*A Project Work Report*

*on*

# "DESIGN OF SOLAR DUAL-AXIS TRACKING WITH IMPLEMENTATION OF WEATHER DEPEDENCE"

*Submitted in the partial fulfilment of the requirements for the award of degree*

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

***Submitted by***


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UNIVERSITY COLLEGE OF ENGINEERING

NARASARAOPET

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

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**DEPARTMENT OF**

**ELECTRONICS AND COMMUNICATION ENGINEERING**

# CERTIFICATE

This is to certify that the Project work entitled "IOT based Vehicle Safety and Security System using Raspberry Pi" is a bona fide work done by SK. NURJAHAN (21035A0413), P. SOWMYA (21035A0411) , N.C.H.VITTAL (20031A0434) & K. JAGGARAO (20031A0424) submitted in partial fulfilment for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering from Jawaharlal Nehru Technological University Kakinada during the academic year 2023-2024 under our guidance and supervision.

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# DECLARATION

We hereby declare that the work described in this project work entitled "*DESIGN OF SOLARDUAL-AXIS TRACKING WITH IMPLEMENTATION OF WEATHER DEPENDENCE"* which is being submitted by as in partial fulfilment for the award of the degree of **Bachelor of Technology in Electronics and Communication Engineering** to the university college of engineering Narasaraopet, Jawaharlal Nehru technological University Kakinada, Andhra Pradesh, is the result of the work done by as under the guidance of **Mr. D. SANTHOSH GUPTA, M.Tech, Ph.D.**

The work is original and has not been submitted for any Degree/Diploma of this or any other University.

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# NOMENCLATURE

| Abbreviation | Description |
|---|---|
| LED | Light Emitting Diode |
| IDE | Integrated Development Environment |
| LDR | Light Dependent Resistor |
| DHT | Digital Temperature and Humidity |
| LCD | Liquid Crystal Oscillator |
| SPV | Solar Photovoltaic |
| MPP | Maximum Power Point |

# ABSTRACT

A solar photovoltaic (SPV) cells based dual axis tracking system on Arduino Uno platform is implemented in this project for achieving maximum power during a day. The key idea of this article is implementing an automatic dual axis solar tracking system. Alignment of solar panel with the Sunlight for getting maximum solar radiation is experimented. This system tracks the maximum intensity of light in terms of maximum power point (MPP). When the light intensity decreases, its alignment changed automatically for catching maximum light intensity. This project shows implementation and analysis of dual axis solar tracker

The main objective of the dual-axis tracker is to follow the position of the sun for maximum energy efficiency. Given that the sun moves at 15 degrees per hour and assuming, the tracker would make position changes every 0. 01 seconds, the change in angular velocity is calculated. To increase the efficiency of the solar panel by 30-45% when compared to the static and single axis solar tracker.

The motivation behind dual axis solar tracking with weather monitoring is to maximize the energy output of solar panels while minimizing the impact of weather conditions. This can help to make solar energy a more reliable and cost-effective source of renewable energy.

# CHAPTER 1

# INTRODUCTION

## 1.1 PROJECT DOMAIN BASICS

As its name suggests, Embedded means something that is attached to another thing. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor-based system which is designed to perform a specific task. For example, a fire alarm is an embedded system; it will sense only smoke.

An embedded system has three components −

- **Hardware:** Embedded system hardware is built with a microprocessor or microcontroller. The embedded system hardware has elements like input output (I/O) interfaces, user interface, memory and the display.
- **Application Software:** The embedded system software is written to perform a specific function. It is typically written in a high-level format and then compiled down to provide code that can be lodged within a non- volatile memory within the hardware.
- **Real Time Operating system:** Real Time Operating system (RTOS) that supervises the application software and provide mechanism to let the processor run a process as per scheduling by following a plan to control the latencies. RTOS defines the Way the system works. It sets the rules during the execution of application program. A small-scale embedded system may not have RTOS.

  So, we can define an embedded system as a Microcontroller based, software driven, and reliable, real-time control system.

### 1.1.1 Characteristics of an Embedded Systems

- **Single-functioned** –An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.
- **Tightly constrained** − All computing systems have constraints on design metrics, but those on an embedded system can be especially tight.
- **Reactive and Real time** − Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay.

- **Memory** − It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.
- **Connected** − It must have connected peripherals to connect input and output devices.
- **HW-SW systems** − Software is used for more features and flexibility. Hardware is used for performance and security.

### 1.1.2 Basic Structure of an Embedded System

Embedded System consists of the following building blocks-

1. Sensor
2. Processer
3. Actuator

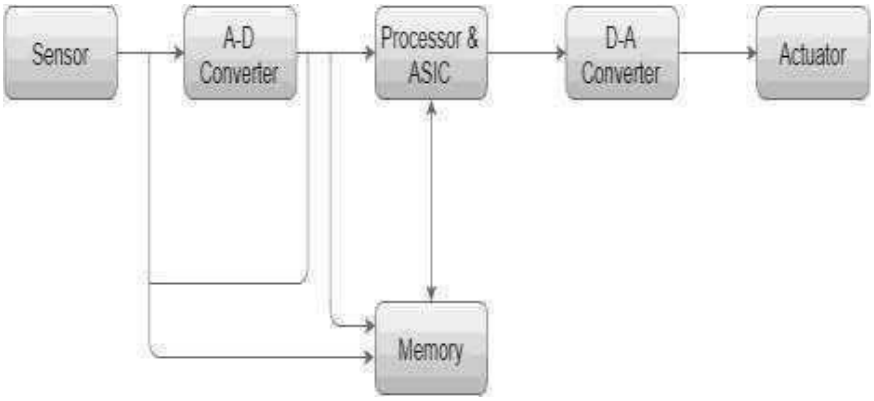



Fig 1: Block Diagram of Embedded System

- **Sensor** − It measures the physical quantity and converts it to an electrical signal which can be read by an observer or by any electronic instrument like an A2D converter. A sensor stores the measured quantity to the memory.
- **A-D Converter** − An analog-to-digital converter converts the analog signal sent by the sensor into a digital signal.
- **Processor & ASICs** − Processors process the data to measure the output and store it to the memory.
- **Actuator** − An actuator compares the output given by the D-A Converter to the actual (expected) output stored in it and stores the approved output.

### 1.1.3 Advantages

- Easily Customizable
- Low power consumption
- Low cost
- Enhanced performance

### 1.1.4 Disadvantages

- High development effort
- Larger time to market

### 1.1.5 Applications

- Automobiles
- Telecommunications
- Agriculture
- Health
- Entertainment
- Home
- Banking and Finance
- Instrumentation
- Security

## 1.2 MOTIVATION OF THE PROJECT

The motivation behind dual axis solar tracking with weather monitoring is to optimize the efficiency of solar panels and increase their energy output. Solar panels are most effective when they are directly facing the sun, but the sun moves throughout the day, which means that the panels are not always in the best position to capture sunlight.

A dual axis solar tracker adjusts the position of the panels both horizontally and vertically to keep them pointed directly at the sun as it moves across the sky. This allows the panels to capture more sunlight and generate more energy.

However, weather conditions can also affect the efficiency of solar panels. For example, cloud cover can reduce the amount of sunlight that reaches the panels, and high winds can damage the panels or cause them to become misaligned.

By incorporating weather monitoring into the dual axis solar tracking

system, the panels can be adjusted to compensate for these conditions. For example, if cloud cover reduces the amount of sunlight reaching the panels, they can be tilted to a steeper

angle to capture more light. If high winds are detected, the panels can be automatically stowed in a safer position to prevent damage.

Overall, the motivation behind dual axis solar tracking with weather monitoring is to maximize the energy output of solar panels while minimizing the impact of weather conditions. This can help to make solar energy a more reliable and cost-effective source of renewable energy.

## 1.3 OBJECTIVES OF THE PROJECT

- The main objective of the dual-axis tracker is to follow the position of the sun for maximum energy efficiency. Given that the sun moves at 15 degrees per hour and assuming, the tracker would make position changes every 0.01 seconds, the change in angular velocity is calculated.
- To increase the efficiency of the solar panel by 30-45% when compared to the static and single axis solar tracker.
- The energy which is stored is used in monitoring the humidity in nature and to find the humidity in forms. And also, It can track seasonal variations in the height of the sun in addition to normal daily motion.

# CHAPTER-II

# LITERATURE SURVEY

## 2.1 SIMPLE SOLAR TRACKING SYSTEM USING STEPPERMOTOR

J. Rizk, Nov, 2021 Designed Simple Dual Axis Solar Tracking Using ARM controller. J. RIJK states the potential system benefits of simple tracking solar system using a stepper motor and light sensor. A solar tracking system is reportedly designed, implemented and experimentally tested. The design details and the experimental results are discussed. A solar tracker is designed employing small solar cells to function as self- adjusting light sensors, providing a variable indication of their relative angle to the sun by detecting their voltage output. By using this method, the solar tracker is found to be successful in maintaining a solar array at a sufficiently perpendicular angle to the sun. The power increase gained over a fixed horizontal array was in excess of 30%.

## 2.2 COMPUTERIZED SUN TRACKING DEVICE

S. M., & Abdallah. S, 2022, designed Computerized Sun Tracking Device. S. Abdallah has presented a computerized sun tracking device for rotating the solar still with the movement of the sun. A comparison between fixed and sun tracked solar stills showed that the use of sun tracking increased the productivity to around 22%, due to the increase of overall efficiency by 2%. It showed that the sun tracking is more effective than fixed system and is capable of enhancing the productivity. Using the sun tracker increases the water temperature while it decreases thermal capacity of the water. This increases the evaporation rate and hence the distillation rate.

## 2.3 DIFFERENT TYPES OF SUN TRACKING SYSTEM

Reza. N. & Mondol. N, July, 2021, discusses different types of sun- tracking systems and their cons and pros. The most efficient and popular sun-tracking device was found to be in the form of polar-axis and azimuth/elevation types. If higher power PV panels are driven by the same tracking mechanism they may produce more energy than the fixed ones

**e.g.** about 38% more energy in case of a 100 Wp PV panel, under the same experimental conditions.

Solar tracking systems primarily come in two types: **single-axis and dual-axis**. Single-axis trackers move along one axis, typically following the sun’s east-west path across the sky. Dual-axis trackers, on the other hand, adjust in two directions, allowing more precise alignment with the sun to maximize energy production

## 2.4 DESIGN AND IMPLEMENTATION OF AN AUTOMATIC SINGLE AXIS SOLAR TRACKING SYSTEM

Shah, S. I. A. (2021, December) states that power consumption rate is increasing daily, and people are greatly dependent on conventional energy sources. If it continues, the conventional energy sources will end very soon. So, it is the appropriate time to use renewable energy sources along with conventional energy sources. Solar energy is the cleanest and sustainable renewable energy source. The electricity production rate from a solar photovoltaic panel depends on some factors such as solar irradiance, solar cell materials, solar cell surface temperature, etc. When the solar cell captures more sunlight, the more power it produces. This research aims to design and implementation microcontroller-based automated single-axis solar tracking system to capture maximum sunlight and to extract maximum power from the solar PV panel in various sun positions. This system helps to face the solar panel towards the sun light according to the sun's movement in the sky.

