Design and Fabrications of a 360 Degree Voice-Controlled Fire Fighting

Submitted
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ABSTARCT

Large flames are put out with the help of friendly, controllable, high-capacity water jets called fire monitors and sprayers. Fire monitors, in contrast to fire extinguishers, are fixed installations that cannot be moved. This fire monitor has RF control, whereas conventional fire monitor systems require a human operator to adjust the water jet's direction and aim it correctly. enabling the user to control it safely from a distance. The system uses a motor that is connected to a potent sprayer motor and a piping system. The orientation and movement of the nozzle are managed by a separate motor. To send movement commands, the user can use a wireless remote. Users can command 60% success result running to command by voice system the motors to produce desired motion by sending commands to the receiver circuitry located on the system. In order to start and stop the spray, the receiver also controls the pump motor. The water spray exit can also be modified by adjusting the sprayer nozzle. The sprayer mechanism is designed to provide 360 degrees of coverage with water spray.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Fire hazards are a common phenomenon in developing countries like India causing loss of lives and property every year. According to the India Risk Survey (IRS) 2018, 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,[1] Fire extinguisher robots will play a vital role. Another aspect is related to the firemen involved in these accidents – they risk their lives while rescuing the victims. The location of the fire accident is important – e.g., chemical mills, garment factories, gas and petrol stations, as it affects the target area including surroundings.[2] 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. [2,3]

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.[3] 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, detect the fire- affected areas using a flame sensor and then letting the user manually control the robot to douse the fire using a water pump connected to a water storage tank.[4]

1.2 Objectives

The objectives of this project are:

- To study about Design and Fabrications of a 360 Degree Voice-Controlled Fire Fighting
- To implement a Fire Protection System.
- To send an alert in gate mane voice controlled by the use of voice recognition module kit v3
- Manual control system practice
- To test the performance of the system:

-Users can command 60% success result running to command by voice system.

1.3 Structure of the Project

This Project is organized as follows:

Chapter 1 Introduction**:**

The first 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 chapter two contains our introduction, literature review part.

Chapter 3 Methodology**:**

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 4 Hardware and Software Analysis**:**

Chapter four describes the theoretical model. Here we mainly discuss about proposed system Hardware and software development of our project etc.

Chapter 5 Result and Project View**:**

Chapter five deals with the result and Project View about our project advantages and application.

Chapter 6 Conclusion & Discussion**:**

Chapter six all about our project conclusion and future scope.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this section topics related to **360 Degree Voice Control Fire Fighting Robot** are included. . The references are summarized below.

2.2 Literature Review

In today's era firefighting in hazardous locations is a difficult 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 litre 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 Behaviour 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 [5]

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[6]. 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

2.3 Advantage

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

- Reduce accident.
- Targeted water spraying to avoid water damage in office
- Remote controlled operation ensures operator remains safe
- Adjustable Nozzle for Spray Tuning
- Powerful Long Distance Water Spray
- The system is user friendly.

2.4 Application

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

- Useful for controlling indoor fires.
- Can provide a low cost fire protection system with limited centralized fire protection.

2.5 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 last year's project.

CHAPTER 3

METHODOLOGY

3.1 Introduction

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

3.2 Methodology

Our used methodology for the project:

- Creating an idea for the design and construction of "**Design and Febrications of a 360 Degree Voice Controlled Fire Fighting".** And 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]

Hardware

- Arduino Nano
- Arduino Pro Mini
- Servo Motor
- NRF Receiver
- Motor Driver
- SMPS
- Relay
- High Speed Pump Motor
- Nozzle

3.3 Arduino Nano

Arduino is an open source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino can sense the environment by

receiving input from a variety of sensors and can affect its surroundings by controlling Lights, motors, and other actuators.[2]



Figure 3.1: Arduino Nano

The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, Maxims'). Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a small, complete, and breadboard friendly component.[3]

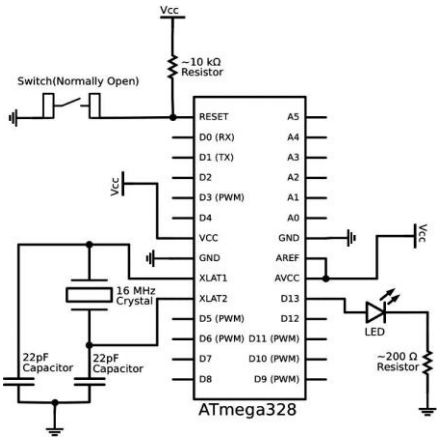


Figure 3.2: Arduino Nano Schematic Diagram

Nano's got the breadboard-ability of the Boarding and the Minibus with smaller footprint than either, so users have more breadboard space. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, and GND on one top, power and ground on the other). This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It has two layers. That make it easier to hack and more affordable. One of the best features of Arduino Nano is, it's easy to use, compact and

also small.

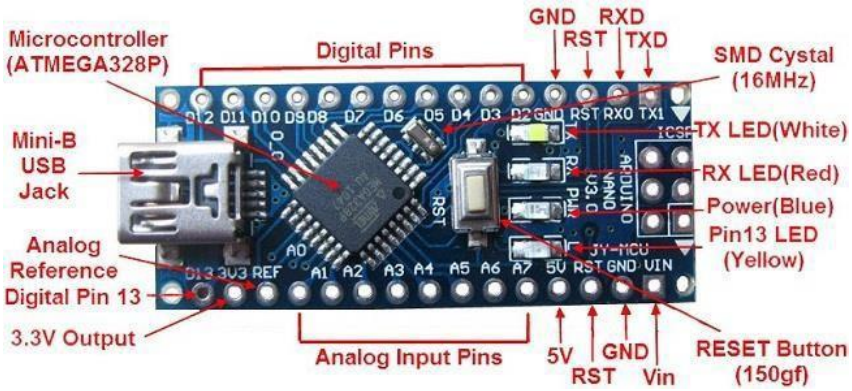


Figure 3.3: How Arduino Nano looks like

Specifications:

