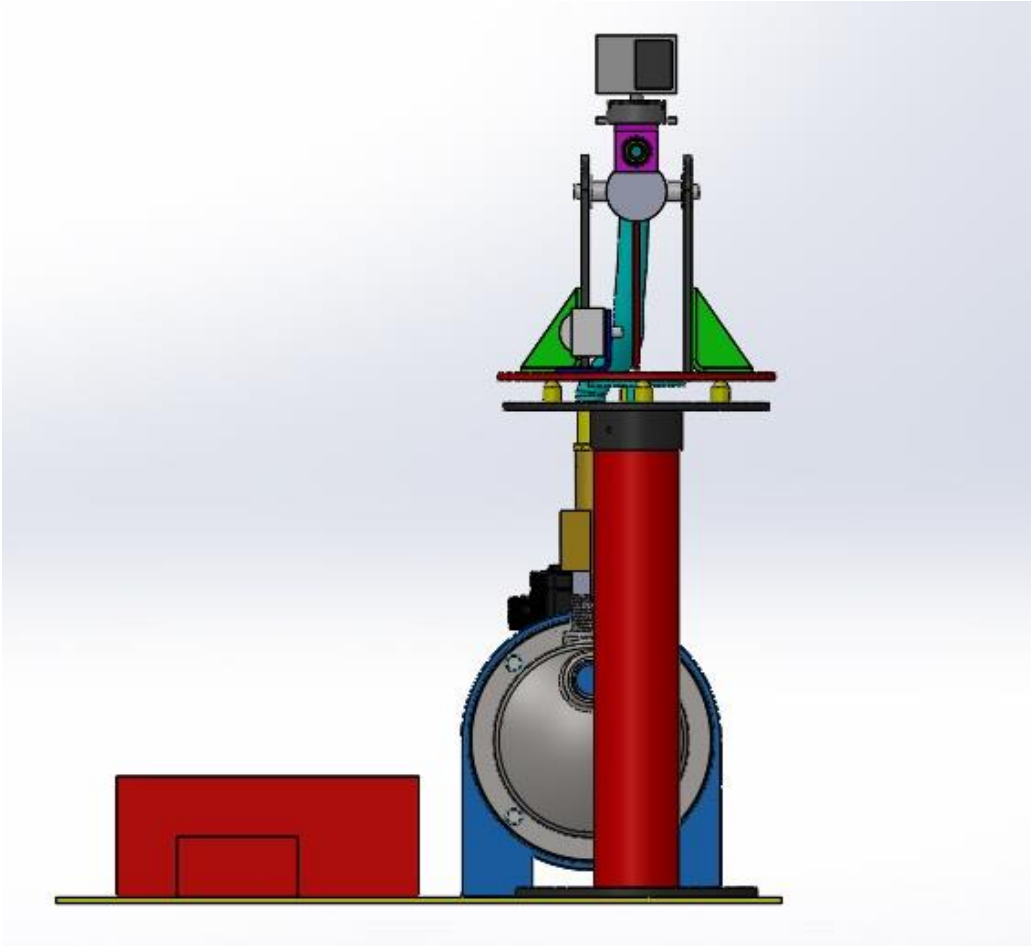


Figure 4.2: Structural View (Front View)

