Design and Fabrication of Automatic Rain Shed Sensing System

A report submitted to the Department of Mechanical, Sonargaon University of Bangladesh in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Mechanical Engineering.

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Letter of Transmittal

December, 2024

To

Name: Md. Minhaz Uddin

Designation: Assistant Professor

Department of Mechanical Engineering

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Subject: Submission of Project Report.

Dear Sir,

We are pleased to submit the project report on "**Automatic Rain Shed Sensing 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,

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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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Abstract

The Automatic Rain Shed Sensing System is an innovative and efficient solution designed to provide automatic protection from rain in outdoor and semi-outdoor environments. The system employs advanced sensing technology to detect rainfall and instantly activate a retractable shed or cover mechanism, offering convenience and protection for users, goods, or equipment. The core components include a rain sensor, which detects precipitation, a microcontroller unit to process sensor data, and a motorized mechanism for the deployment and retraction of the shed. Additional features may include a solar-powered energy source for sustainable operation, manual override controls, and a weatherproof design to ensure durability and reliability in diverse environments. This system is ideal for residential, commercial, and industrial applications, such as protecting vehicles in open parking spaces, outdoor seating areas, or exposed equipment. By automating the process of rain protection, the system enhances user convenience, prevents damage caused by unexpected rainfall, and promotes better resource efficiency. The project aligns with smart automation trends, showcasing an eco-friendly and practical approach to managing environmental challenges.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The Automatic Rain Shed Sensing System is a smart solution designed to provide instant protection from unexpected rainfall in outdoor and semi-outdoor spaces. Sudden rain can disrupt activities, damage property, and cause inconvenience. This system addresses these challenges by automatically detecting rainfall and deploying a protective shed.



Figure 1.1 : Rain Shed

The system comprises a rain sensor, a microcontroller, and a motorized mechanism that works together to sense precipitation and activate the shed. Once the rain stops, the shed retracts, ensuring convenience and efficiency without manual intervention. Designed with weather-resistant materials and energy-efficient components, the system can optionally incorporate solar power for sustainable operation.Applications include protecting vehicles, outdoor furniture, and equipment in residential, commercial, and industrial settings. By combining automation with practicality, the Automatic Rain Shed Sensing System offers a reliable and innovative approach to managing environmental challenges while enhancing convenience and reducing weather-related risks.

1.2 Background

Farming is the science and art of creating plants and creatures. Agriculture was the key headway in the climb of stationary human advancement whereby the developing of prepared species made sustenance surpluses that engaged people to live in urban regions. The chronicled background of agriculture began an enormous number of years earlier. Consequent to get-together wild grains beginning at any rate 1,05,000 years earlier, early farmers began to plant them around 11,500 years back. Pigs, sheep, and cows were prepared over 10,000 years earlier. Plants were autonomously developed in any event 11 districts of the world. Modern horticulture dependent on the enormous scope of monoculture in the twentieth century came to overwhelm agrarian yield, however around two billion individuals although everything relied on subsistence agribusiness into the twenty-first. The natural impact of agribusiness is the effect that diverse cultivating practices have on the general conditions, and how those effects can be followed back to those practices. The characteristic impact of agribusiness fluctuates reliant on the wide combination of agricultural practices used over the world. Finally, the normal impact depends upon the creative practices of the system used by farmers. The relationship between spreads into the earth and the developing system is convoluted, in this manner it depends upon other air factors such as precipitation and temperature. There are two kinds of markers of natural impact: "signifies based", which relies upon the farmer's creation procedures, and "impact-based", which is the impact that developing strategies have on the cultivating structure or spreads to the earth.

An instance of a strategies-based marker would be the idea of groundwater that is impacted by the proportion of nitrogen applied to the earth. A marker reflecting the loss of nitrate to groundwater would be impact based. The techniques based on assessment realize farmers' demonstrations of agribusiness, and the impact-based assessment deliberates the genuine effects of the agrarian system. For illustrations, the methods-based analysis may look at pesticides and treatment. Systems that farmers are using, and impact-based assessment would consider the CO2 which is being released or what the Nitrogen substance of the soil is. The natural effect of agribusiness includes an assortment of components from the dirt, to water, the air, creature and soil assortment, individuals, plants and the nourishment itself. A portion of the ecological issues that are identified with farming is environmental change, deforestation, no man's lands, hereditary building, water system issues, contamination, soil corruption, and waste. These days, during the

stormy season the developed harvests get influenced because of overwhelming precipitation.

The proposed framework includes security of the harvests via auto rooftop which covers the specific region. The downpour sensor is actuated when there is precipitation, and it will offer implications to the farmer through the GSM module by sending SMS. Hence to close the rooftop, the farmer needs to send an SMS to the GSM module. When the downpour is halted, the controller consequently opens the rooftop. This research paper is more acquainted with the objective and motivation behind the proposed method. Collected fields get influenced or demolished because of substantial downpour and shortage issues. Various existing systems are discussed in the literature survey also listed their practical views and explained proposed strategies to defeat the impediments of the current one and give the best outcomes to farmers. The significant objective of this paper is to keep the reaped crops from the overwhelming precipitation and spare the downpour water. The rain sensor is utilized for the working of the rooftop when there is precipitation.

1.3 Problem Statement

The Automatic Rain Shed Sensing System addresses the need for rapid and efficient protection of outdoor spaces and equipment during rainfall. This system employs rain sensors to detect precipitation and automatically activates a motorized shed or cover to shield the area. Designed for residential, commercial, and agricultural applications, the system reduces the need for manual intervention, ensuring quick response to weather changes. It integrates smart technologies for real-time monitoring, energy efficiency, and reliable operation. By preventing damage to assets, improving convenience, and supporting sustainable living, this innovative solution offers a practical approach to mitigating the impact of sudden rain events.

1.4 Objective

The objectives of this project are:

- To study the Automatic Rain Shed Sensing System
- To design and construct to find the Automatic Rain Shed Sensing System
- To decrease the cost of machine by application of simple mechanism.