- Microcontroller: Atmel ATmega328
- Operating Voltage (logic level): 5 V
- Input Voltage (recommended): 7-12 V
- Input Voltage (limits): 6-20 V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 8
- DC Current per I/O Pin: 40 mA
- Flash Memory: 32 KB (of which 2KB used by boot loader)
- SRAM : 2 KB
- EEPROM: 1 KB

Features:

- Automatic reset during program download
- Power OK blue LED
- Green (TX), red (RX) and orange (L) LED
- Auto sensing/switching power input
- Small mini-B USB for programming and serial monitor
- ICSP header for direct program download
- Standard 0.1 spacing DIP (breadboard friendly)
- Manual reset switch

Micro-controller IC ATmega328p



Figure 3.4: Micro-controller IC AT mega 328p

The high-performance Microchip Pico Power 8-bit AVR RISC-based micro-controller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages),[4] programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed. [5]

3.4 Arduino Pro Mini

The Arduino Pro Mini is a micro-controller board based on the ATmega168. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, an on- board resonator, a reset button, and holes for mounting pin headers. A six pin header can be connected to an FTDI cable to provide USB power and communication to the board. [6]

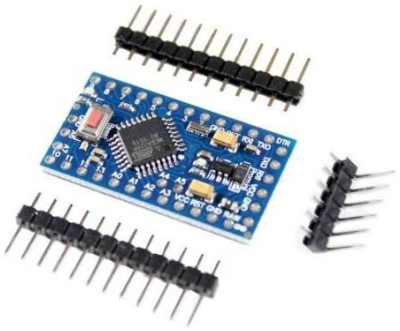


Figure 3.5: Arduino Pro Mini

Specification

- Micro-controller ATmega168
- Operating Voltage: 3.3V or 5V (depending on model)
- Input Voltage: 3.35 -12 V (3.3V model) or 5 - 12 V (5V model)
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- Flash Memory: 16 KB (of which 2 KB used by boot loader)
- SRAM: 1 KB
- EEPROM: 512 bytes
- Clock Speed: 8 MHz (3.3V model) or 16 MHz (5V model)

Pin Out

Each of the 14 digital pins on the Pro Mini can be used as an input or output, using pin Mode(), digital Write(), and digital Read() functions. They operate at 3.3 or 5 volts (depending on the model). Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the TX-0 and RX-1 pins of the six pin header.

- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

  The Pro Mini has 6 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). Four of them are on the headers on the edge of the board; two (inputs 4 and 5) on holes in the interior of the board. The analog inputs measure from ground to VCC. Additionally, some pins have specialized functionality:

- I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library.

There is another pin on the board:

- Reset. Bring this line LOW to reset the micro controller. Typically used to add a reset button to shields which block the one on the board.

  See also the mapping between Arduino pins and ATmega168 ports.

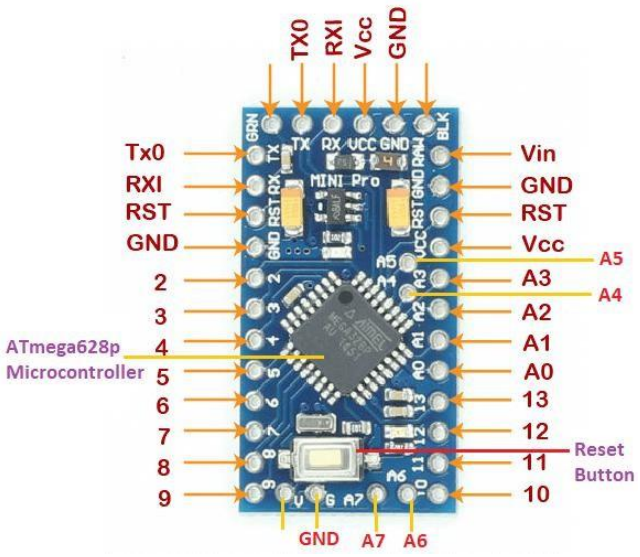


Figure 3.6: Arduino Pro Mini Pin Out

3.5 Switch Mode Power Supply (SMPS)

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as a personal computer, while converting voltage and current characteristics. [7]

Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power.[8] Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles). In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.[9]



Figure 3.7: SMPS

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.[10]

12V 5A Industrial SMPS Power Supply – 60W – DC Metal Power Supply – Good Quality – Non Waterproof with Aluminum casing.

- Input Voltage: AC 100 – 264V 50 / 60Hz
- Output Voltage: 12V DC, 0-5A
- Output voltage: Adjustment Range: ±20%
- Protections: Overload / Over Voltage / Short Circuit
- Auto-Recovery After Protection
- Universal AC input / Full range
- 100% Full Load Burn-in Test
- Cooling by Free Air Convection
- High Quality and High Performance
- LED power supply with a metal body for hidden installation for LED lighting
- Design with Built-in EMI Filter, improve signal precision.
- Certifications: CE & RoHs

Switched-mode power supplies are classified according to the type of input and output voltages. The four major categories are:

- AC to DC
- DC to DC
- DC to AC
- AC to AC

A basic isolated AC to DC switched-mode power supply consists of:

- Input rectifier and filter
- Inverter consisting of switching devices such as MOSFETs
- Transformer
- Output rectifier and filter
- Feedback and control circuit

The input DC supply from a rectifier or battery is fed to the inverter where it is turned on and off at high frequencies of between 20 KHz and 200 KHz by the switching MOSFET or power transistors. The high-frequency voltage pulses from the inverter are fed to the transformer primary winding, and the secondary[11] AC output is rectified and smoothed to produce the required DC voltages. A feedback circuit monitors the output voltage and instructs the control circuit to adjust the duty cycle to maintain the output at the desired level.[12]