## 2.5 DESIGN OF TRACKING SYSTEM BASED ON EMBEDDED SOLAR PANEL

Hou, D., Yang, S., & Lian, Y. (2021, October) promotes the development of new energy, the solar energy project is one focus of the country. Due to the imperfection of photoelectric and mechanical solar tracking and positioning technology steps, this paper will introduce an intelligent solar photovoltaic tracking device based on an STM32 processor with ARM Cortex-M as the core. The operating principle of the device is that it will determine the rotation direction and rotation angle of the panel around the vertical and horizontal axes based on the voltage output generated by the photo resistor detection of light and have two stepper motor drivers run the dual- axis automatic solar tracking system to complete the operation of the whole system.

# CHAPTER-III

# PROPOSED SYSTEM

## 3.1 BLOCK DIAGRAM WITH DESCRIPTION

The entire set up is divided into 3 parts the light detecting unit, monitoring unit and the movement controlling unit. The details are as follows;

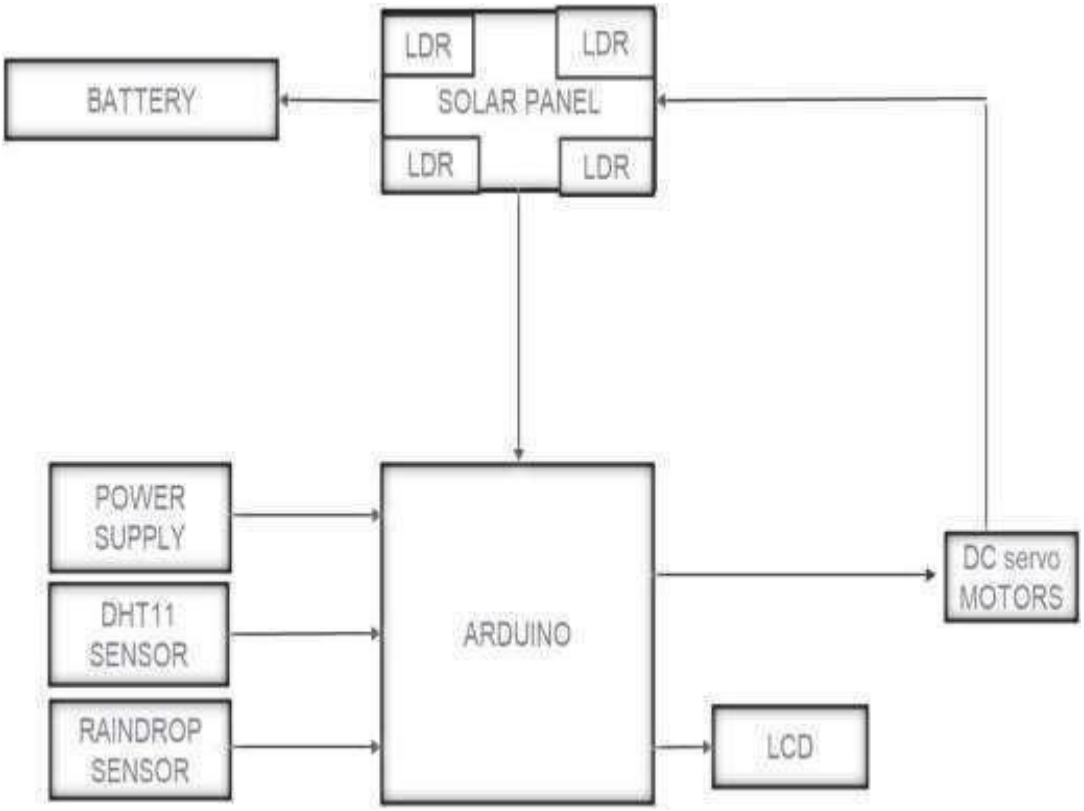



Fig 3.1: Block diagram of dual Axis Solar tracking System

### 3.1.1 Light Detecting Unit

It consists of four light detecting resistors each forming a pair of two. It measures the light intensity and converts it into analog voltage and gives the input to the controller. One pair of LDR trace the location of sun in east- west direction and the other pair senses in the north-south direction. Resistance is inversely proportional to intensity of light and hence it decreases with increase in light intensity. The relationship between light intensity and resistance is given in the equation below.

RL = 500/LUX.

### 3.1.2 Monitoring Unit

Arduino is the main monitoring unit of the entire apparatus as showed in fig.1..LDRis connected to the first four pins of Arduino i.e. A0- A4.Arduino takes the input from the LDR and based on that it gives instructions to servomotors to rotate either in horizontal or vertical directions.

### 3.1.3 Movement Controlling Unit

The movement controlling unit comprises of two DC motors. The Arduino gives an output of 5v which is used to drive the DC motor which can be driven by an input of about

4.5 volts. One of the motor controls the horizontal rotation while the other controls the vertical rotation. Only one motor functions at a time so as to reduce the power consumption.

### 3.1.4 Hardware And Software Components

The implementation part is mainly divided into two parts. One is the hardware part and another is the software part. The implementation part is described in details as follows

,**Hardware Components and its Specifications-**

1. **Arduino UNO**

Arduino Uno is a popular open-source microcontroller board based on the ATmega328P microcontroller. It is designed for creating interactive projects and prototyping with electronics and programming. The board features digital input/output pins, analog inputs, a USB interface for programming and serial communication, and a power jack for powering the board.

Arduino Uno boards can be programmed using the Arduino software, which is a free and open-source Integrated Development Environment (IDE) that simplifies the programming process. The programming language used is based on Wiring, a simplified version of C++, and the software includes a large library of pre-written code for various tasks and components, making it easy to get started with a wide range of projects.

Arduino Uno boards are widely used in the maker and DIY communities, and are popular for creating projects such as robots, drones, smart home devices, and more.

The board has 14 digital input/output pins, of which 6 can be used as PWM (pulse width modulation) outputs, and 6 analog inputs. The board has a 16 MHz quartz crystal oscillator, which provides accurate timing for the

microcontroller. Arduino Uno can be powered by either a USB connection or an external power supply, which can be connected via the power jack. The recommended voltage range for the board is 7-12V.


Fig 3.2 :Arduino UNO

**Arduino hardware**

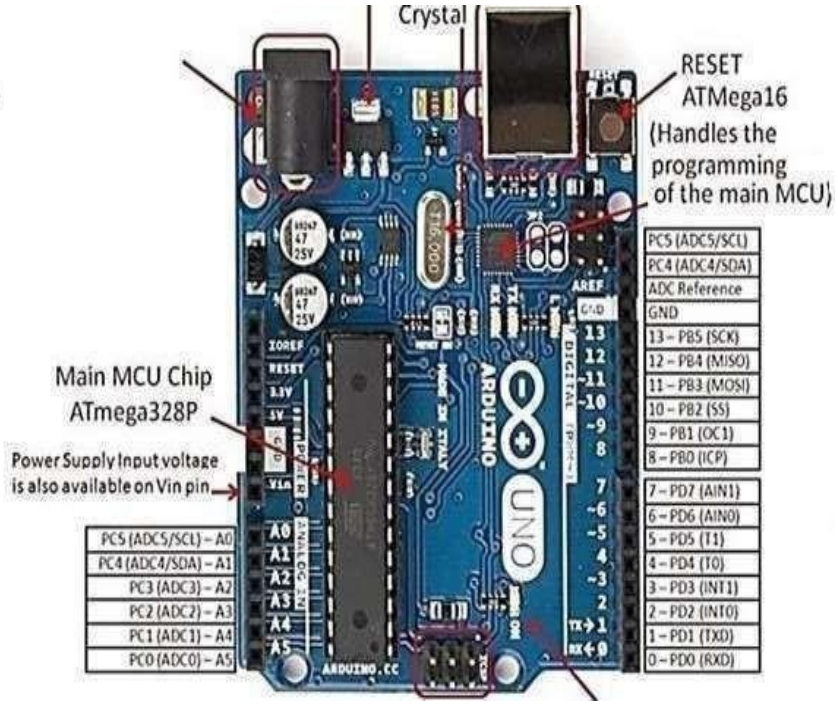



Fig 3.3 : Pin Diagram of Arduino UNO

**Arduino UNO Pinout Configuration**

| Pin category | Pin name | Description |
|---|---|---|
| Power | Vin, 3.3V, 5V, GND | Vin: Input voltage to Arduino when using an external power source.<br>5V: Regulated power supply used to power microcontroller and other components on the board.<br>3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA.<br>GND: ground pins. |
| Reset | Reset | Resets the microcontroller |
| Analog Pins | A0 – A5 | Used to provide analog input in the range of 0-5V |
| Input/Output Pins | Digital Pins 0 – 13 | Can be used as input or output pins. |
| Serial | 0(Rx), 1(Tx) | Used to receive and transmit TTL serial data. |
| External Interrupts | 2, 3 | To trigger an interrupt |
| PWM | 3, 5, 6, 9, 11 | Provides 8-bit PWM output. |
| SPI | 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK) | Used for SPI communication |
| Inbuilt LED | 13 | To turn on the inbuilt LED. |
| TWI | A4(SDA), A5(SCA) | Used for TWI communication. |
| AREF | AREF | To provide reference voltage for input voltage. |

Table 3.1: Pinout configurations

## SPECIFICATIONS OF ARDUINO UNO

- Microcontroller: ATmega328P – 8 bit AVR family microcontroller
- Operating Voltage: 5V
- Recommended Input Voltage: 7-12V
- Input Voltage Limits: 6-10V
- Analog Input Pins: 6 (A0 – A5)
- Digital I/O Pins: 14 (Out of which 6 provide PWM output)
- DC Current on I/O Pins: 40 mA
- DC Current on 3.3V Pin: 50 mA
- Flash Memory: 32 KB (0.5 KB is used for Bootloader)
- SRAM: 2 KB
- EEPRAM: 1 KB

# 2. POWER SUPPLY

A power supply is a component that provides at least one electrical charge with power. It typically converts one type of electrical power to another, but it can also convert a different Energy form in electrical energy, such as solar, mechanical, or chemical.