4.2 Block Diagram

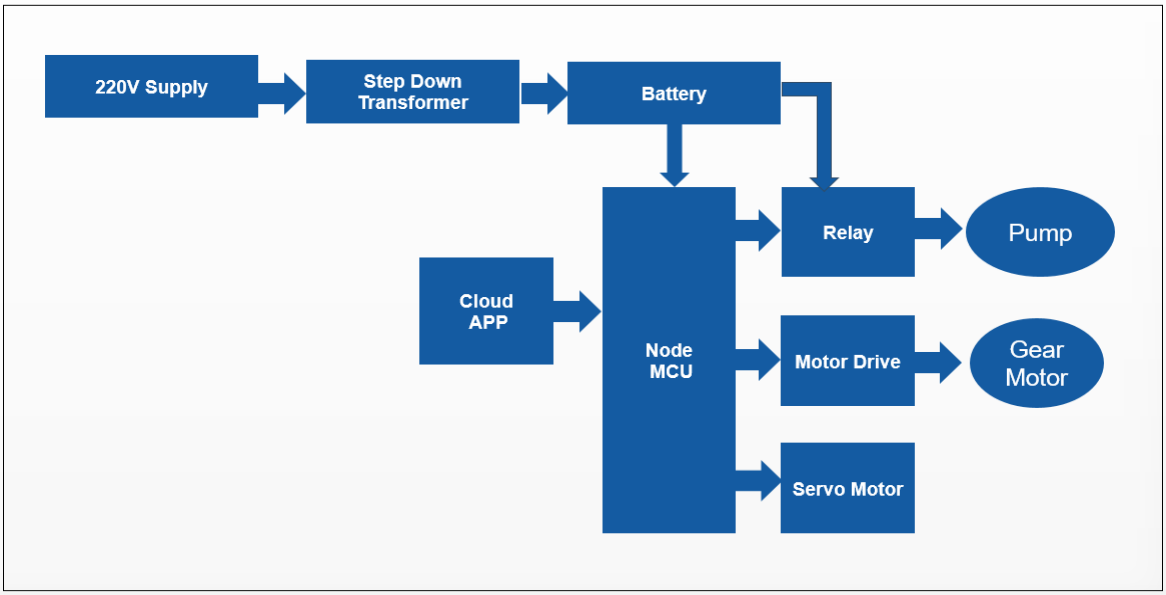


Figure 4.3: Block Diagram of the System

4.3 Schematic Diagram

The schematic diagram here is representing the electrical circuit and the components of the project. Here we have used standardized symbols and lines.

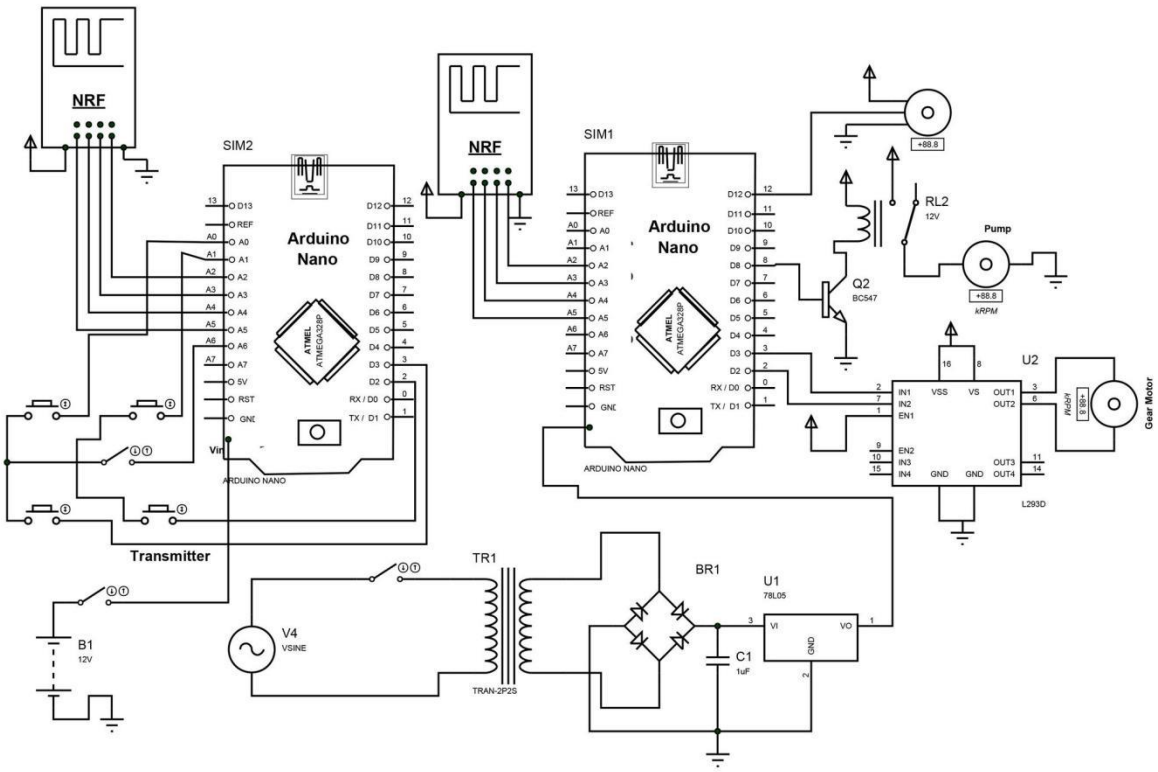


Figure 4.4: Schematic Diagram of the Project

4.4 Working Principle

The way of 360 degree rotating fire protection system works is that we take the 220V rms from the supply voltage and then give it to the Battery. the Battery has a step down transformer inside that stepped that voltage down to 12V DC. Where need 5V then voltage regulator convert it 5VDC. We feed this voltage to the Node MCU Micro-controller, Arduino Pro mini for it to run. Here we also use Motor driver, High speed pump, nozzle, servo motor, structural base etc.