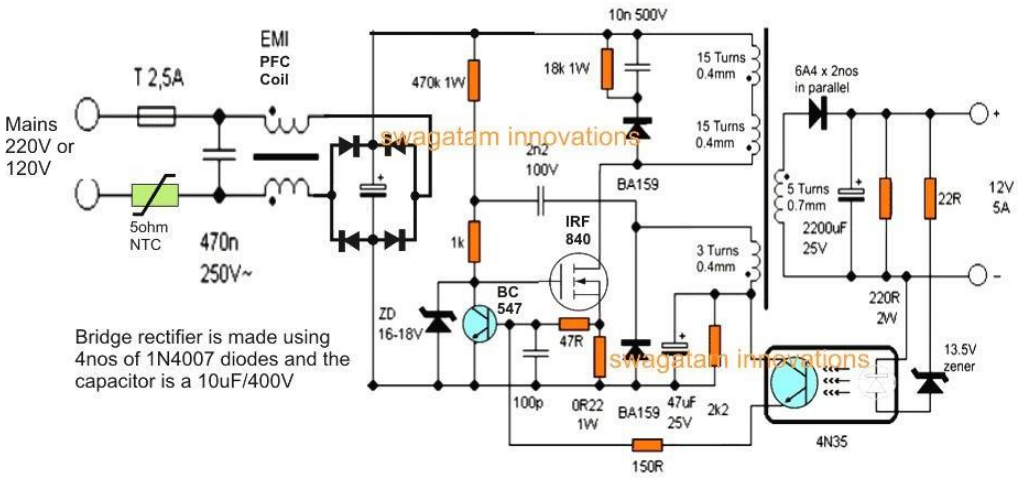


Figure 3.8: SMPS Circuit Design

Basic working concept of an SMPS

A switching regulator does the regulation in the SMPS. A series switching element turns the current supply to a smoothing capacitor on and off. The voltage on the capacitor controls the time the series element is turned. The continuous switching of the capacitor maintains the voltage at the required level.

Design basics

AC power first passes through fuses and a line filter. Then it is rectified by a full-wave bridge rectifier. The rectified voltage is next applied to the power factor correction (PFC) pre-regulator followed by the downstream DC-DC converter(s). Most computers and small appliances use the International Electro technical Commission (IEC) style input connector. As for output connectors and pin outs, except for some industries, such as PC and compact PCI, in general, they are not standardized and are left up to the manufacturer.[1,2]

There are different circuit configurations known as topologies, each having unique characteristics, advantages and modes of operation, which determines how the input power is transferred to the output. Most of the commonly used topologies such as fly back, push-pull, half bridge and full bridge, consist of a transformer to provide isolation, voltage scaling, and multiple output voltages. The non-isolated configurations do not have a transformer and the power conversion is provided by the inductive energy transfer.[3,4]

Advantages of switched-mode power supplies:

- Higher efficiency of 68% to 90%
- Regulated and reliable outputs regardless of variations in input supply voltage
- Small size and lighter
- Flexible technology
- High power density

Disadvantages:

- Generates electromagnetic interference
- Complex circuit design
- Expensive compared to linear supplies

Switched-mode power supplies are used to power a wide variety of equipment such as computers, sensitive electronics, battery-operated devices and other equipment requiring high efficiency [4]

Switch Mode Power Supply

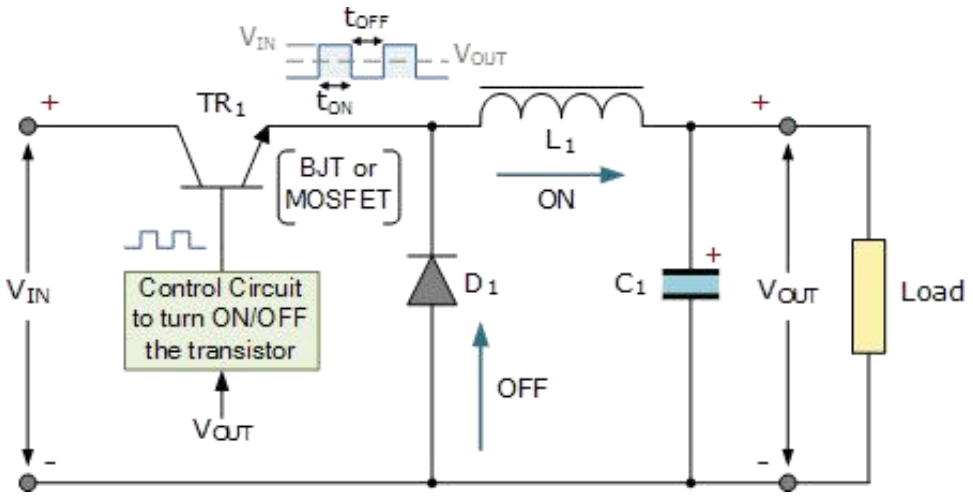


Figure 3.9: Power Supply Connection

Linear voltage IC regulators have been the basis of power supply designs for many years as they are very good at supplying a continuous fixed voltage output. Linear voltage regulators are generally much more efficient and easier to use than equivalent voltage regulator circuits made from discrete components such a zener diode and a resistor, or transistors and even op-amps.[6] The most popular linear and fixed output voltage regulator types are by far the positive output voltage series, and the 79 negative output voltage series. These two types of complementary voltage regulators produce a precise and stable voltage output ranging from about 5 volts up to about 24 volts for use in many electronic circuits.[5]

There is a wide range of these three-terminal fixed voltage regulators available each with its own built-in voltage regulation and current limiting circuits. This allows us to create a whole host of different power supply rails and outputs, either single or dual supply, suitable for most electronic circuits and applications. There are even variable voltage [9]

linear regulators available as well providing an output voltage which is continually variable from just above zero to a few volts below its maximum voltage output.[10]

Most D.C. power supplies comprise of a large and heavy step-down mains transformer, diode rectification, either full-wave or half-wave, a filter circuit to remove any ripple content from the rectified D.C. producing a suitably smooth D.C. voltage, and some form of voltage regulator or stabilizer circuit, either linear or switching to ensure the correct regulation of the power supplies output voltage under varying load conditions. Then a typical D.C. power supply would look something like this:

Typical DC Power Supply

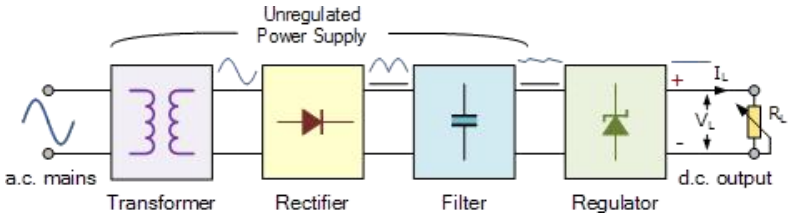


Figure 3.10: DC Power Supply Step

These typical power supply designs contain a large mains transformer (which also provides isolation between the input and output) and a dissipative series regulator circuit. The regulator circuit could consist of a single zener diode or a three-terminal linear series regulator to produce the required output voltage. The advantage of a linear regulator is that the power supply circuit only needs an input capacitor, output capacitor and some feedback resistors to set the output voltage.

3.6 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 use servo motors. 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 3.11: Servo Motor

Servo motors are rated at kg / cm (centimeters per kilogram). 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.[1]

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.

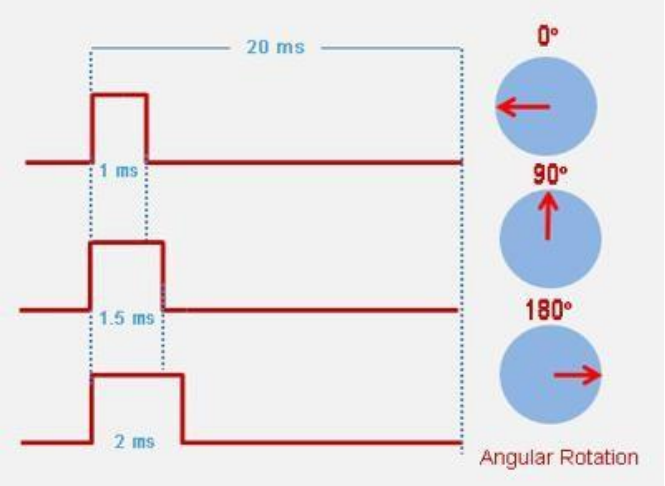


Figure 3.12: Schema Diagram of servo motor

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.

3.7 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 3.13: 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 02: 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.

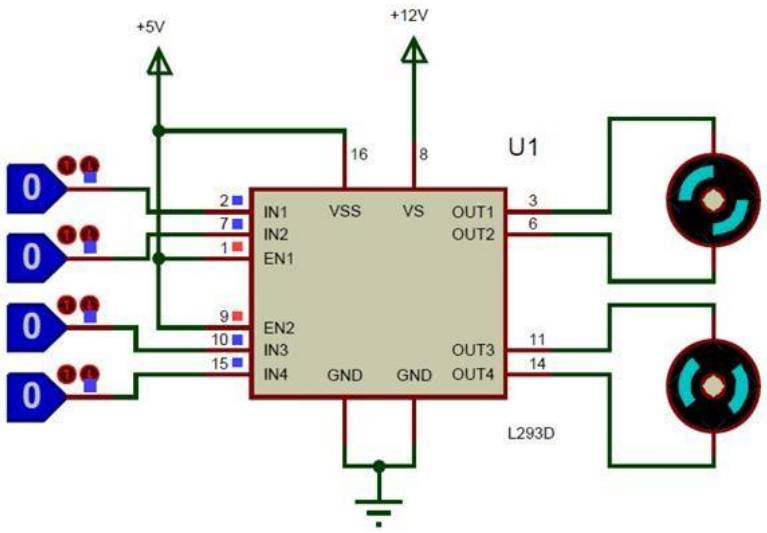


Figure 3.14: L293D circuit Diagram

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)

3.8 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: 12V - 24V
- Power: 120W Max
- Working Pressure: 160Psi (10.5 Bar) Cutoff
- Cutoff Automatic Switch
- Flow (MAX): 10L/min
- Pressure Adjustable Copper Head Water Spray
- Water Pressure Limit : Adjustable
- Sprayers Size : 20cm
- Spray Distance: 9 m
- Thread Diameter: 1.5cm
- Main Material: Copper, Plastic
- Power supply Voltage: 12V DC
- Power supply Current: 5A



Figure 3.15: High Speed Pump

3.9 NRF Wireless Module

The nRF24L01 is a **wireless transceiver module**, meaning each module can both send as well as receive data. They operate in the frequency of 2.4GHz, which falls under the ISM band and hence it is legal to use in almost all countries for engineering applications.

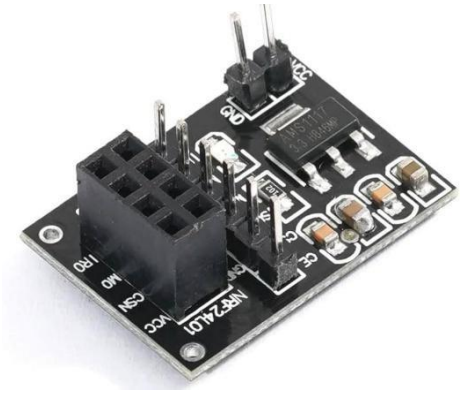


Figure 3.16: NRF Receiver

Power

The module's operating voltage ranges from 1.9 to 3.9V. Please keep in mind that powering the module with 5V will most likely damage your nRF24L01+ module.Despite the fact that the module operates at 1.9V to 3.6V, the logic pins are 5-volt tolerant, so you do not need a logic level translator.The output power of the module can be programmed to be 0 dBm, -6 dBm, -12 dBm, or -18 dBm. At 0 dBm, the module consumes only 12 mA

during transmission, which is less than the consumption of a single LED. And the best part is that it consumes only 26 µA in standby mode and 900 nA in power down mode. That's why it's the go-to wireless device for low-power applications.