A power supply provides electrical power to components. Usually the term refers to devices built into the powered component. Computer power supplies, for example, convert AC current to DC current and are generally located along with at least one fan at the back of the computer case.

Most computer power supplies also have an input voltage switch that, depending on the geographic location, can be set to 110v/115v or 220v/240v. Due to the different power voltages supplied by power outlets in different countries, this switch position is crucial.

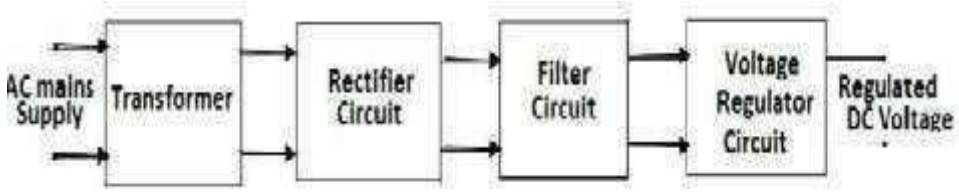



Fig 3.4 : Block Diagram of power Supply

## 3. Digital Voltmeter:

Voltmeter is an electrical measuring instrument used to measure the potential pdifference between two points. The voltage to be measured may be AC or DC. Two types of voltmeters are available for the purpose of voltage measurement i.e. analog and digital.

Analog voltmeters generally contain a dial with a needle moving over it according to the measure and hence displaying the value of the same. With time analog voltmeters are replaced by **digital voltmeters** due to the same advantages associated with digital systems. The voltage controllers are that their yield voltage as information requires no

Fig 3.5: Digital voltmeter

less than 2 volts. For example, 7805 as sources of information will require no less than 7V, and7812, no less than 14 volts. This voltage is called Dropout Voltage, which should be given to voltage controllers.

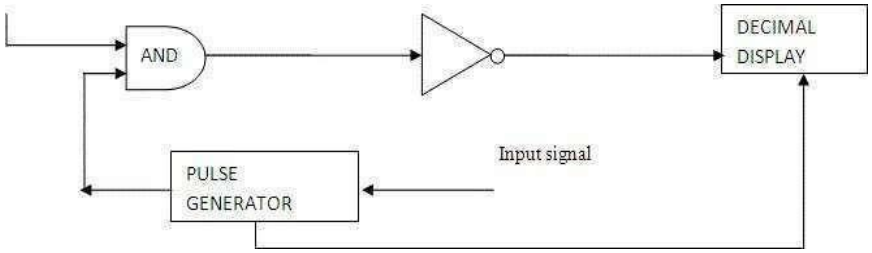



Fig 3.6: block diagram of a simple digital voltmeter

## 4. Solar panel

A **solar panel,** or **photo-voltaic (PV) module**, is an assembly of photo- voltaic cells mounted in a framework for installation. Solar panels use sunlight as a source of energy to generate direct current electricity. A collection of PV modules is called a PV panel, and a system of panels is an array. Arrays of a photovoltaic system supply solar electricity

To either the top layer or the back layer. Cells must be protected from mechanical damage and moisture. Most modules are rigid, but semi- flexible ones based on thin-film cells are also available. The cells are usually connected electrically in series, one to another to the desired voltage, and then in parallel to increase current. The power (watts) of the module is the mathematical product of the voltage (volts) and the current (amps) of the module. The manufacture specifications on solar panels are obtained under standard condition which is not the real operating condition the solar panels are exposed to on the installation site.

A PV junction box is attached to the back of the solar panel and functions as its output interface. External connections for most photovoltaic modules use MC4 connectors to facilitate easy weatherproof connections to the rest of the system. A USB power interface can also be used.

Fig 3.7: Solar panel

## 5. SERVO MOTOR

A **servo motor** is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a **servo mechanism**

If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only about the **DC servo motor working**.

Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications

like toy car, RC helicopters and planes, Robotics, etc..

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly, and a controlling circuit. First of all, we use gear assembly to reduce RPM and to increase torque of the motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier.

## Servo Motor Working Mechanism

It consists of three parts:

Controlled device

Output sensor

Feedback system


Fig 3.8: Servo motor

Now motor shaft is connected with the potentiometer and as the motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

## 6. DHT11 Sensor

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds.

Fig 3.9: DHT11 Sensor

**Technical Specifications :**

| Item | Measurement Range | Humidity Accuracy | Temperature Accuracy | Resolution | Package |
|---|---|---|---|---|---|
| DHT1 1 | 20-90%RH<br>0-50$^0$C | ±5%RH | ±2$^0$C | 1 | 4 Pin<br>Single Row |

Table 3.2: DHT11 Specifications

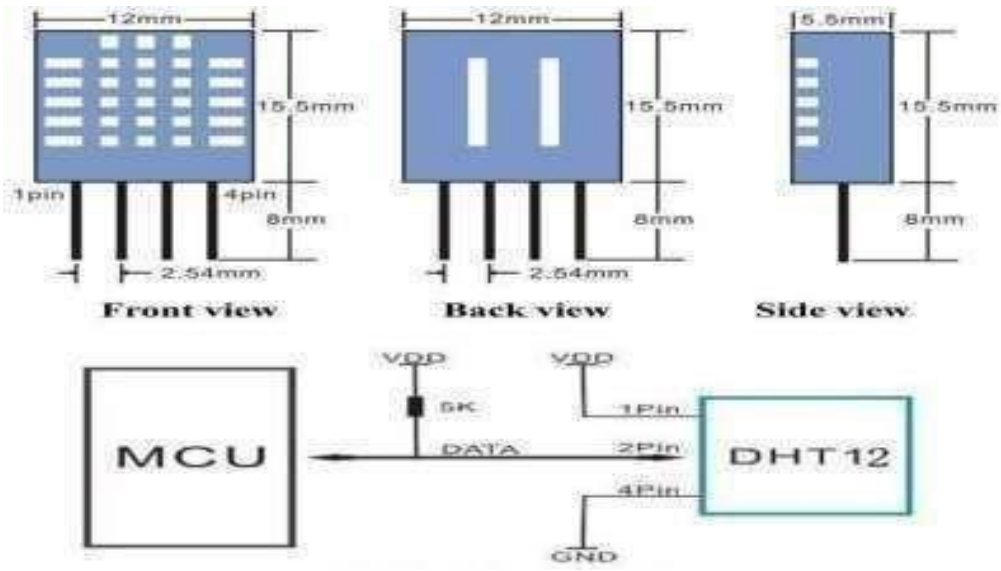



Fig 3.10 : DTH11 Sensor Pin Diagram

## Power and Pin

DHT11's power supply is 3-5.5V DC. When power is supplied to the sensor, do not send any instruction to the sensor in within one second in order to pass the unstable status. One Capacitor valued 100nF can be added between VDD and GND for power filtering.

## 7. LCD Display

LCD stands for Liquid Crystal Display. It is a type of flat panel display that uses the properties of liquid crystals to create images and text. LCDs are commonly used in electronic devices such as televisions, computer monitors, calculators, and digital clocks. LCDs are made up of two polarizing filters, with a layer of liquid crystal material in between. The liquid crystal material can be controlled by electrical signals to change the orientation of the crystals, which in turn changes the amount of light that passes through the polarizing filters. This allows LCDs to display images and text by selectively blocking or allowing light to pass through specific areas of the display.

LCDs have several advantages over other types of displays, including:

- Low power consumption: LCDs use less power than other types of displays, making them ideal for portable devices such as smartphones and tablets.
- High resolution: LCDs can display high-resolution images and text with sharp detail.
- Thin and lightweight: LCDs are thin and lightweight, making them easy to incorporate into a variety of devices.
- Wide viewing angles: LCDs can be viewed from a wide range of angles without distortion, making them ideal for use in televisions and other large displays.

LCD displays can be interfaced with microcontrollers, such as the Arduino, using various types of communication protocols such as Serial Peripheral Interface (SPI) or Inter-Integrated Circuit (I2C). There are also specialized LCD modules available that come with built- in controllers, making them easy to interface with microcontrollers using simple commands.

**Images of LCD Display:-**


Fig 3.11 : LCD – Front View


Fig 3.12: LCD – Back

**Pin Diagram:**

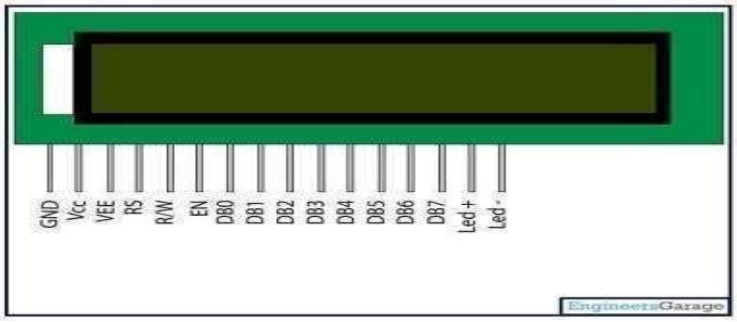



Table 3.13: Pin Diagram

**Pin Description:**

| Pin No | Function | Name |
|---|---|---|
| 1 | Ground (0V) | Ground |
| 2 | Supply voltage; 5V (4.7V – 5.3V) | Vcc |
| 3 | Contrast adjustment; through a variable resistor | $V_{EE}$ |
| 4 | Selects command register when low; and data register when high | Register Select |
| 5 | Low to write to the register; High to read from the register | Read/write |
| 6 | Sends data to data pins when a high to low pulse is given | Enable |
| 7 | 8-bit data pins | DB0 |
| 8 | | DB1 |
| 9 | | DB2 |
| 10 | | DB3 |
| 11 | | DB4 |
| 12 | | DB5 |
| 13 | | DB6 |
| 14 | | DB7 |
| 15 | Backlight $V_{cc}$ (5V) | Led+ |
| 16 | Backlight Ground (0V) | Led- |

Table 3.3: Pin Description

## Register Select

A 16X2 LCD has two order and information registers. The determination of the register is utilized to change starting with one register then onto the next. RS=0 for the register of directions, while RS=1 for the register of information.

### Command Register

The guidelines given to the LCD are put away by the direction register. An order is a direction given to LCD to play out a predefined assignment, for example, instating it, clearing its screen, setting the situation of the cursor, controlling showcase, and so on. Order preparing happens in the direction register.

### Data Register:

The information register will store the information that will be shown on the LCD. The information is the character's ASCII incentive to show on the LCD. It goes to the information register and is prepared there when we send information to the LCD. While choosing RS=1, the information register.