CHAPTER 2

LITURATURE REVIEW

2.1 Literature review

P. Goutham Goud et al [1] Rain sensor, a sophisticated microprocessor, and a DC motor are used in a system where the deluge is recognised and a protective shield is wrapped around the rooftop. The rain sensor of such a drying shed protects the harvest from rain and wetness. To automate this task, a rainfall detects the downpour and sends the information to the microcontroller. A defensive wrapper is wrapped over the rooftop top, and the microcontroller forms the information and activates the DC motor control circuit.

Dheekshith et al [2] developed a system for identifying precipitation by using a downpour distinguishing sensor. The sensor is connected to a direct actuator motor and a spread job that protects against rain. When the sensor detects rain, it goes to work and pivots the spreading roll, which covers the gathered merchandise and protects the farmer from losses.

Naveen K B et al [3] suggested a framework that was structured using the Proteus programming language. When the rain sensor detects a deluge, the soil moisture sensor determines dampness content, which is displayed on the LCD. . The value sent to the PIC microcontroller is determined by the soil moisture sensor, temperature sensor, and rain sensor. The automatic rainwater and crop saving system protect crops from excessive rainwater by taking into consideration the attributes.

A. Arduino and Water Sensor: In recent years, water sensors along with Arduino or Raspberry Pi are used in many applications specifically related to smart irrigation. In [4] water flow sensor along with temperature sensor and soil moisture sensors are used with Arduino. Data collected by these sensors are sent to the interactive website by a WIFI module attached with an Arduino. This allows user to control water pump and sprinklers from distance which will facilitate farmer to obtain maximum quality crops. In [5] smart drip irrigation system is proposed using Arduino, Raspberry Pi and Zigbee modules. Arduino micro-controllers are used to receive the on/off commands from the Raspberry Pi using Zigbee protocol. The water pump can automatically start by just sending an email to system. In [6] Arduino and water sensors are used for measuring and monitoring

water quality for fish farming. It is used to measure temperature and pH value of water. Collected data is sent via Bluetooth to mobile application for monitoring purpose.

B. Arduino and Temperature Sensor: Many researchers have used Arduino and temperature sensors along with GSM, GPRS, Bluetooth and Zigbee modules for automation of various systems. Some of the systems are as follows: “Home Weather Station” is a mobile weather station that displays weather details on a LCD screen [7]. The outdoor station measures temperature, pressure and humidity and send it to indoor module for display. In [8] designed a low cost environment monitoring system using Raspberry Pi and Arduino with Zigbee. In [9]continuous heart rate and body temperature monitoring system is proposed using Arduino UNO and Android device.

C. Arduino and Light Dependent Resistor: Light Dependent Resistor (LDR) has used in many applications where light has to be used or sensed for automation purpose. In [10] used LDR as sensor and Light Emitting Diode (LED) as light source to design water turbidity gauge. Turbidity of water is measured by passing a light source through water to measure the intensity of light reflected. Analog data received by Arduino from LDR is converted into digital form and the result is displayed on LCD. In [11] an intelligent street light system is proposed. Street light not only depends on darkness but also on motion. Street light will only turn on if its dark and motion is detected otherwise it will stay off, thus energy is saved.

In [12] proposed origami-based automatic solar panels. Normally, solar panels are stationary and energy absorbed is not optimum. To make sure maximum solar energy is absorbed by solar panels rotational solar panels are proposed. LDR will obtain and measure sun light and solar panels will automatically rotate towards maximum sun light. Above are some of the systems that have used Arduino as microprocessor and LDR, LM 35 and water sensors individually for data collection. None of the systems have combined all these sensors and designed a system to automatically open or close a shed or an rain shed. This paper proposed a system that will automate shed depending upon temperature, light and water to facilitate user needs accordingly.

CHAPTER 3

METHODOLOGY

3.1 System Design

In this project, we have used a SMPS section to produce power in the system. Here we use micro-controller. All kind of controlling system work under Arduino Nano . Here we also use Rain Sensor, IR sensor, Motor Driver, Gear Motor. All of this equipment's are connected like circuit design and it full our desire outcome.

3.2 Methodology

Our methodology for the project:

- Creating an idea for design and construction of a Automatic Rain Shed Sensing System with the combination of Arduino micro controller.
- 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 the whole system.
- Setting up all the components in a PCB board & then soldering. Lastly, assembling all the blocks in a board and to run the system & for checking purposes.

3.3 Working Principle

The Automatic Rain Shed Sensing System operates by detecting rainfall through a rain sensor and automatically deploying a protective shed using a motorized mechanism. The rain sensor sends a signal to the Arduino Nano, which processes the input and triggers the motor driver to activate the gear motor. The motor rotates, extending or retracting the shed through bearings for smooth movement. An IR sensor ensures the shed's position, preventing over extension or collision. The system is powered by an SMPS (Switched-Mode Power Supply) for stable and efficient voltage supply. This integrated design ensures fast, reliable, and energy-efficient operation during rainfall.

3.4 Block Diagram

Here is the block diagram of the **Automatic Rain Shed Sensing System** with all the essential components. All of the components are shown in below as a block in this diagram. Here we use Arduino Nano for the main micro-controller which automatically operates the system. Other equipment's are attached with this micro-controller and work together for perform as our desire outcome.