SPI Interface

The nRF24L01+ communicates over a 4-pin SPI (Serial Peripheral Interface) with a maximum data rate of 10Mbps. All parameters, including frequency channel (125 selectable channels), output power (0 dBm, -6 dBm, -12 dBm or -18 dBm), and data rate (250kbps, 1Mbps, or 2Mbps), can be configured through the SPI interface. The SPI bus uses the concept of a master and a slave. In most of our projects, the Arduino serves as the master and the nRF24L01+ module serves as the slave.

Technical Specifications

Here are the specifications:

Frequency Range	2.4 GHz ISM Band
Maximum Air Data Rate	2 Mb/s
Modulation Format	GFSK
Max. Output Power	0 dBm
Operating Supply Voltage	1.9 V to 3.6 V
Max. Operating Current	13.5mA
Min. Current (Standby Mode)	26µA
Logic Inputs	5V Tolerant
Communication Range	800+ m (line of sight)

3.10 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.

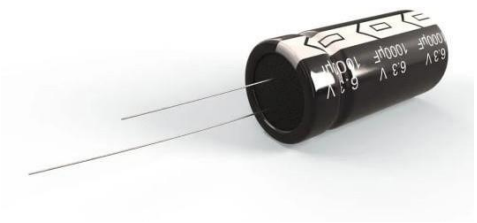


Figure 3.17: Capacitor

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.

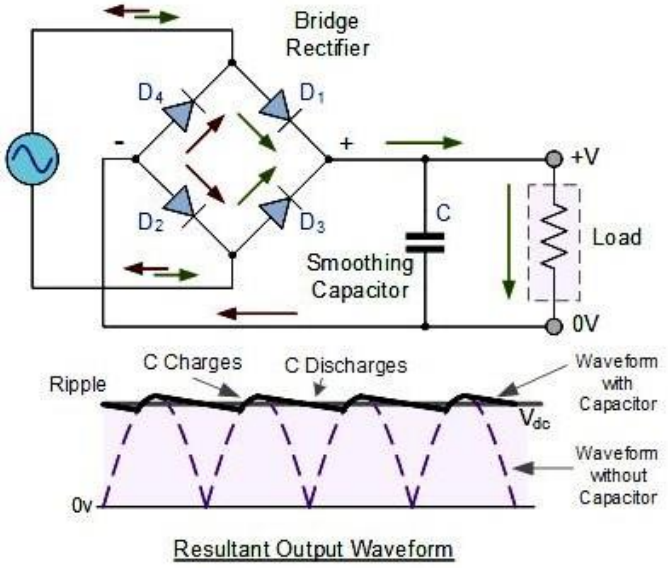


Figure 3.18: The Smoothing Capacitor with Full Bridge Rectifier

3.11 Microphone

In a 360 Degree Voice Control Fire Fighting Robot, the microphone serves as a crucial component for receiving voice commands from the operator or user. This microphone is typically integrated into the robot's system to capture verbal instructions or alerts from the surroundings.

With voice control capabilities, the operator can remotely command the robot to perform various firefighting tasks such as moving to specific locations, deploying firefighting agents, or assessing the environment for potential hazards. The 360-degree aspect implies that the microphone is designed to capture sound from all directions, allowing for effective communication regardless of the robot's orientation.

In essence, the microphone enables intuitive and hands-free operation, enhancing the robot's usability and responsiveness in firefighting scenarios.



Figure 3.19: Microphone

3.12 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 3.20: 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.

3.13 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.

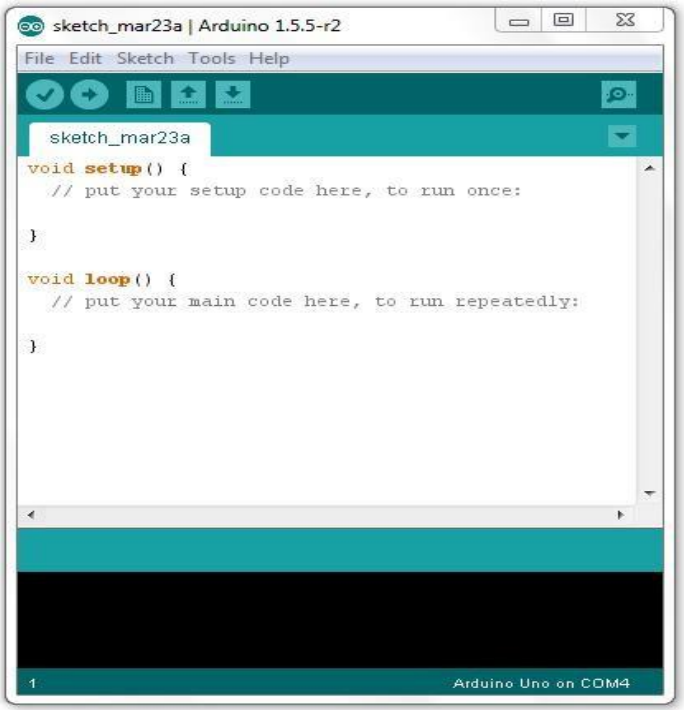


Figure 3.21: Arduino Software Interface IDE

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. ino. 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 its #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).

3.14 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 during transmission, which is less than the consumption of a single LED. And the best part is that it consumes only 26 µA in standby mode and 900 nA in power down mode. That's why it's the go-to wireless device for low-power applications.

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.