**Read and Write Mode of LCD:**

As stated, the LCD itself comprises of an interface IC. This interface IC can be perused or composed by the MCU. A large portion of the occasions we're simply going to keep in touch with the IC since perusing will make it increasingly perplexing and situations like that are exceptionally uncommon. Information such as cursor position, status completion interrupts, etc. can be read if necessary.

## 8. LDR Sensor

A Light Dependent Resistor (also known as a photo resistor or LDR) is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light-sensitive devices. They are also called as photoconductors, photoconductive cells or simply photocells.

They are made up of semiconductor materials that have high resistance. There are many different symbols used to indicate a photo resistor or LDR, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it.

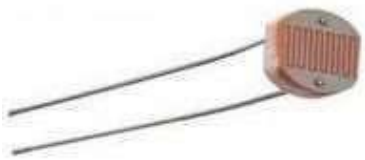


Fig 3.14 : LDR Sensor

## Working Principle of Photoresistor (LDR)

So how exactly does a photoresistor (i.e. a light dependent resistor or LDR) work? Photoresistors work based off of the principle of photoconductivity. Photoconductivity is an optical phenomenon in which the material's conductivity is increased when light is absorbed by the material.

When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the bandgap of the semiconductor material to make the electrons jump from the valence band to the conduction band.

Hence when light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in a large number of charge carriers. The result of this process is more and more current starts flowing through the device when the circuit is closed and hence it is said that the resistance of the device has been decreased. This is the most common working principle of LDR.

## 9. Rain Drop Sensor

**Raindrop sensor** is basically a board on which nickel is coated in the form of lines. It works on the principal of resistance. **Rain Sensor** module allows to measure moisture via analog output pins and it provides a digital output when a threshold of moisture exceeds.

The rain drop sensor module is a smart and low-cost rain sensing device. It has two parts i.e. a rain sensing pad and a control board. The sensitive sensing pad detects any water present on it while the control board reads these signals and can also binarize them. The rain drop module has a major application in the automobile industry. It can be used to monitor the rain and send closure requests to shutters or windows whenever the rain is detected.

Specifications of Raindrop Sensor

- Adopts high quality of RF-04 double sided material.
- Area: 5cm x 4cm nickel plate on side.
- Anti oxidation, anti-conductivity, with long use time.
- Comparator output signal clean waveform is good, driving ability, over 15mA.
- Potentiometer adjusts the sensitivity.
- Working voltage 5V.
- Output format: Digital switching output (0 and 1) and analog voltage output AO.
- With bolt holes for easy installation.
- Small board PCB size: 3.2cm x 1.4cm.
- Uses a wide voltage LM393 comparator.

**Pin Configuration of Rain Sensor:**

| S.NO | Name | Function |
|---|---|---|
| 1 | VCC | Connects supply voltage- 5V |
| 2 | GND | Connected to ground |
| 3 | D0 | Digital pin to get digital output |
| 4 | A0 | Analog pin to get analog output |

Table 3.4: Pin Configuration of Rain Sensor

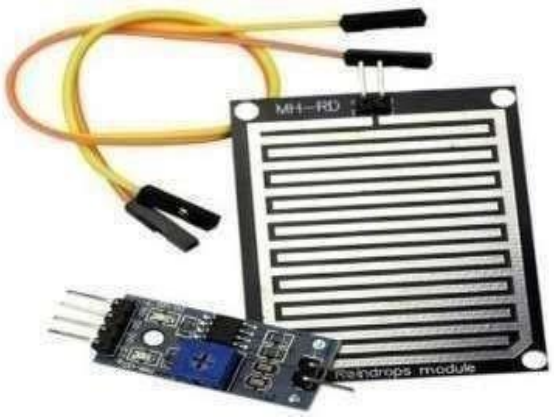



Fig 3.15 : Rain Drop Sensor

### 3.1.5 SOFTWARE REQUIRED AND IT'S DETAILS

#### 1. Arduino IDE

Arduino IDE where IDE stands for Integrated Development Environment – An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go.

#### Introduction to Arduino IDE:

- Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.
- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is easily available for operating systems like MAC, Windows, and Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the codein the environment.

A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.

- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languages.

**How to install Arduino IDE:**

You can download the Software from Arduino main website. As I said earlier, the software is available for common operating systems like Linux, Windows, and MAX, so make sure you are downloading the correct software version thatis easily compatible with your operating system.

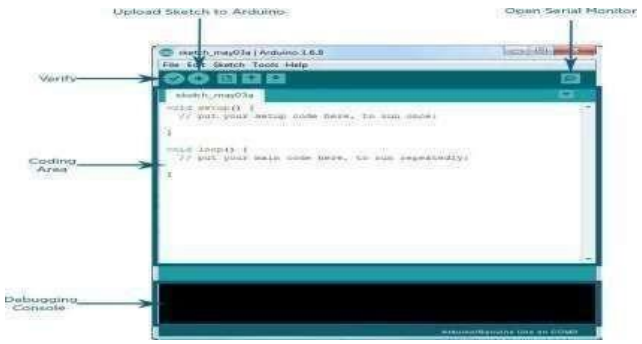
- If you aim to download Windows app version, make sure you have Windows

5.1 or Windows 10, as app version is not compatible with Windows 7 or older version of this operating system.

The IDE environment is mainly distributed into three sections

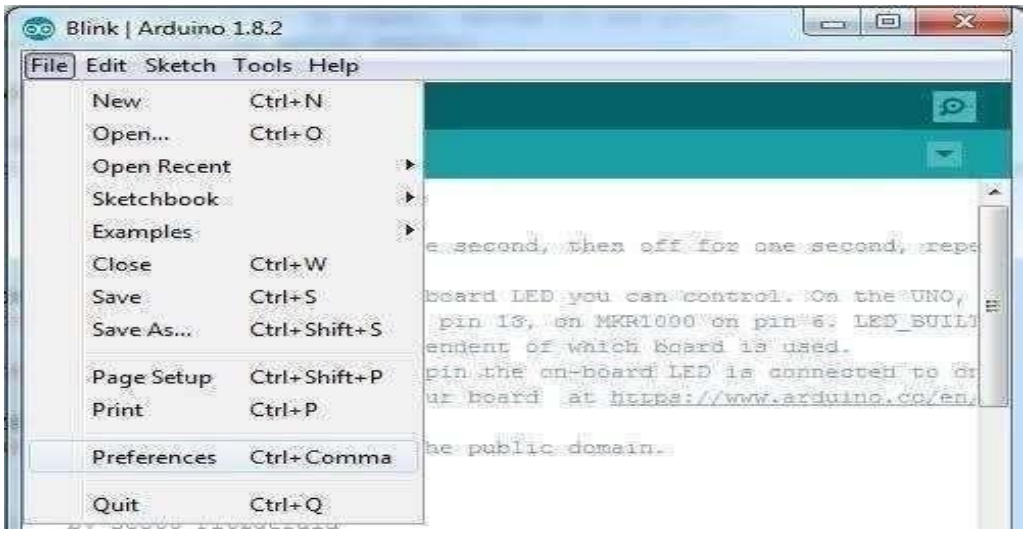
1. Menu Bar
2. Text Editor
3. Output Pane

As you download and open the IDE software, it will appear like an image below.

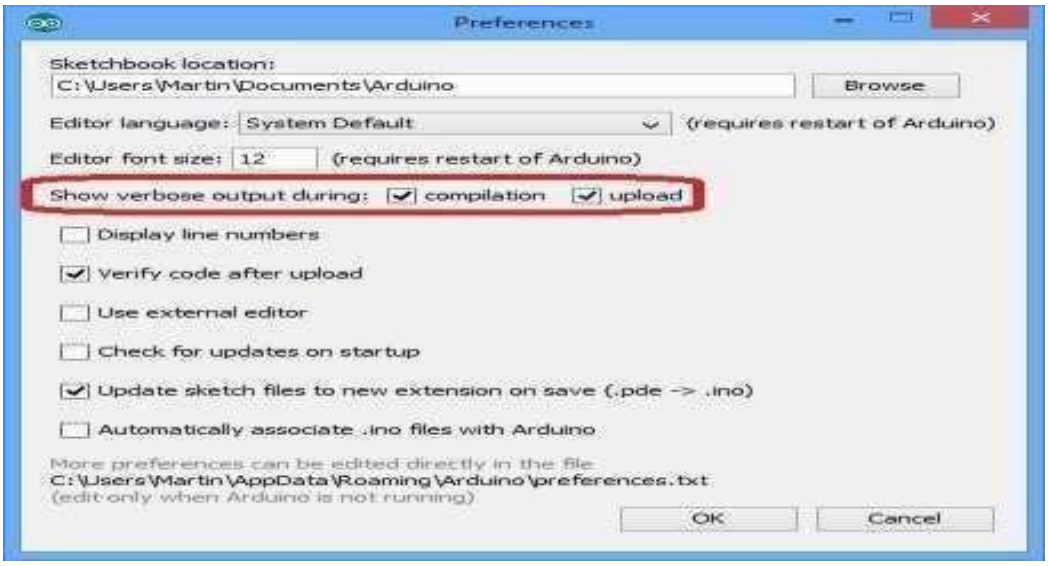


The bar appearing on the top is called **Menu Bar** that comes with five different options as follow

- **File** – You can open a new window for writing the code or open an existing one. Following table shows the number of further subdivisions the file option is categorized into.



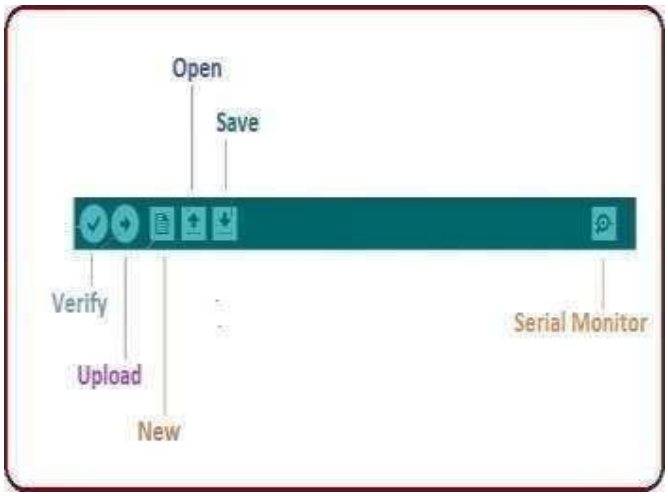

As you go to the preference section and check the compilation section, the Output Pane will show the code compilation as you click the upload button.