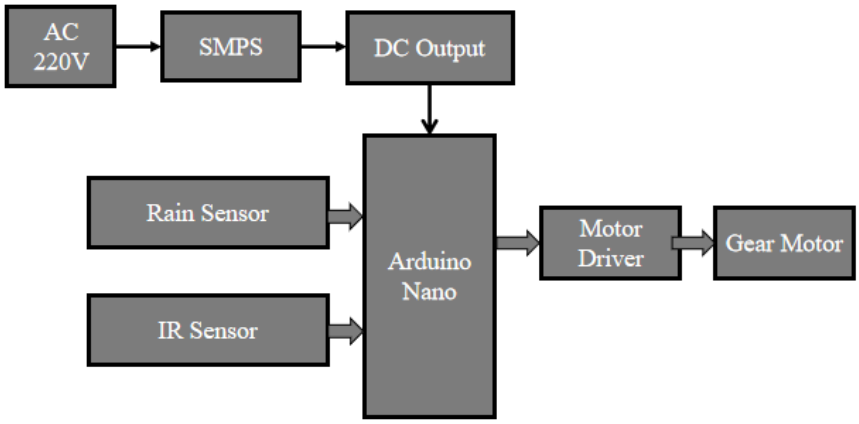


Figure 3.1: Block Diagram

3.5 Circuit Design

Arduino Pro Mini has been used as main controller for this project. With the help of controller which the project can be controlled our system automatically. .

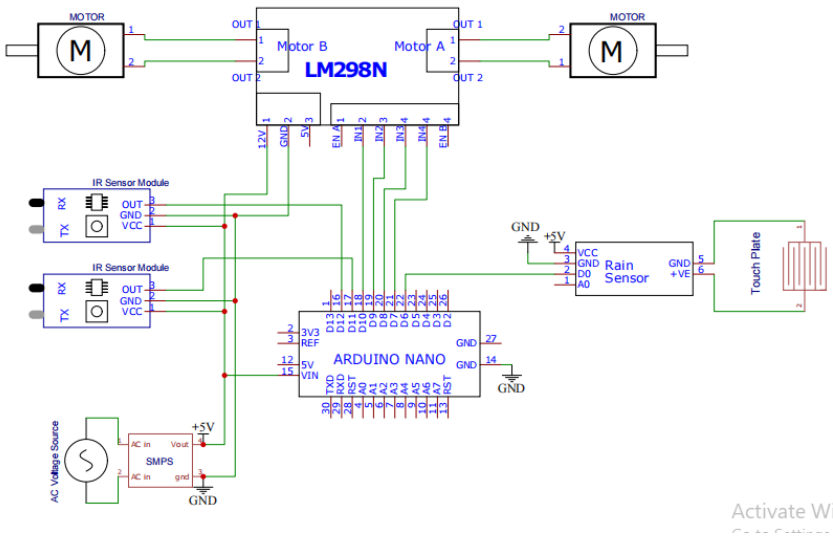


Figure 3.2: Schematic Diagram

3.6 Components List

- Arduino Nano
- SMPS
- Gear Motor
- Motor Driver
- Bearing
- Motor Pully
- Rain Sensor
- IR Sensor

Software

- Arduino IDE
- Easy EDA

3.7 Arduino Nnao

Arduino is 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.

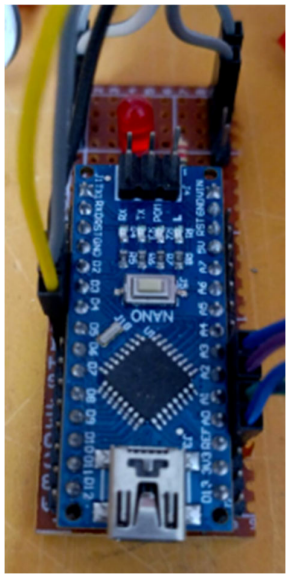


Figure 3.3: Arduino Nano

The micro-controller 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. It has everything that Decimal/ Duemilanove has (electrically) with more analog input pins and onboard +5V AREF jumper. Physically, it is missing power jack. The Nano can automatically sense and switch to the higher potential source of power.

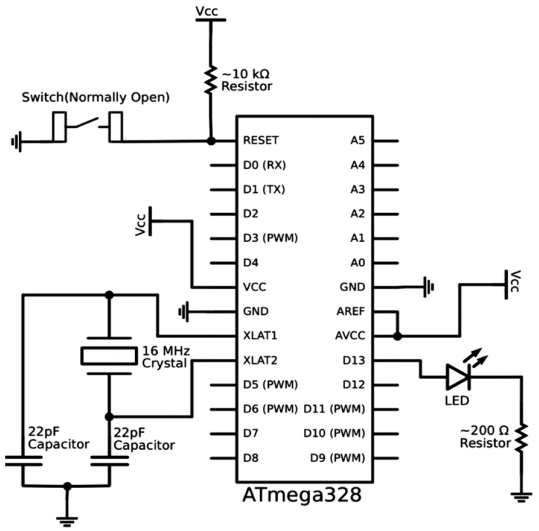


Figure 3.4: Arduino Nano Schematic Diagram

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.

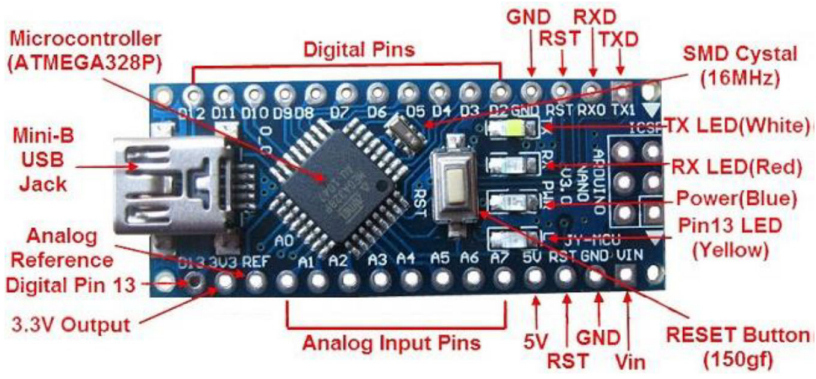


Figure 3.5: How Arduino Nano looks like

Specifications:

- Micro-controller: 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
- Clock Speed: 16 MHz
- Dimensions: 0.70” x 1.70”

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
- Manual reset switch

Micro-controller IC ATmega328p

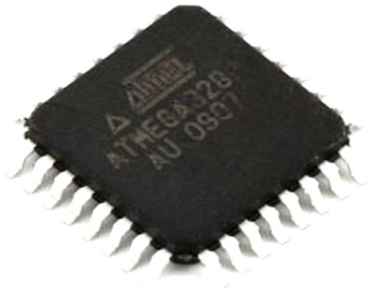


Figure 3.6: Micro-controller IC AT mega 328p

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), 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 throughput's approaching 1 MIPS per MHz, balancing power consumption and processing speed.