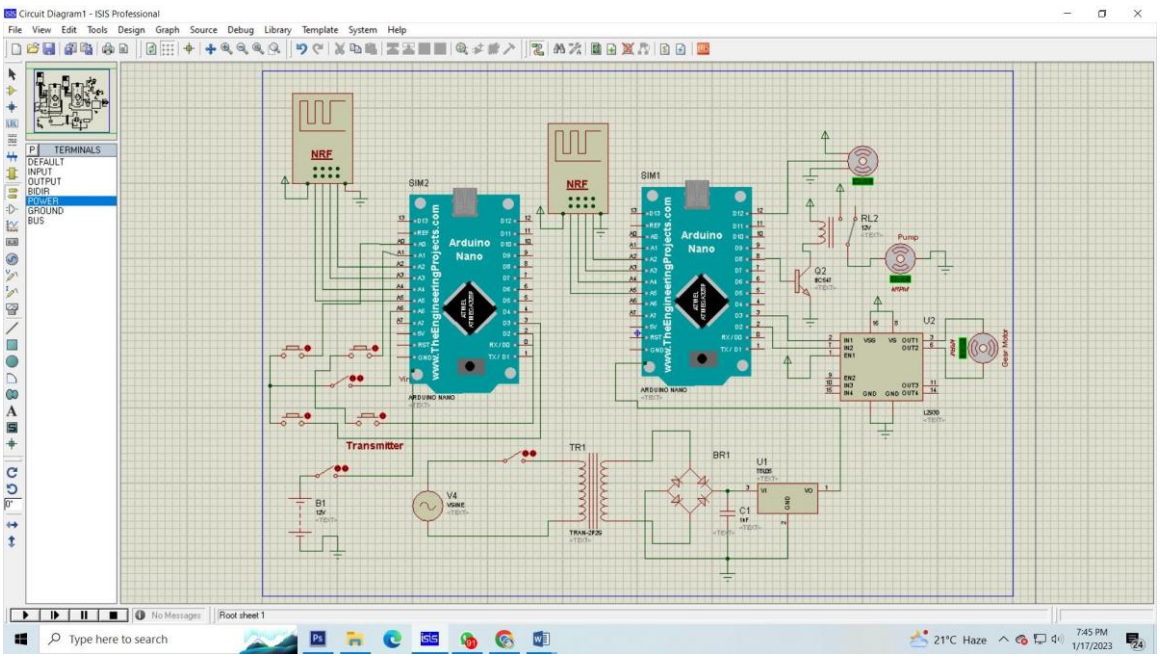


Figure 3.22: Proteus Software Interface

CHAPTER 4

HARDWARE AND SOFTWARE ANALYSIS

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 man oeuvre 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 utilised 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 utilised 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 utilise to finish their industrial projects because it takes minimal resources and ingredients.

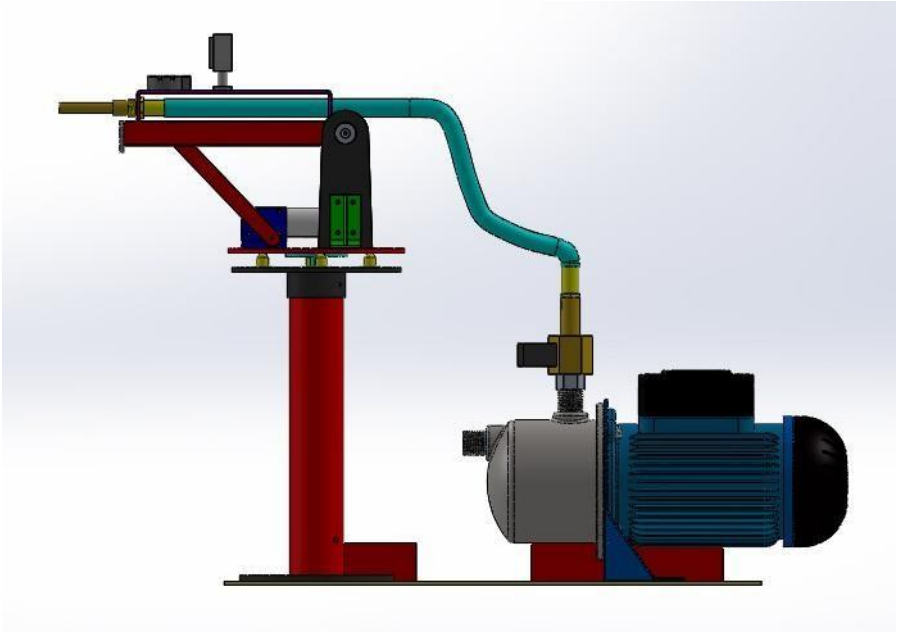


Figure 4.1: Structural View (Side View)