And at the end of compilation, it will show you the hex file it has generated for the recent sketch that will send to the Arduino Board for the specific task you aim to achieve.

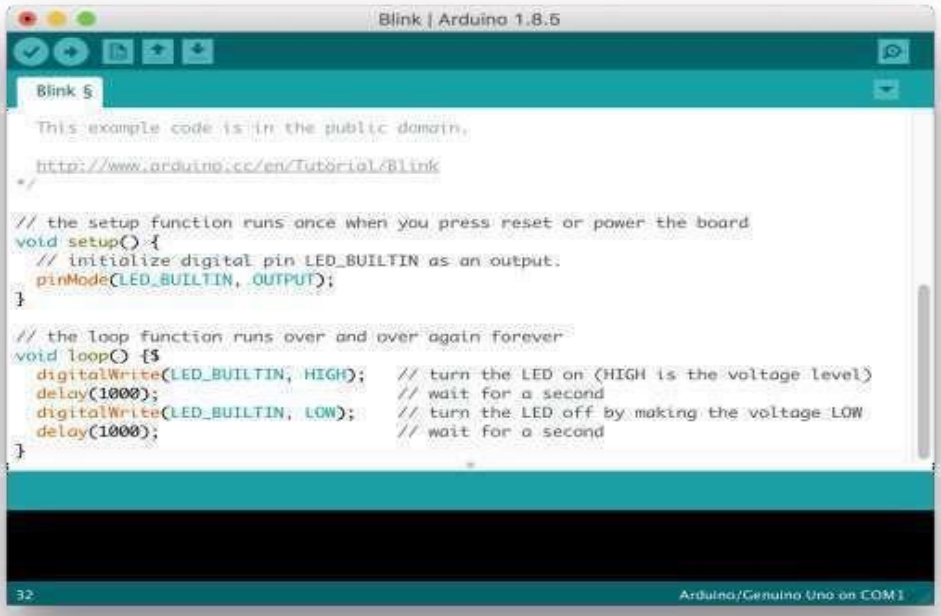

- **Edit** – Used for copying and pasting the code with further modification for font
- **Sketch** – For compiling and programming
- **Tools** – Mainly used for testing projects. The Programmer section in this panel is used for burning a bootloader to the new microcontroller.
- **Help** – In case you are feeling skeptical about software, complete help is available from getting started to troubleshooting.

The **Six Buttons** appearing under the Menu tab are connected with the running program as follow.




- The check mark appearing in the circular button is used to verify the code. Click this once you have written your code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a **Serial Monitor** – A separate pop-up window that acts as an independent terminal and plays a vital role for sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+ Shift+ M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.
- You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno Baud Rate is 9600, as you write the following code and click the Serial Monitor, the output will show as the image below.


The main screen below the Menu bard is known as a simple text editor used for writing the required code.




The bottom of the main screen is described as an Output Pane that mainly highlights the compilation status of the running code: the memory used by the code, and errors occurred

in the program. You need to fix those errors before you intend to upload the hex file into your Arduino Module.

More or less, Arduino C language works similar to the regular C language used for any embedded system microcontroller, however, there are some dedicated libraries used for calling and executing specific functions on the board.

**Libraries:**

Libraries are very useful for adding the extra functionality into the Arduino Module. There is a list of libraries you can add by clicking the Sketch button in the menu bar and going to Include Library.


As you click the Include Library and Add the respective library it will on the top of the sketch with a #include sign. Suppose, I Include the EEPROM library, it will appear on the text editor as

#include < EEPROM.h >.

Most of the libraries are preinstalled and come with the Arduino software. However, you can also download them from the external sources.

**Making pins Input and output:**

The digital Read and digitalWrite commands are used for addressing and making the Arduino pins as an input and output respectively.

These commands are text sensitive i.e. you need to write them down the exact way they are given like digital Write starting with small “d” and write with capital “W”. Writing it down with Digital write or digital write won’t be calling or addressing any function.

**How to select the board:**

In order to upload the sketch, you need to select the relevant board you are using and the ports for that operating system. As you click the Tools on the Menu, it will open like the figure below.


- Just go to the "Board" section and select the board you aim to work on. Similarly, COM1, COM2, COM4, COM5, COM7 or higher are reserved for the serial and USB board. You can look for the USB serial device in the ports section of the Windows Device Manager.

  Following figure shows the COM4 that I have used for my project, indicating the Arduino Uno with COM4 port at the right bottom corner of the screen.

- After correct selection of both Board and Serial Port, click the verify and then upload button appearing in the upper left corner of the six button section or you can go to the Sketch section and press verify/compile and then upload.
- The sketch is written in the text editor and is then saved with the file extension .ino.

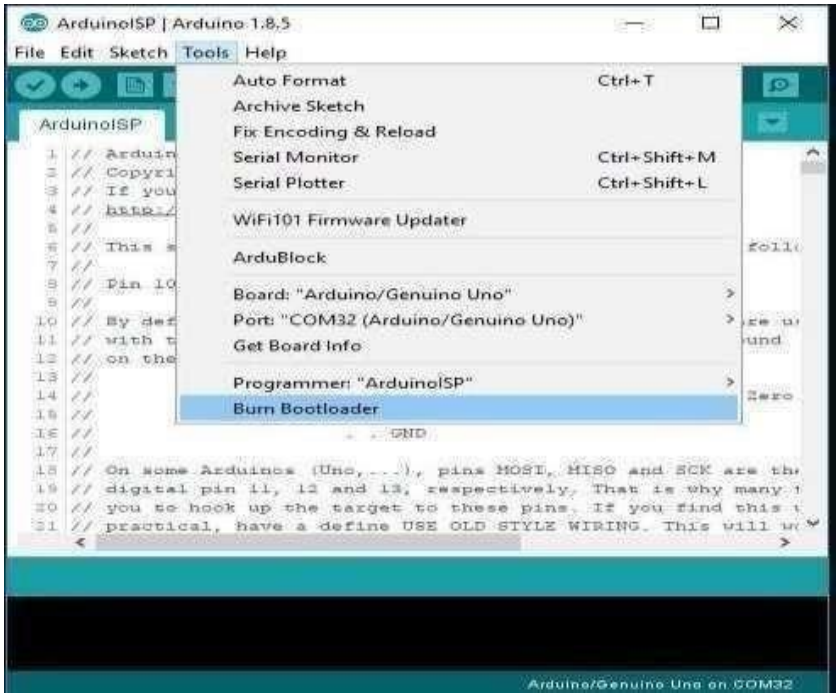
  **Note:** It is important to note that the recent Arduino Modules will reset automatically as you compile and press the upload button the IDE software, however, older version may require the physical reset on the board.

- Once you upload the code, TX and RX LEDs will blink on the board, indicating the desired program is running successfully.
- **Note**: The port selection criteria mentioned above is dedicated for Windows operating system only, you can check this Guide if you are using MAC or Linux.

- The amazing thing about this software is that no prior arrangement or bulk of mess is required to install this software, you will be writing your first program within 2 minutes after the installation of the IDE environment.

**Boot Loader:**

As you go to the Tools section, you will find a bootloader at the end. It is very helpful to burn the code directly into the controller, setting you free from buying the external burner to burn the required code.




When you buy the new Arduino Module, the bootloader is already installed inside the controller. However, if you intend to buy a controller and put in the Arduino module, you need to burn the bootloader again inside the controller by going to the Tools section and selecting the burn bootloader.

More or less, Arduino C language works similar to the regular C language used for any embedded system microcontroller, however, there are some dedicated libraries used for calling and executing specific functions on the board.

## 2. Proteus 8 Professional

Proteus 8 Professional stands as a software tool for Virtual System Modelling and circuit simulation. It integrates mixed mode SPICE circuit simulation, dynamic components, and microprocessor models to enable the simultaneous simulation of entire microcontroller-based designs. Additionally, Proteus allows for the simulation of the

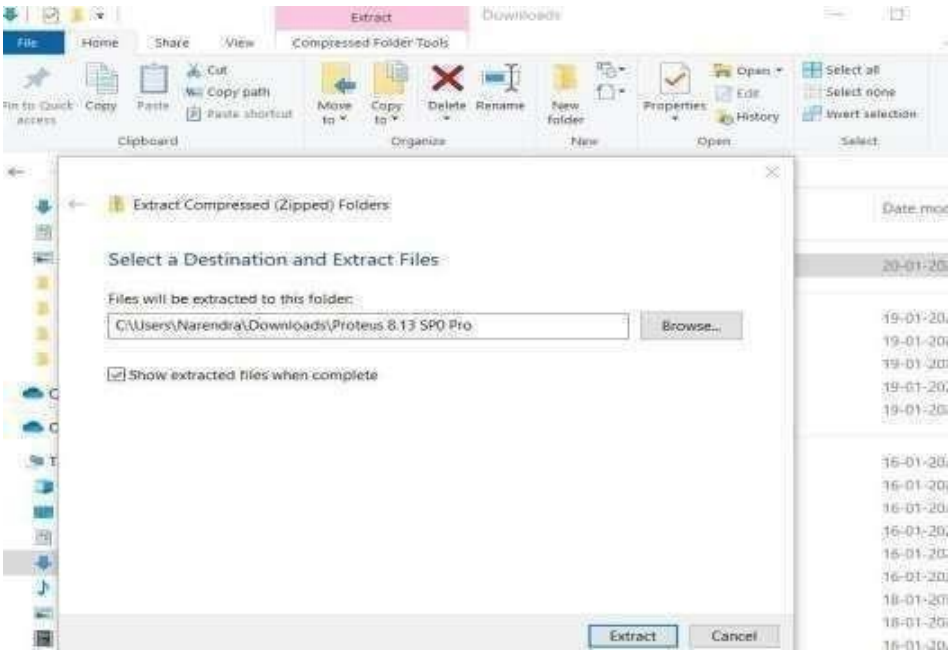
interaction between microcontroller software and connected analog or digital electronics. It covers the simulation of various elements such as Input/Output ports, interrupts, timers, USARTs, and other peripherals across each supported processor. **Introduction to Proteus 8 Software:**

- Proteus 8 is a versatile software package designed for Virtual System Modeling and circuit simulation.
- It offers a comprehensive suite of tools that cater to various aspects of circuit design and simulation needs.
- One of its key features is the mixed mode SPICE circuit simulation capability, allowing users to simulate both analog and digital circuits within the same environment.
- Proteus 8 includes animated components that visually represent the behavior of electronic components during simulation, aiding in understanding and debugging designs.
- It provides a library of microprocessor models, enabling the co-simulation of complete microcontroller-based designs alongside other electronic components.
- With its co-simulation capabilities, Proteus 8 allows users to simulate the interaction between software running on microcontrollers and connected analog or digital electronics.
- The software facilitates the simulation of various peripherals commonly found in microcontroller-based systems, such as Input/Output ports, interrupts, timers, USARTs, and more.
- Proteus 8 boasts a user-friendly interface that makes it accessible to both beginners and experienced users, streamlining the design and simulation process.
- Whether you're a hobbyist, student, or professional engineer, Proteus 8 offers a versatile platform for designing, simulating, and testing electronic circuits and systems.
- It seamlessly integrates circuit design, simulation, and debugging functionalities, providing a comprehensive solution for electronic design projects of all scales.