3.8 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. 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. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles)



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 hav a poor power factor. 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 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.

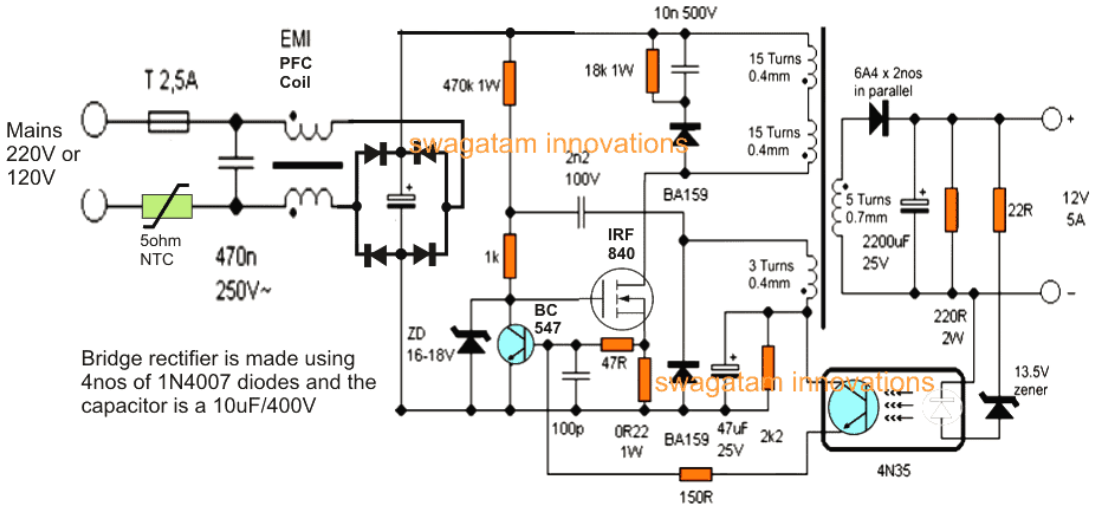


Figure 3.8: SMPS Circuit

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. 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.

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.

Switch Mode Power Supply

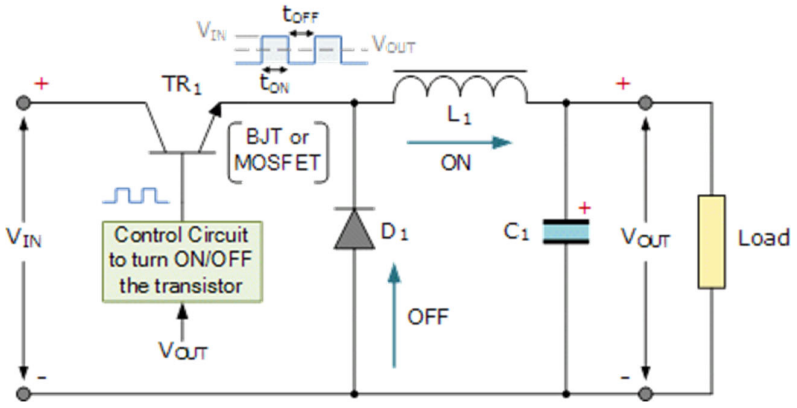


Figure 3.9: SMPS Circuit Connection

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. The most popular linear and fixed output voltage regulator types are by far the positive output voltage series, and the 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.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 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.

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 stabiliser 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

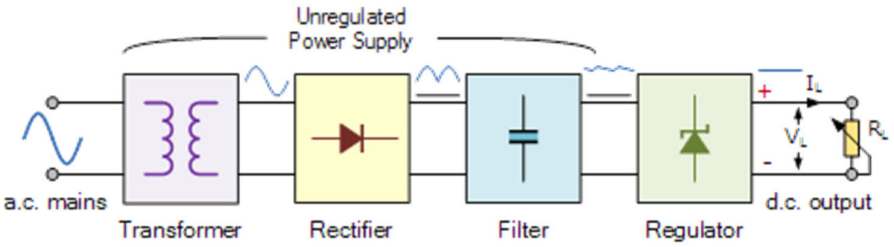


Figure 3.10: DC power Supply

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.

3.9 Motor Driver

The **L298N** is a popular 16-Pin **Motor Driver** IC. As the name suggests it is mainly used to drive **motors**. A single **L298N** IC is capable of running two DC **motors** at the same time; also the direction of these two **motors** can be controlled independently.

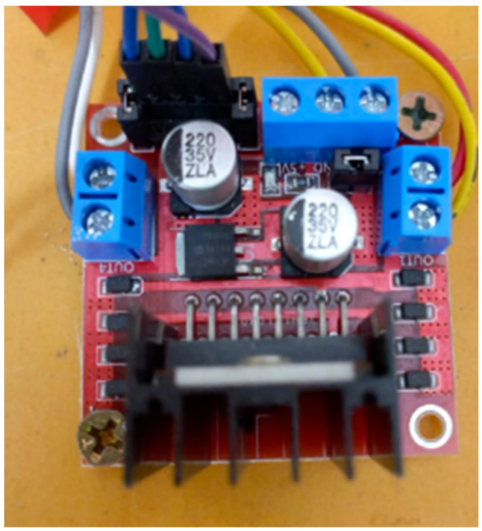


Figure 3.11: Motor driver

Working Process

L298N 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 **L298N** 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
- Supply Voltage to Vcc1(vss): 4.5V to 7V
- Transition time: 300ns (at 5Vand 24V)
- Automatic Thermal shutdown is available

L298N Pin Configuration

Table 1: Motor Driver Pinout

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
15	Input 4	Directly controls the Output 4 pin. Controlled by digital circuits
16	Vcc2 (Vss)	Connected to +5V to enable IC function

Use of a L298N Motor Driver IC:

Using this L298N 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.