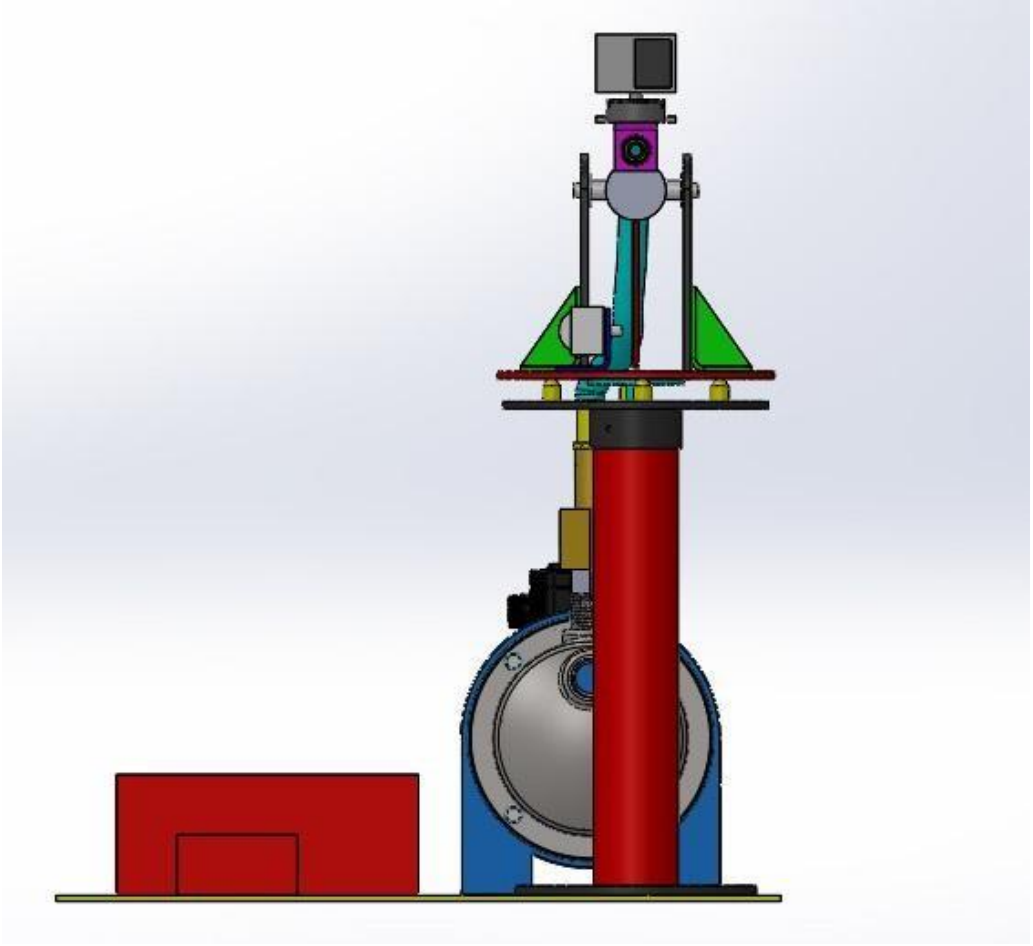


Figure 4.2: Structural View (Front View)

4.2 Block Diagram

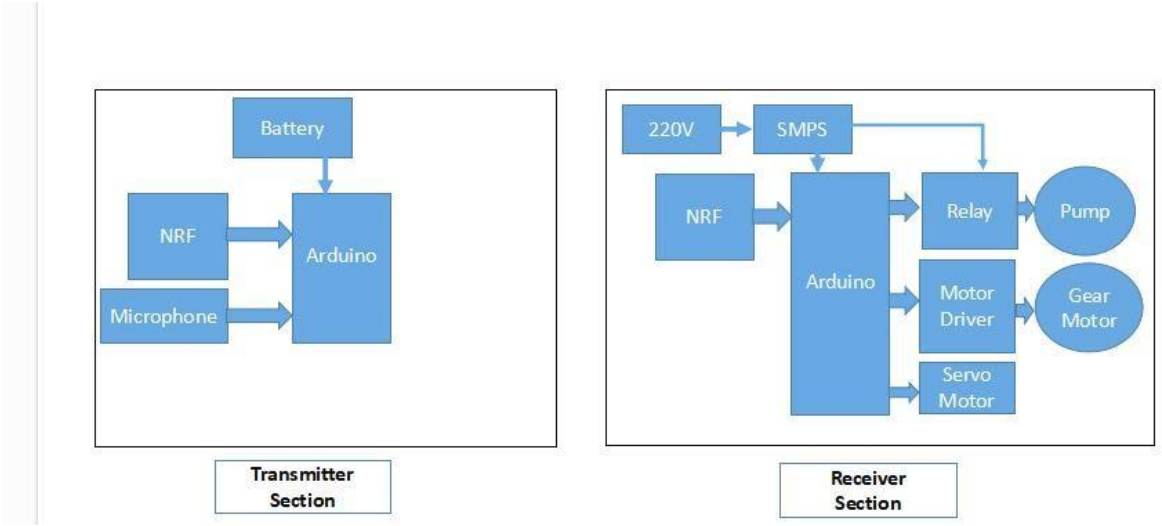


Figure 4.3: Block Diagram of Our System

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.