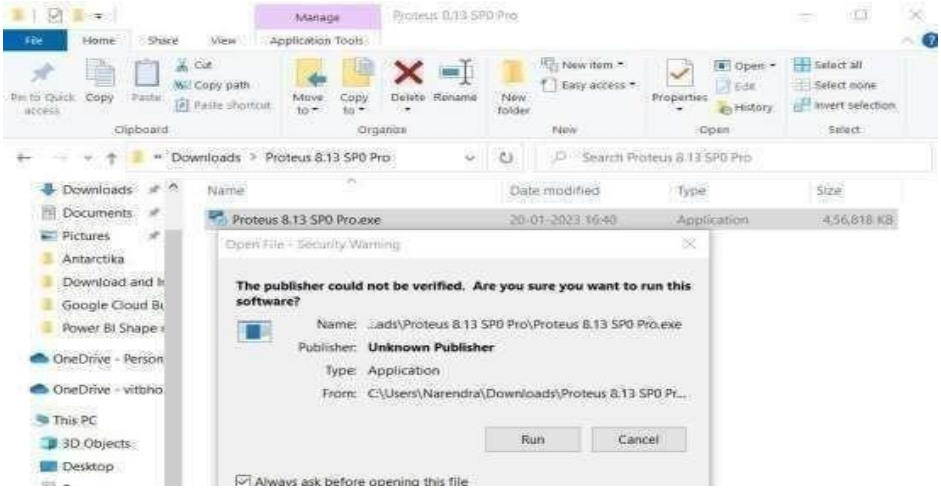
**How to install Proteus 8 Software:**

- First we need to Download Proteus. Here we are going to download Proteus 8 from the labcenter.com
- Use the below link to download the Proteus 8.13
- https://drive.google.com/file/d/18dc8n0lpLu9QRzxbgZzciAwhg6NeqnPp/vi ew

- After Downloading the file extract the .zip file as shown below




- After extracting the .zip a folder will be created and in that folder we need to run the .exe file as shown below to complete the installation

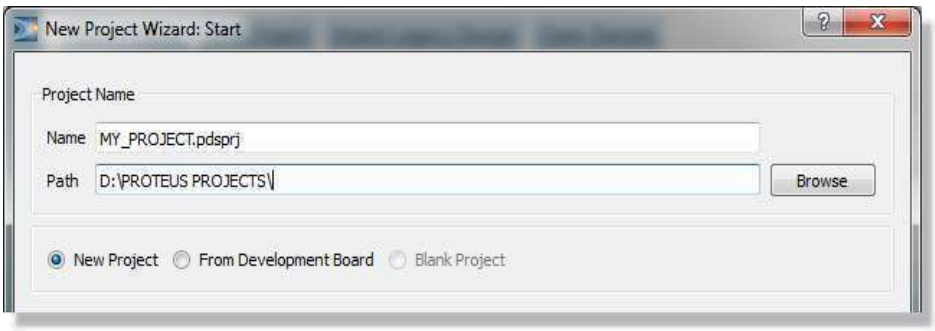



- After installing the Software we get the interface of the proteus as shown below

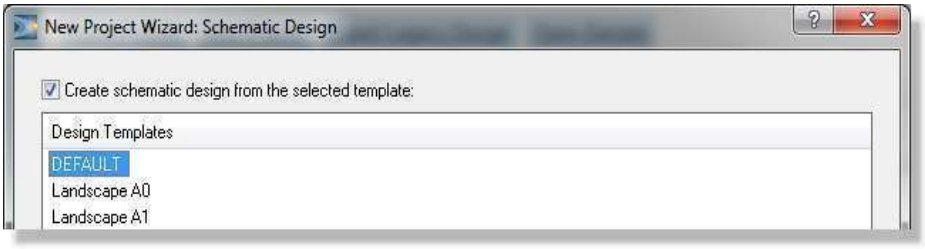

**Creating a New Project**

- We shall assume at this point that you have installed the Proteus 8 software package.
- To start the software, click on the Start button and select Programs, Proteus 8 Professional and then the Proteus 8 application. The main application will then load and run and you will be presented with the Proteus home page.
- If you have a Demonstration copy of the software you can start the Proteus application via the Proteus 8 Demonstration tab from the Start Menu.
- In order to create a schematic we must first create a project. Since this tutorial is partnered with the PCB tutorial we will create a project for schematic/PCB.
- Start by pressing the new project button near the top of the home page in Proteus.

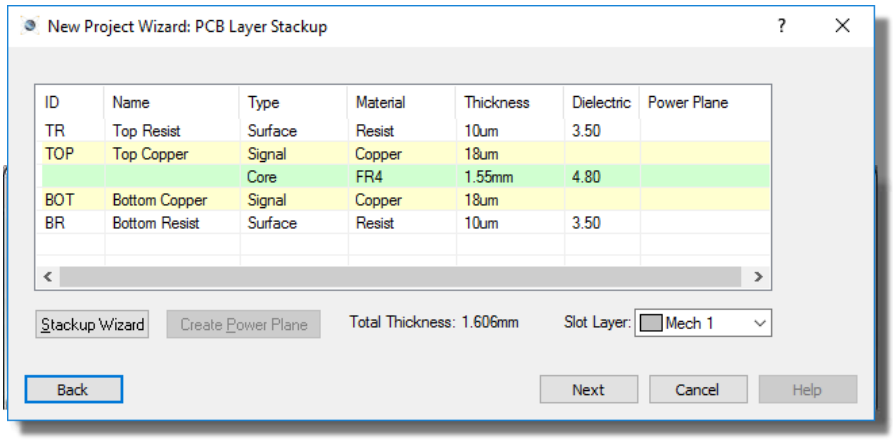

- On the first page of the wizard specify a name and path for the project.




- We need a schematic so check the box at the top of the next step and then choose the default template.

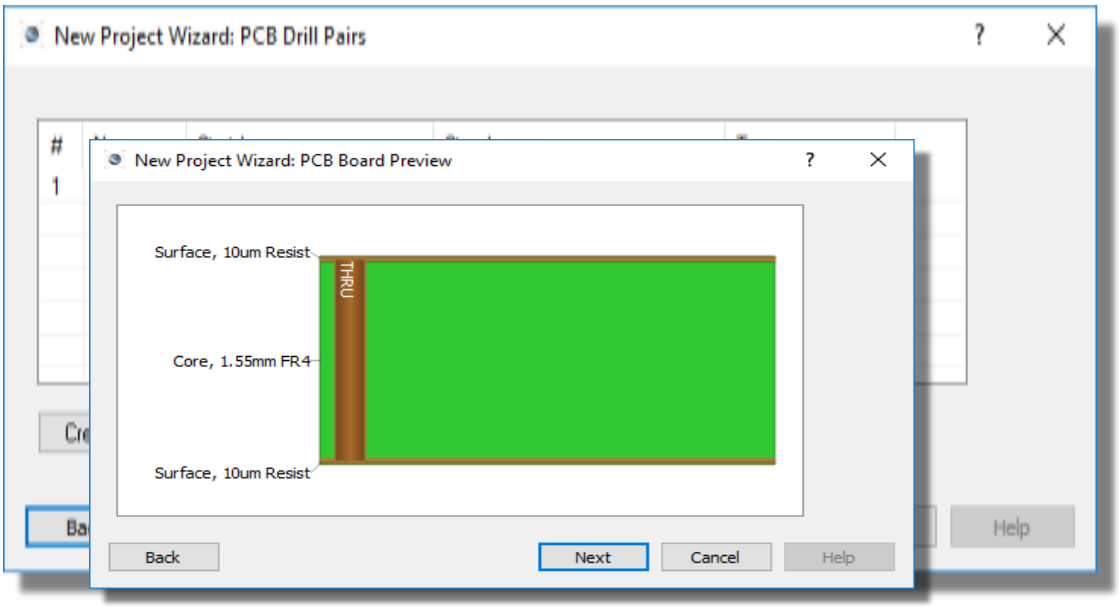



- Similarly, we need a layout so check the box at the top of the layout page and
- again choose the default temp



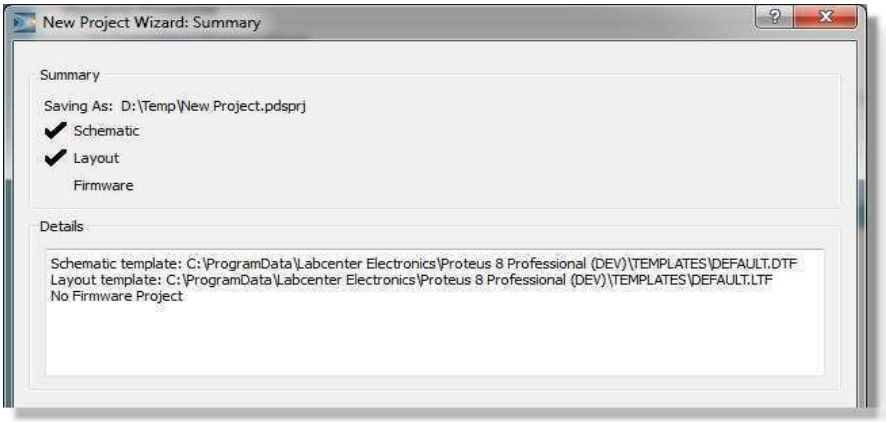

- The next screen allows us to define the layer stack for our PCB.
- Since we will be designing a simple two layer board there is no configuration necessary here.
- For multi-layer PCB's the stack up wizard button would be used to define the number of copper layers, cores and pre-preg' s. This is discussed in more detail in the accompanying PCB tutorial.

- The next screen is for configuration of drill spans. Again, for our proposed 2-layer board the only possibility is thru-hole so there is no action required




- The final screen in the PCB configuration is simply a preview of a PCB cross section that displays visually what has been set up in the previous screens.

- We are not simulating the design so leave the firmware page blank and continue on to the summary which should look like the following:.