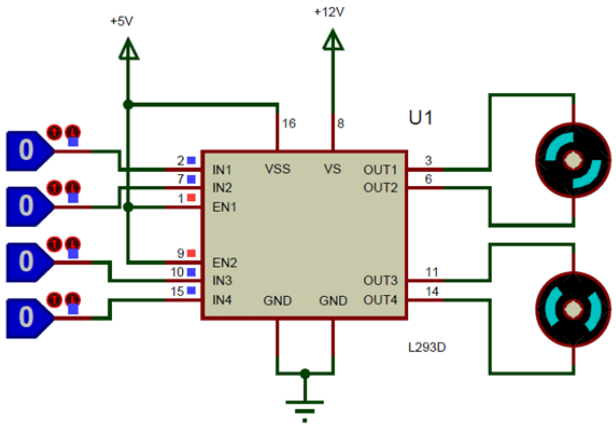


Figure 3.12: L298N circuit Diagram

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)

3.10 Gear Motor

A DC motor is any motor within a class of electrical machines whereby direct current electrical power is converted into mechanical power. ... A 12v DC motor is small and inexpensive, yet powerful enough to be used for many applications.

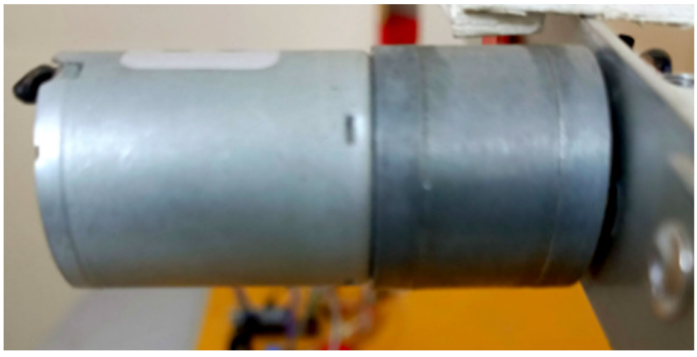


Figure 3.13: Gear Motor

Specification:

- Voltage: 12V DC
- Gear ratio: 1/31
- No-load speed: 200RPM
- Rated Speed: 140RPM
- Rated torque: 10kg.cm
- Rated current: 2.5Amp
- Length of Motor(including spindle): 106mm/4.17″
- Diameter: 37mm/1.45″
- Shaft length: 21mm/0.82″
- Shaft diameter: 6mm/0.24″

3.11 Motor Pulley

A **pulley** is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the cable or exert a force, the supporting shell is called a block, and the pulley may be called a sheave.A pulley may have a groove or grooves between flanges around its circumference to locate the cable or belt. The drive element of a pulley system can be a rope, cable, belt, or chain.

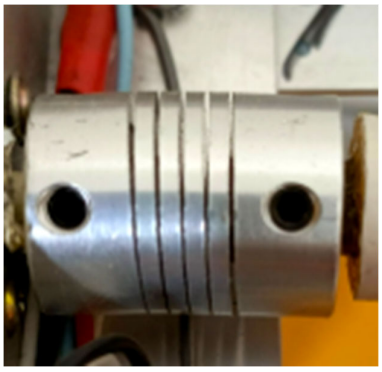


Figure 3.14: Pulley

The earliest evidence of pulleys dates back to Ancient Egypt in the Twelfth Dynasty (1991-1802 BCE) and Mesopotamia in the early 2nd millennium BCE. In Roman Egypt, Hero of Alexandria (c. 10-70 CE) identified the pulley as one of

six simple machines used to lift weights. Pulleys are assembled to form a block and tackle in order to provide mechanical advantage to apply large forces. Pulleys are also assembled as part of belt and chain drives in order to transmit power from one rotating shaft to another. Plutarch's *Parallel Lives* recounts a scene where Archimedes proved the effectiveness of compound pulleys and the block-and-tackle system by using one to pull a fully laden ship towards him as if it was gliding through water.

3.12 Rain sensor

A rain sensor is one kind of low-cost electronic sensor which is used to detect the rainfall or water drops. It works as a switch. Normally the switch is open condition. This sensor is consisting of mainly two parts, one is Sensing Pad and another one is the Sensor Module. When rainfall or water drops fall on the Sensing Pad surface, then the switch will be closed.

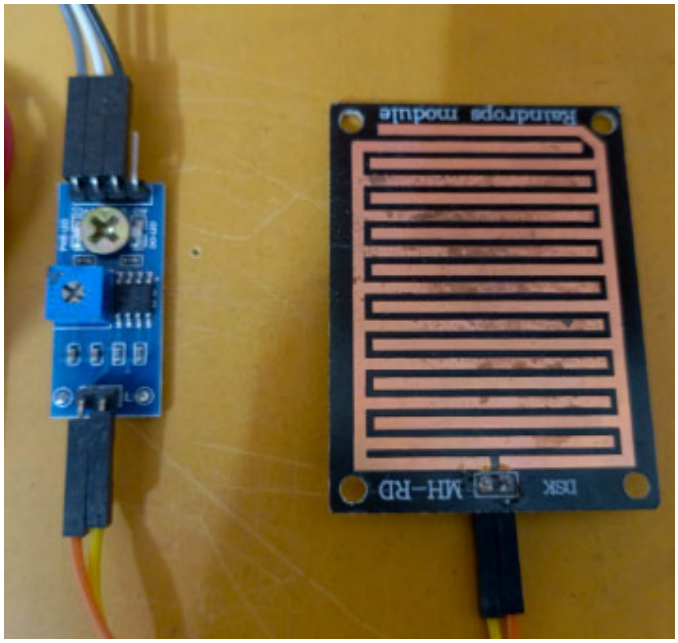


Figure 3.15: Rain Sensor

The Sensor Module reads data from the sensor pad and processes the data and converts it into a digital/analog output. So, the sensor can provide both types of output Digital output (DO) and Analog output (AO). The Rain Sensor Module's Sensing Pad consists of two nickel-coated series copper tracks. Also, it has two Header pins, these are internally connected to the two copper tracks of the Sensing Pad. These pins are used to connect the Sensing Pad to the rain sensor module circuit through two jumper wire. Always, one pin of the rain sensor circuit provides a +5v power supply to the one track of the sensing pad,