In this project one micro-controller work for main circuit, another is use for system controller. Our system is very useful when there is a fire somewhere but the car cannot enter that location. With a Mobile Apps (BlynkIoT), the system is brought close to the fire situation and the nozzle is fixed towards the fire and pump will be on, it will spray water. This system is able to rotate 360 degrees. The system moves forward and backward according to the signal coming from the controller. The pump can be turned on and off from a button on the (BlynkIoT) Mobile Apps. This is the main procedure of our system.

4.5 Final System View

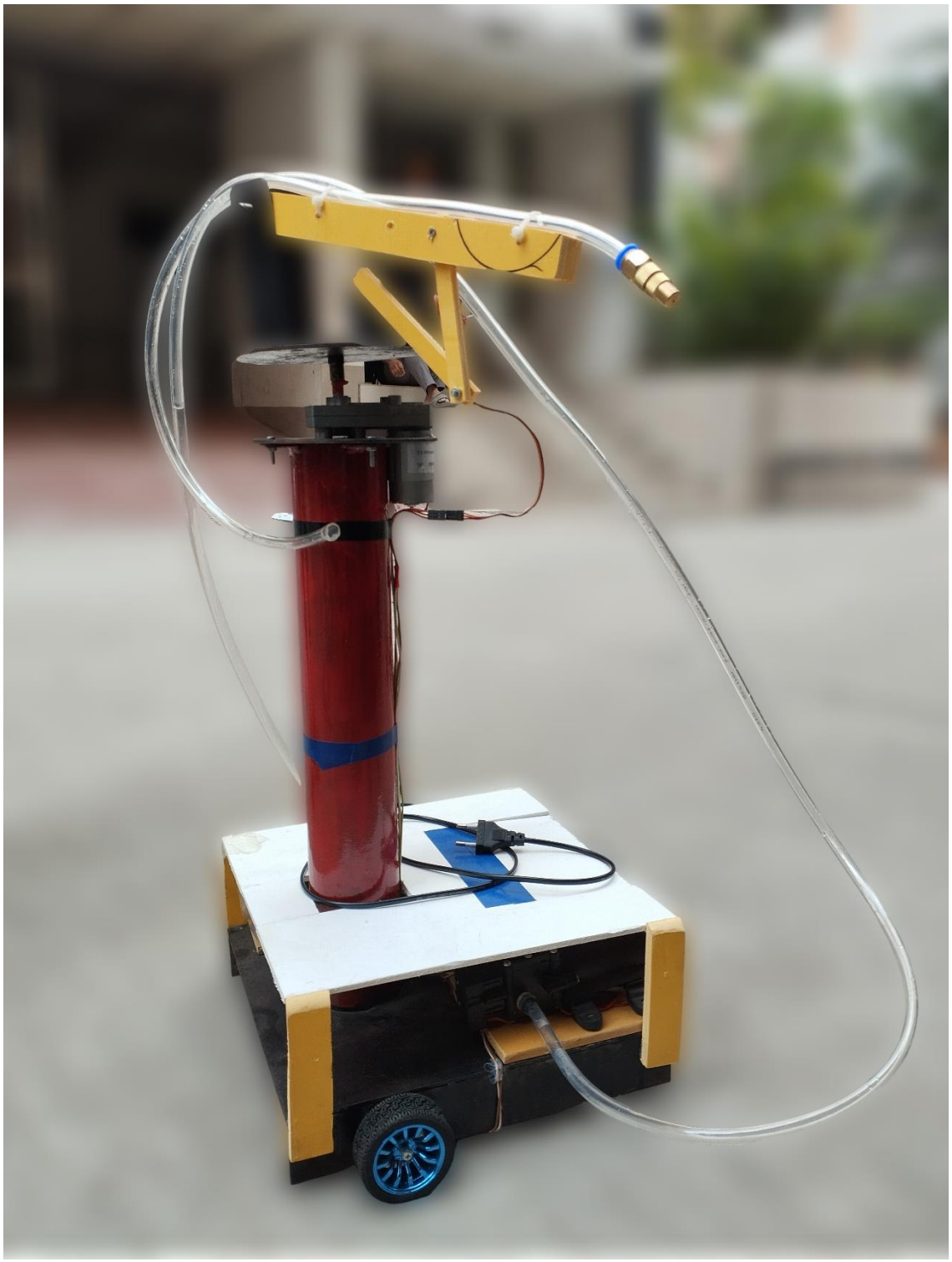


Figure 4.5: Final System Overview

CHAPTER 5
RESULTS AND DISCUSSION

5.1 Results

Now, it's time to talk about the results. We have written our commands using the Arduino IDE and the following things can happen:

- After powered the project then system will be Activate.
- Then connect the system with BlynkIoT mobile apps to operate.
- Then microcontroller will control the system.
- When fire will occur but fire fighter will not be able to enter there. In this situation our 360 degree fire protection robot able to go there and watered on fire.
- Our nozzle head portion is 360 degree moveable.

5.2 Technical Data

- Time taken for battery charging (Full): 03 Hours (Approximate)
- Battery Consumption Time: 4-5 Hours (Depends on operating condition)
- Pump Details: 5A, 12V DC, 100 PSI (6.88 Bar) Cutoff, 4.5 L/min (Max), Spray Distance: 9 m (Max)

Table 5.1: Practical Data of Pump and Water Jet.

No of Test.	Pumped water volume	Time			Discharge Rate	Water Jet Distance (meter)	Remarks
		Start	Finished	Total			
1	1 L	18:10:00	18:10:54	54 Sec	0.9 L/s	4	
2	1 L	18:15:12	18:15:55	43 Sec	0.72 L/s	2.8	
3	1 L	18:18:00	18:18:38	38 Sec	0.63/s	1	

Table 5.2: Wireless Control Data Using Blynk IoT (Mobile App)

No of Test.	Wireless App Control Distance (meter)	Receiver Response Time (Sec.)	Head Rotating Time (360 Degree) in Sec.	Nozzle Up/Down (Sec.)	Forwarding Speed (m/s)	Reserving Speed (m/s)	Remarks
1	2	0.1	1	2	0.11	0.07	
2	3	0.1	1	2	0.11	0.07	
3	5	0.1	1	2	0.13	0.07	

5.3 Applications

This project has applications in many fields due to its necessity. We have selected a few of them and they are given below:

- Useful for controlling both indoor and outdoor fires.
- Can provide a low cost fire protection system with limited centralized fire protection.
- Proficient to use for extinguish chemical fire or fire where firefighters unable to access due to excessive heat or toxic fumes.

5.4 Advantages

There are many advantages of our project because of its accuracy. Some of the advantages are pointed out below:

- Reduce Accidental Losses.
- Water Spray at Targeted Point.
- Blynk IoT Mobile Apps Controlled Operation Ensures Operator Safety.
- Adjustable Nozzle for Spray Tuning.
- Powerful Long Distance Water Jet.
- The system is user friendly.

5.5 Limitations

There are some limitations of this project. Those are point out below:

- Internet connection is required to operate the system.
- Dependency with Blynk IoT Mobile Apps.
- Trained operator is required.

5.6 Discussion

While working with this project, we had face some difficulties as it is a very complex system like electromechanical functionalities and program controlled but the end results, we came up with quite satisfactory solution. We have put the whole system through several tasks to validate our work and also have taken necessary notes for future improvements. Some future recommendations that we have involves improvement in system design and wiring, adding features for more efficient.

CHAPTER 6
CONCLUSION

6.1 Conclusion

Fire has always been a devastating phenomenon but the technology advancements it become easier to tackle it. Firefighters try their best to respond quickly to case of fire and even put their lives at risk of they endeavor to save human life and protect property loss from the fires. Some attempts have been made to automatic fire fighting for the navy (ship board autonomous firefighting robot). This paper describes one such solution to the problem of fire fighting with help of 360 degree fire protection system. In conclusion there are many possible ways to put out fires but it always safer to use the constantly this idea to reduce the involvement of fire fighters thereby decreasing the risk of physical injuries and life threats. Comparing this prototype with the existing technology we implement the sensor and wireless technology. Nowadays the firefighting technologies are fully manual. In scope of future we implement wireless technology to control the fires.

6.2 Future Scope

- In future, we make it more efficient.
- In future, we are thinking about adding more features to the system such as Fire detection sensor, monitoring cameras, lifting or Height accessibility, Distance measurement sensor between fire & system.

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