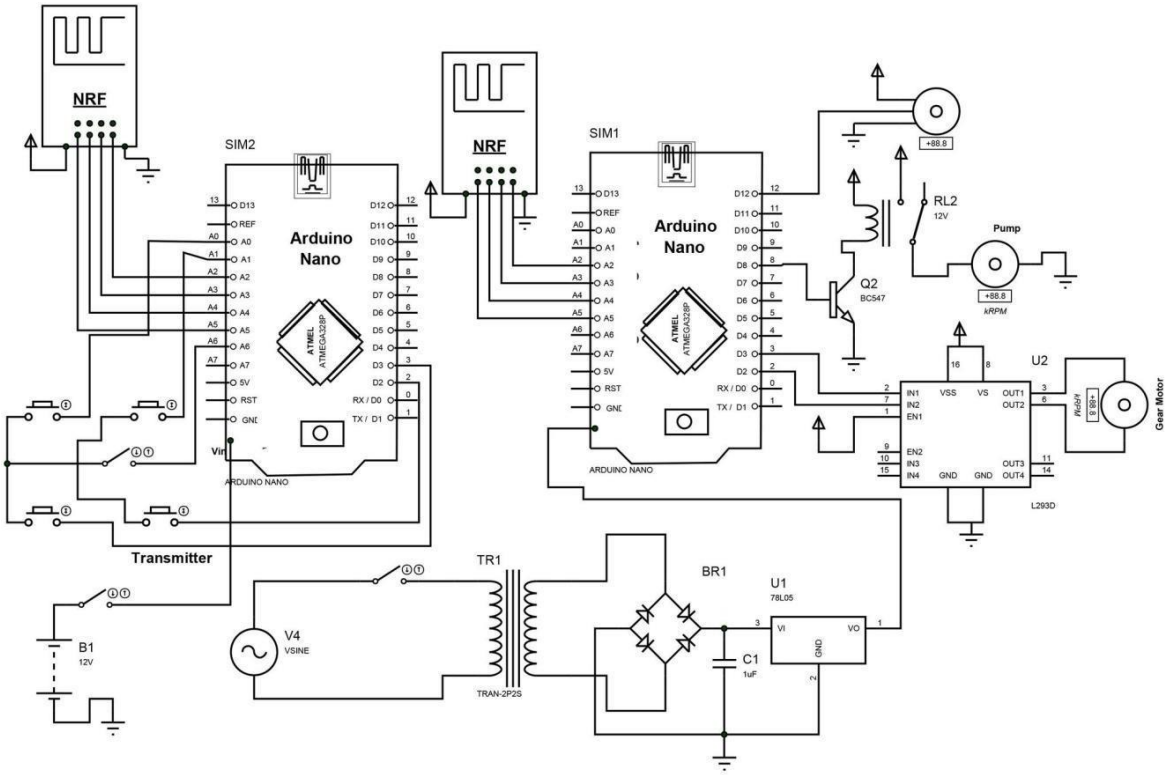


Figure 4.4: Schematic Diagram of the Project

4.4 Working Principle

The way our 360° Rotating Fire Protection System works is that we take the 220V rms from the supply voltage and then give it to the SMPS, the SMPS 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 Arduino Nano Micro- controller, Arduino Pro mini for it to run. Here we also use Motor driver, 12V SMPS, High speed pump, NRF receiver, 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 little manual controller, 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 controller. This is the main procedure of our system.

CHAPTER 5
RESULT AND DISCUSSION

5.1 Result

Table:

No of Command	Result or Taken Command	Position	Accuracy
1	Yes	Front (Go)	**60%**
2	No	Reverse	
3	Yes	Reverse	
4	No	Right	
5	Yes	Right	
6	Yes	Left	
7	No	Turn Off	
8	Yes	Turn Off	
9	No	Nozzle Up	
10	Yes	Nozzle Up	
11	Yes	Nozzle Down	
12	No	Pump ON	
13	Yes	Pump ON	
14	No	Pump Off	
15	Yes	Pump Off	

Accuracy:

No of command (Yes) = 09, Total Command = 15

Accuracy = [Number of Command/ Total Command] *100%

= [9/15] * 100

= 60 %

5.2 Our Final System View

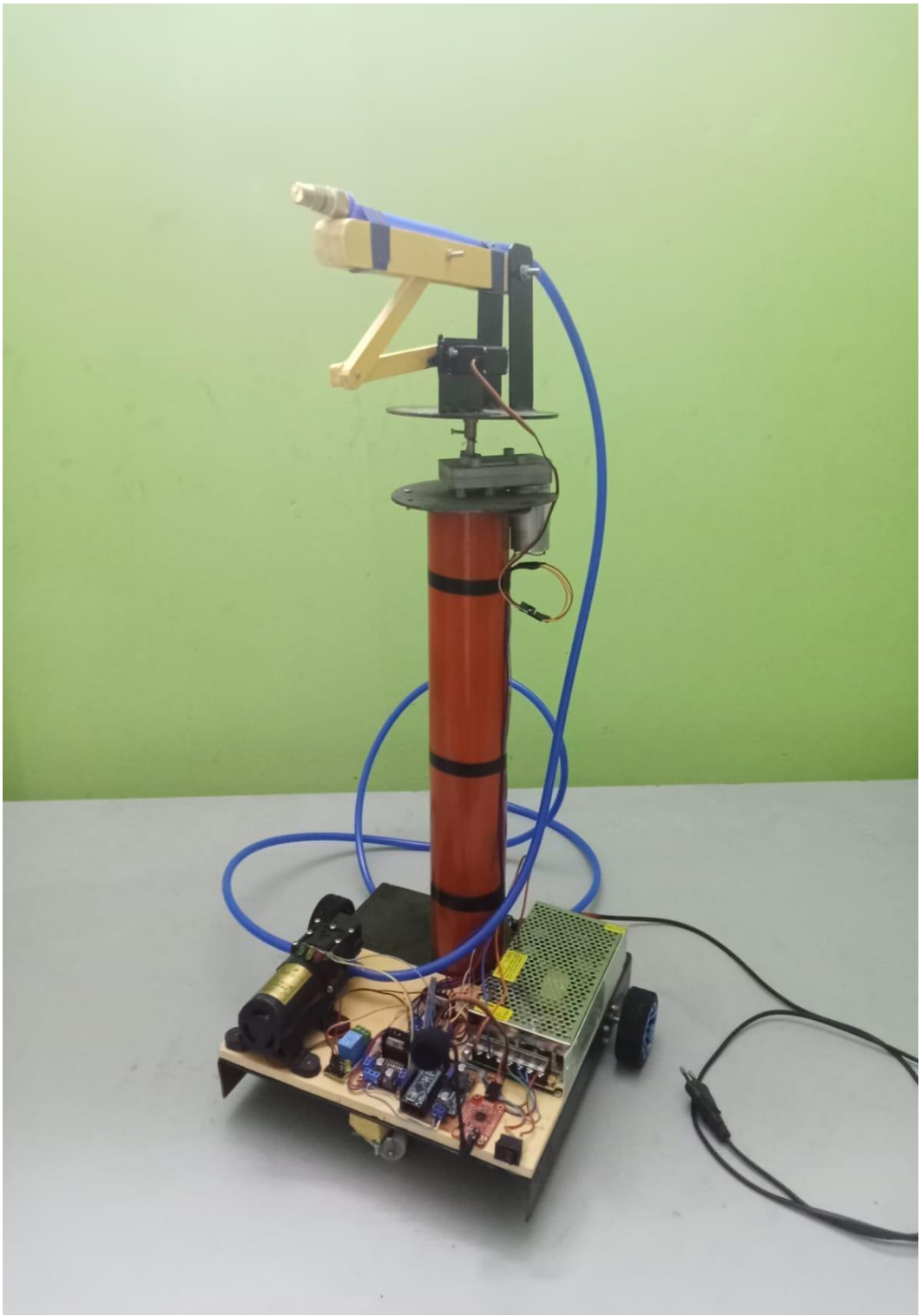


Figure 5.1: Our Final System Overview

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 event put their lives at risk of they endeavor to save human life and protect property 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 Discussion

While working on our project, we did face some difficulties as it is a very complex system but the end results, we came up with were quite satisfactory. 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.

6.3 Future Scope

- In future, we make it more efficient.
- In future, we are thinking about adding more features to the system such as sensor and monitoring cameras.

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