and another pin is received the return power supply from another track of the sensing pad. Normally under dry conditions, the sensing pad provides high resistance and low conductive. So, the 5v power supply cannot be passed from one track to another track. Its resistance varies according to the amount of water on the surface of the sensing pad. When water drops fall on the sensor pad surface its resistance will decrease and conductivity will increase. So, when water drops increase on the pad surface it can pass more power supply through one track to another track.



Figure 3.16: Rain Sensor Pin Indication & Description

Pin Description

Table 2 : Rain sensor Pin Description

	Pin Name	Description
1	**VCC**	+5 v power supply
2	**GND**	Ground (-) power supply
3	**DO**	Digital Output (0 or 1)
4	**AO**	Analog Output (range 0 to 1023)

Sensor Module Hardware Overview

The Sensor module is consisting of some key components. These are LM393 Comparators, Variable Resistor (Trimpot), Power LED, output LED.

Rain Sensor Specifications

Table 3: Rain Sensor Specification

Parameter	Value
Operating Voltage	3.3V – 5V
Operating Current	15 mA
Comparator chip	LM393
Sensitivity	Adjustable via Trimpot
Output type	Analog output voltage (AO) and Digital switching voltage (DO)
LED lights indicators	Power (red/green) and Output (red/green)
Sensing pad	5cm x 4 cm nickel plate on one side.
Module PCB Size	3.2cm x 1.4cm

Application

- Rainfall detection
- It's used in an irrigation system, when rainfall is started it shut down the watering system automatically.

3.13 Bearing

A **bearing** is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts. Rotary bearings hold rotating components such as shafts or axles within mechanical systems, and transfer axial and radial loads from the source of the load to the structure supporting it. The simplest form of bearing, the plain bearing, consists of a shaft rotating in a hole. Lubrication is used to reduce friction. In the ball bearing and roller bearing, to reduce sliding friction, rolling elements such as rollers or balls with a circular cross-section are located between the races or journals of the bearing assembly. A wide variety

of bearing designs exists to allow the demands of the application to be correctly met for maximum efficiency, reliability, durability and performance.



Figure 3.17: Bearing

3.14 IR Sensor

An infrared sensor is an electronics device that emits certain features around it and / or detects infrared radiation. Infrared sensors are capable of measuring the heat emitted by an object and detecting motion. In this project we will control the fan and light automatically through the closed loop system so the IR sensor for the system is definitely needed as a response. Here the fan will turn on and the light will turn on when the IR sensor detects an object and the fan and light will switch off automatically when an object leaves the house.

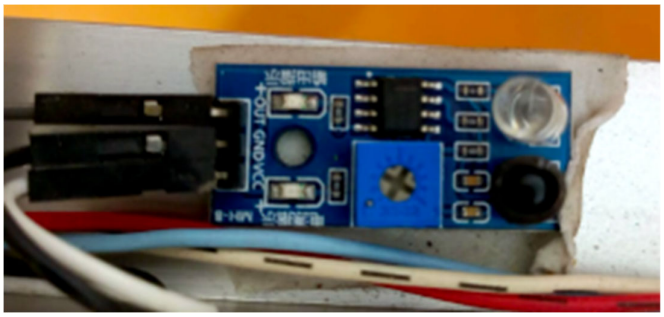


Figure 3.18: IR Sensor

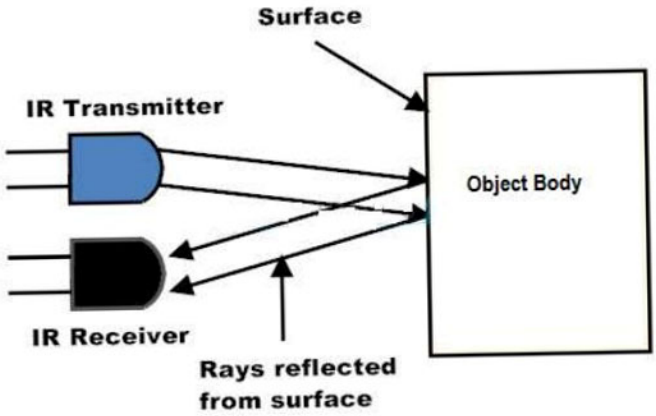


Figure 3.19: IR sensor reflection System.

Principles of operation:

Sensor works with sense. When an object intersects the sensor light then the sensor detects something .Some infrared ray is deflected from the object and scene the length of this distance. In this sensor we can make a fixed length light and detect our exact object. If some object comes in front of this sensor then the sensor detects it and sends a signal in LED.

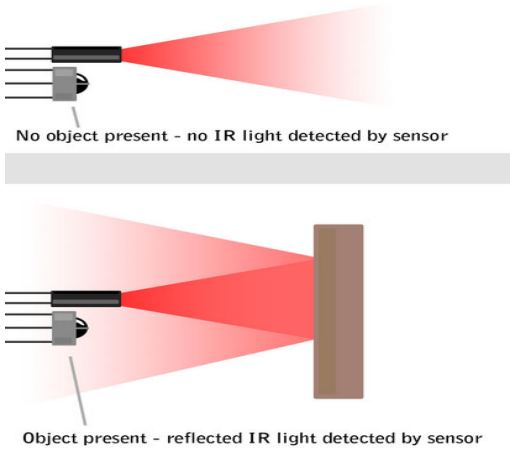


Figure 3.20: IR sensor Detection System

3.15 Arduino IDE

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.

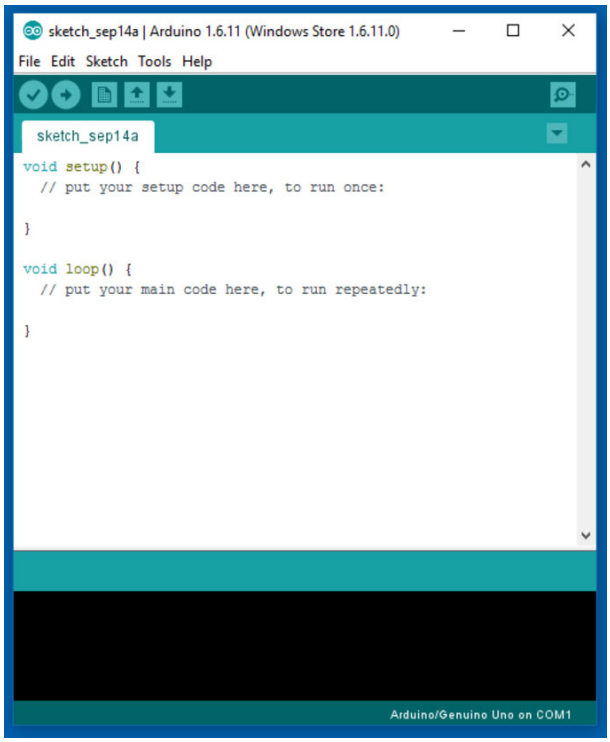


Figure 3.21: Arduino Software Interface IDE

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. As the Arduino platform uses Atmel micro-controllers, Atmel's development environment, AVR Studio or the newer Atmel Studio, may also be used to develop software for the Arduino. The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

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.

Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog. Beginning with version 1.0, files are saved with a .ino file extension. Previous versions use the .pde extension. You may still open .pde named files in version 1.0 and later, the software will automatically rename the extension to .ino.

Tabs, Multiple Files, and Compilation

Allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

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 a 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 sports 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.

When you upload a sketch, you're using the Arduino Bootloader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The Bootloader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The Bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

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. There is a list of libraries in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager. Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch. See these instructions for installing a third-party library.

Third-Party Hardware

Support for third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, Bootloaders, and programmer definitions. To install, create the hardware directory, then unzip the third-party platform into its own sub-directory. (Don't use "Arduino" as the sub-directory name or you'll override the built-in

Arduino platform.) To uninstall, simply delete its directory. For details on creating packages for third-party hardware, see the Arduino IDE 1.5 3rd party Hardware specification.

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.

4.16 Easy EDA

Easy EDA is a web-based EDA tool suite that enables hardware engineers to design, simulate, share-publicly and privately-and discuss schematics, simulations and printed circuit boards. Other features include the creation of a bill of materials, Gerber files and pick and place files and documentary outputs in PDF, PNG and SVG formats. Easy EDA allows the creation and editing of schematic diagrams, SPICE simulation of mixed analogue and digital circuits and the creation and editing of printed circuit board layouts and, optionally, the manufacture of printed circuit boards.



Figure 3.22: Easy EDA Software Interface

Subscription-free membership is offered for public plus a limited number of private projects. The number of private projects can be increased by contributing high quality public projects, schematic symbols, and PCB footprints and/or by paying a monthly subscription. Registered users can download Gerber files from the tool free of charge; but for a fee, Easy EDA offers a PCB fabrication service. This service is also able to accept Gerber file inputs from third party tools.

CHAPTER 4

RESULT & DISCUSSION

4.1 Result Analysis

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

- When this project is run then it will sense the rain on the rain sensor then the shed will fold or extend automatically.
- It is also operated it manually.

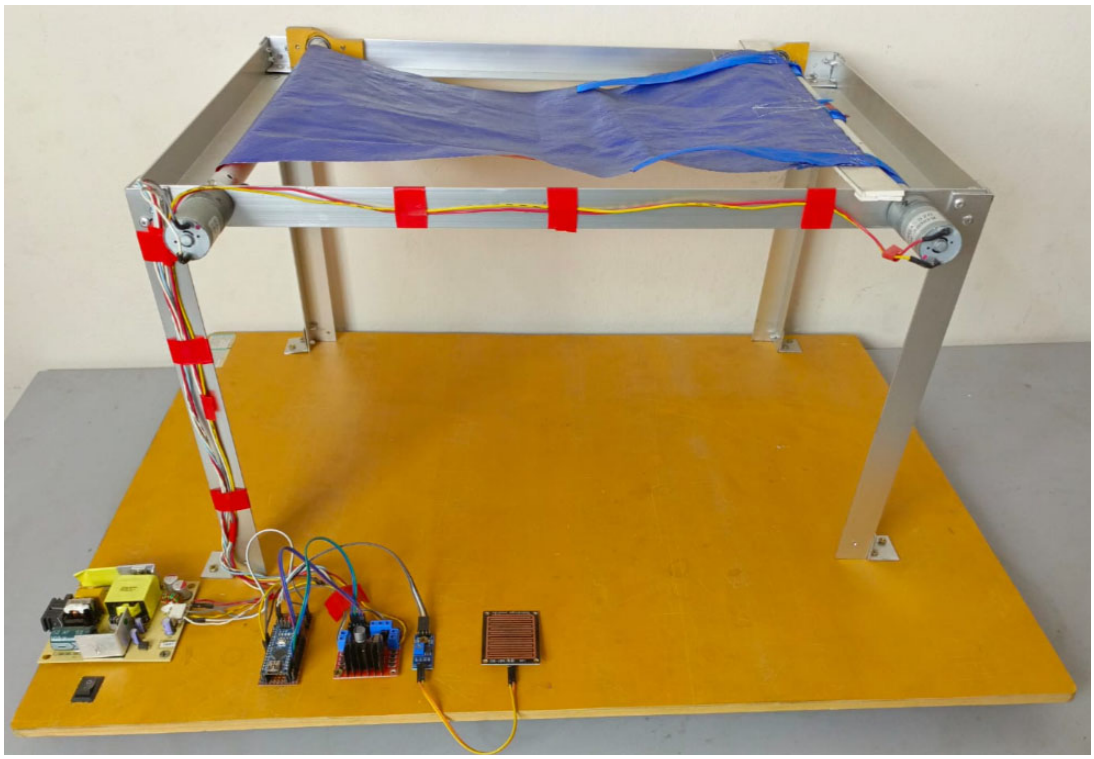


Figure 4.1: Complete Project Picture

4.2 Advantage

- Automatic Rain protection System
- Automatic and Manual Control
- Time saving machine for industrial work.
- No Oil consumption.
- Time saving equipment.
- Installation is simplified very much.
- Simple construction
- Ease of operation.

4.3 Application

The project has a major application in the

- It can be used for Industrial work.
- It can be used in football field
- It can be use rooftop garden

4.4 Limitation

It is a demo project so we found some limitation. In future we will work for reduce this kind of limitation. These limitations are –

- It is a demo project so it has some error.
- Our project may delay in work.

4.5 Discussion

In this project we added all of this equipment and setup it properly. Then observe our system. In the very beginning time, we can't do it properly, after a great teamwork we solve our problem and finally able to measure water level, water temperature and weather condition like rain and end notification in our phone, After using this system we really know our pond condition.

4.6 Cost Analysis

Sl.no	Particulars	Specification	Qty.	Unit Price (Taka)	Total Price (Taka)
1	Arduino Nano		1	600	600
2	SMPS	5V 7A	1	550	550
3	Pulley		2	200	400
4	Rain Sensor	HC-SR04	1	250	250
5	IR Sensor		1	250	250
6	Bearing		2	150	300
7	Gear Motor		2	350	700
8	Frame				1200
9	Others			1000	1000
				Total	5250/=

Table 4: Component Name and Price

CHAPTER 5

CONCLUSION

5.1 Conclusion

The Automatic Rain Shed Sensing System is a practical and efficient solution for weather-responsive protection. By utilizing sensors to detect rainfall and an automated mechanism to deploy the shed, this system ensures quick and reliable operation without manual intervention. It is particularly useful for safeguarding outdoor spaces, machinery, or goods from unexpected weather changes, thereby minimizing damage and inconvenience.

The system's simplicity, coupled with its ability to integrate seamlessly with existing structures, makes it a cost-effective choice for residential, commercial, and industrial applications. Furthermore, its low maintenance and energy-efficient design add to its sustainability and user-friendliness.

Incorporating such technology not only enhances convenience but also supports innovative practices in automation. This project demonstrates the potential of combining sensor technology and automation to address everyday challenges effectively, paving the way for smarter and more resilient infrastructure.

5.2 Future Scope

The model can be improved by making some changes in the program and components. Some suggestions are given below-

- We will increase its working accuracy level.
- We will think about adding leaser cutting and PCB Design.
- In Future Develop IoT online System

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APPENDIX

```
int rain_sensor = 2; // Pin for rain sensor
int rain;            // Variable to store rain sensor state

int ir_sensor1 = 3;  // Pin for IR sensor 1 (open position detection)
int oir;             // Variable to store IR sensor 1 state
int ir_sensor2 = 4;  // Pin for IR sensor 2 (closed position detection)
int cir;             // Variable to store IR sensor 2 state

int in1 = A0;        // Motor 1 control pin (forward)
int in2 = A1;        // Motor 1 control pin (reverse)
int in3 = A2;        // Motor 2 control pin (forward)
int in4 = A3;        // Motor 2 control pin (reverse)

enum State { IDLE, CLOSING, OPENING }; // System states
State currentState = IDLE;

void setup() {
  Serial.begin(9600);

  // Sensor pins as input
  pinMode(rain_sensor, INPUT);
  pinMode(ir_sensor1, INPUT);
  pinMode(ir_sensor2, INPUT);

  // Motor control pins as output
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);
  pinMode(in3, OUTPUT);
  pinMode(in4, OUTPUT);

  // Stop motors initially
  stopMotors();
}

void loop() {
  // Read sensor values
  rain = digitalRead(rain_sensor);
  oir = digitalRead(ir_sensor1);
  cir = digitalRead(ir_sensor2);

  // Debugging outputs
  Serial.print("IR Sensor 1 (Open): ");
  Serial.println(oir);
  Serial.print("IR Sensor 2 (Close): ");
  Serial.println(cir);
  Serial.print("Rain Sensor: ");
  Serial.println(rain);

  switch (currentState) {
```

```
    case IDLE:
      if (rain == 0) { // Rain detected
        Serial.println("Rain detected. Starting to close the shed...");
        currentState = CLOSING;
      } else if (rain == 1) { // No rain
        Serial.println("No rain. Starting to open the shed...");
        currentState = OPENING;
      }
      break;

    case CLOSING:
      if (cir == HIGH) { // Shed not fully closed yet
        moveForward();
      } else { // Shed fully closed
        Serial.println("Shed is fully closed.");
        stopMotors();
        currentState = IDLE;
      }
      break;

    case OPENING:
      if (oir == HIGH) { // Shed not fully open yet
        moveReverse();
      } else { // Shed fully open
        Serial.println("Shed is fully open.");
        stopMotors();
        currentState = IDLE;
      }
      break;
  }

  delay(100); // Small delay for stabilization
}

// Function to move motors forward (close the shed)
void moveForward() {
  analogWrite(in3, 130); // Motor 2 forward
  analogWrite(in4, 0);
}

// Function to move motors reverse (open the shed)
void moveReverse() {
  analogWrite(in1, 0);   // Motor 1 reverse
  analogWrite(in2, 130);
}

// Function to stop the motors
void stopMotors() {
  analogWrite(in1, 0);
  analogWrite(in2, 0);
  analogWrite(in3, 0);
  analogWrite(in4, 0);
}
```