- Click on the finish button to create the project.
- A schematic template can contain sheet size, color scheme, company logo, header
- block and various other aestheticpresets. Furtherinformation can be found in the Templates chapter of the reference manual.
- A PCB template can contain board edge, mounting holes, design rules, layer stack
- and various other technology information. Refer to the Templates chapter in the
- PCB documentation for more information.

- The configuration of the Layer Stack and Drill Spans is really important for
- multi-layer PCB's and is discussed in some detail in the reference manual.
- The project will open with two tabs, one schematic capture and the other for PCB layout. Click on the schematic tab to bring the Schematic module to the Foreground.


*Schematic Capture Window*

- The largest area of the screen is called the Editing Window, and it acts as a window on the drawing - this is where you will place and wire-up components. The smaller area at the top left of the screen is called the Overview Window.
- In normal use the Overview Window displays, as its name suggests, an overview of the entire drawing - the blue box shows the edge of the current sheet and the green box the area of the sheet currently displayed in the Editing Window.


- However, when a new object is selected from the Object Selector the Overview Window is used to preview the selected object - this is discussed later.
- Toolbars and menu options will switch according to which tab is active (at the front).

- Throughout this tutorial when we refer to an icon or a menu command we are assuming that the schematic tab is active.
- Right clicking the mouse either in the Object Selector or in the Overview Window will provide a context menu, including the option to 'auto hide' the left hand pane. This is extremely useful if you want to maximize the editing area of the application.
- When enabled the Object Selector and Overview Window will be minimized to a 'flyout bar' at the left (or right) of the application by default and will appear either when the mouse is placed over the bar or when the mode of operation is changed by selecting a different icon.

**Library Parts**

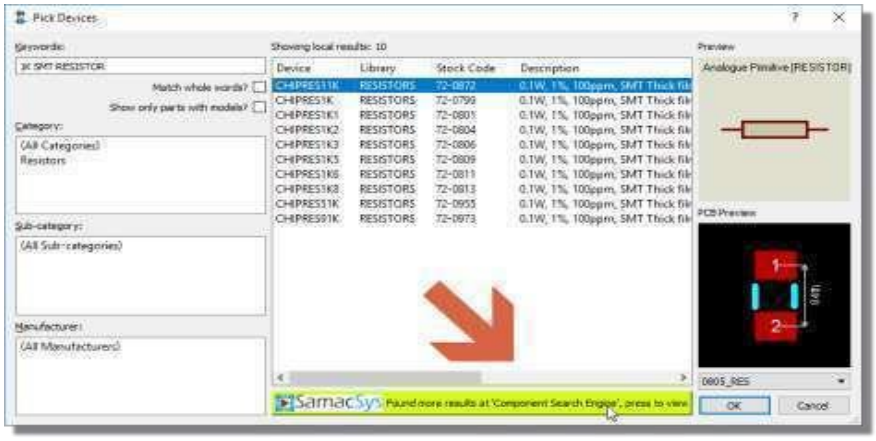
- The Proteus Design Suite comes with a significant installed base of schematic components, almost all of which are already packaged with the correct PCB footprint. However, with the number of new parts entering the market every day and the vast choice available to engineers it is inevitable that users will have to either import library parts into Proteus or create library parts inside Proteus.

**Importing Library Parts**

- Importing Library Parts is by far the preferred option. It is both much faster to do, is far less error prone and you can import both the schematic part and the layout footprint at the same time.
- Proteus supports two ways to import parts:
- Integrated Web Search and Import (Requires a valid USC) Manual Library Part Import Dialogue

**Web Search Import**

The integrated web search import works directly from the library picker dialogue. You simply type the part name you want and, after searching the installed libraries, you can search a database of over 15 million parts from our partner Samacsys. This service requires a free account to be registered with Samacys and a valid USC to import the parts.




**Library Part Import Dialogue**

This method enables you to manually import via the Import Part command on the Library menu in either the schematic of the layout editors. This import will work with all major vendor files such as those generated by Ultra-Librarian, Samacys, Snap EDA and PCB Library Expert as well as through common supplier portals such as Digi key or RS Components. It does not require a valid maintenance contract to work but does involve slightly more effort.

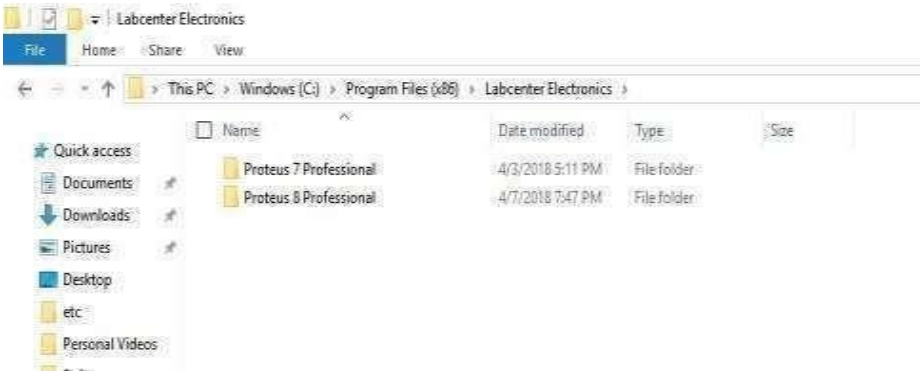
**Adding New Library**

**Step1: Downloading a Library**

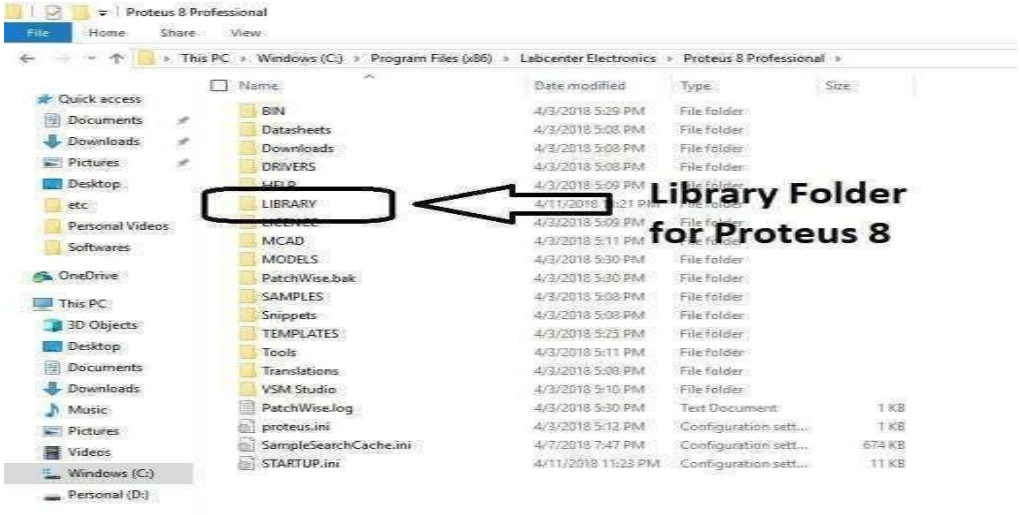
- First of all, download any Proteus Library from our site, let's use Vibration Sensor Library for Proteus.
- Proteus Library zip file download link is given in the post, so simply click on the Download link in order to download Proteus Library zip file.
- Open this Proteus Library .zip file and you will get three files in it, named:
- VibrationSensorTEP.LIB

- Vibration Sensor TEP. IDX
- Vibration Sensor TEP.HEX
- These are the Proteus library files of the vibration sensor and need to be placed in the Library folder of Proteus software.

- **Step2: Install Proteus Library**
  - We have downloaded the Proteus Library zip file in Step 1 and now we need to install it in Proteus software. For installation, we don't need to execute any file, instead, we simply need to copy & paste these Proteus Library Files into the library folder of Proteus.
  - If you are using Windows 7, 8 or 10, normally Proteus software is installed in the Program File (x86) folder, but it could be in the Program File folder as well.
  - So, go to your C drive and then in both of these Program File folders, search for Lab center Electronics.
  - This Lab center Electronics folder is automatically generated by Proteus setup.
  - If you have installed Proteus 7 or Proteus 8 or both, they will be present here. Here's a screenshot of my Lab center Electronics folder:

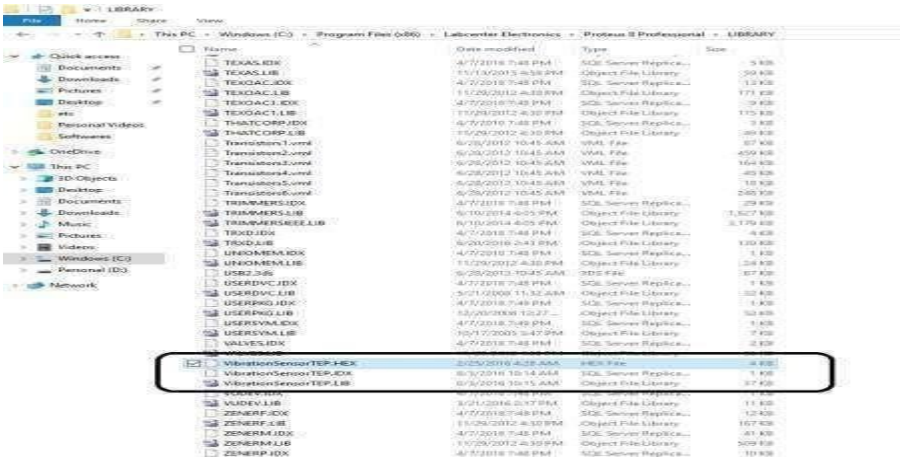



  - Once you are here, now if you want to add Library in Proteus 8, click on Proteus 8 software as shown in the below figure:



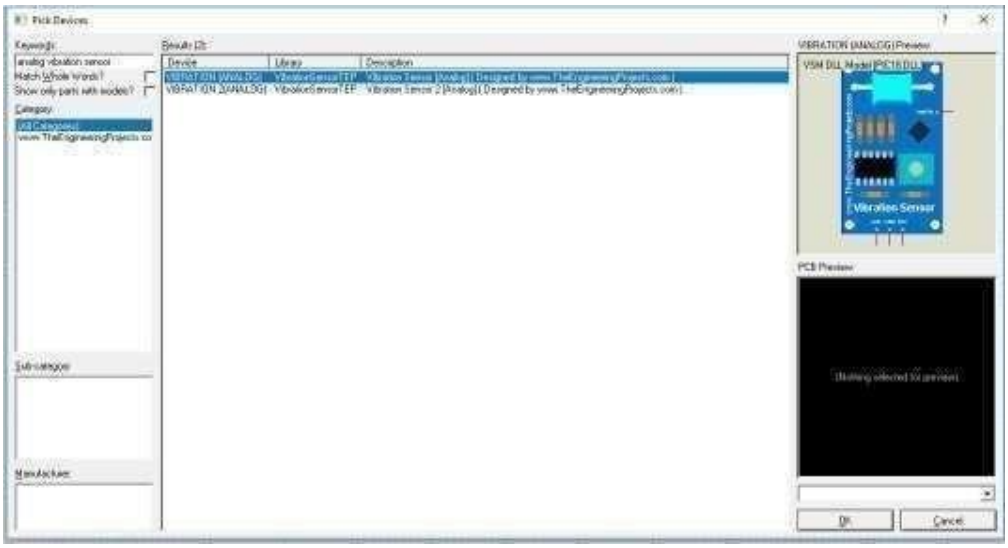

- First of all, download any Proteus Library, let's use Vibration Sensor Library for Proteus.
- You can see the Library folder in the above image
- so simply paste your Proteus Library files into this Library folder.
- Here's the complete link to Proteus 8 Library folder:
- C:\Program Files (x86)\Lab center Electronics\Proteus 8 Professional\LIBRARY.
- In some Proteus 8 Installations, you may find the Library folder at this link: C:\ProgramData\LabcenterElectronics\Proteus8\Professional\LIBRARY.
- After adding these Proteus Library files, restart your Proteus software.
- You have to restart it otherwise it won't update its components' database.
- Now in the components search box, type vibration sensor and you will get the results.
- Similarly, if you want to install Proteus Library in Proteus 7, open your Proteus
- Here's the complete link to Proteus 7 Library folder:
- Professional and you will find the Library folder in it as well. Here's the screenshot:
- C:\Program Files(x86)\Lab center Electronics\Proteus7Professional\LIBRARY
- Let's open this Library folder and have a look at our Vibration Sensor Library files.
- Here's the screenshot:


- You can see our Vibration Sensor Library Files in the above image, I have encircled them as well.



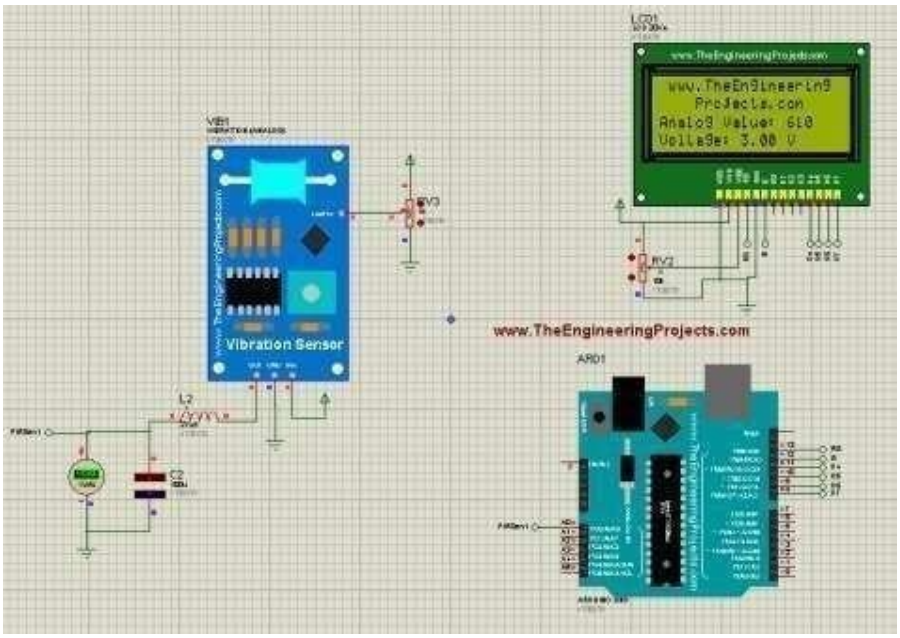
**Step3: Simulate Proteus Library**

- After adding Proteus Library Files, open Proteus software or restart it(if it's already open).
- In the components database, search for Vibration Sensor& you will get results as shown in the below figure:



- Place it in your workspace and you are now ready to simulate it in Proteus.
- Here's a working simulation of the vibration sensor in Proteus:

  **Note: es, it happens that the Library folder is hidden, so if you are unable to find the Proteus Library folder then check your hidden folders too.**
- So, that was all for today. I hope now you can quite easily add new Library in Proteus 8.




**Basic Schematic Entry**

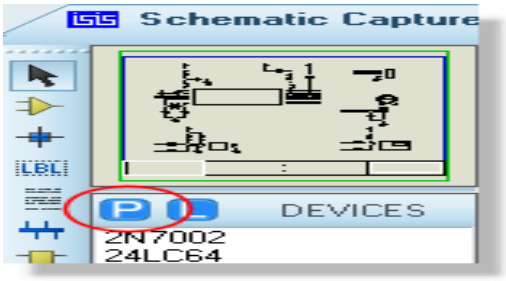
The design in question is relatively large and there is therefore a reasonable amount of drawing involved. We provide a completed schematic at the end of this section so, if you feel that you have mastered the basics at any point, there is no need to continue with drawing the remainder of the circuitry. We do however urge you to read through the full contents of the documentation as we introduce important features throughout.

The first thing we need to do is to get the parts from the libraries that we need in our schematic.

**Selecting Parts from the Library**

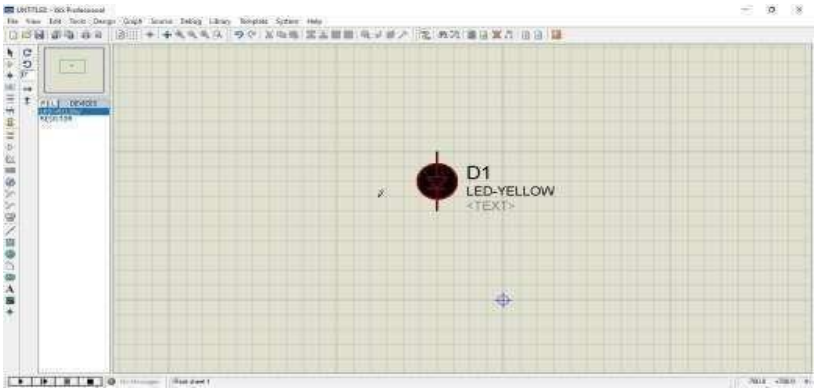
You can select parts from the library in one of two ways:

- Click on the P button at the top left of the Object Selector as shown below.




You can also use the Browse Library icon on the keyboard shortcut for this command (by default this is the P key on the keyboard).

- Right click the mouse on an empty area of the schematic and select Place




Component(LED yellow in figure) in the editing window as shown below.

- The Proteus Design Suite comes with a significant installed base of schematic components, almost all of which are already packaged with the correct PCB footprint. However, with the number of new parts entering the market every day and the vast choice available to engineers it is inevitable that users will have to either import library parts into Proteus or create library parts inside Proteus.

- The design in question is relatively large and there is therefore a reasonable amount of drawing involved. We provide a completed schematic at the end of this section so, if you feel that you have mastered the basics at any point, there is no need to continue with drawing the remainder of the circuitry. We do however urge you to read through the full contents of the documentation as we introduce important features throughout.

The first thing we need to do is to get the parts from the libraries that we need in our schematic.

## 3.1.6 FLOW CHART OF THE ALGORITHM

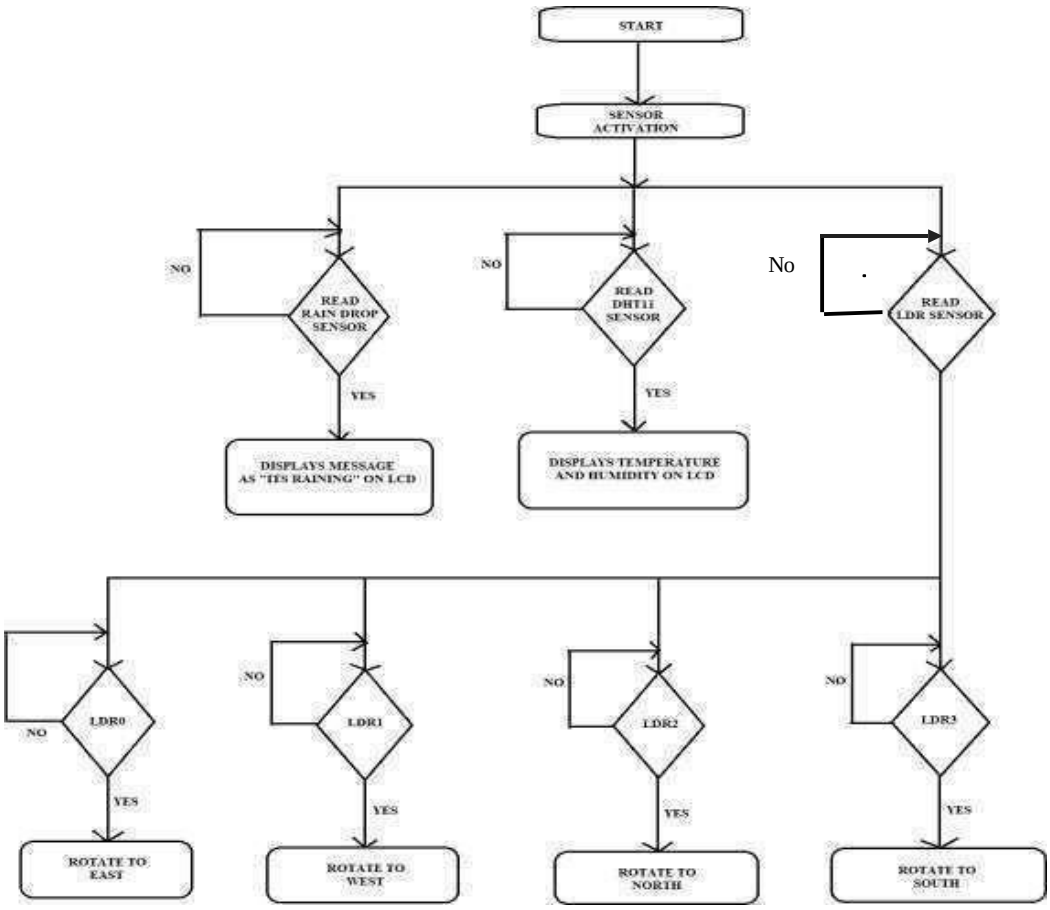



Fig 3.16: Flow Chart of the Algorithm

### 3.1.7 EXPERIMENTAL SETUP

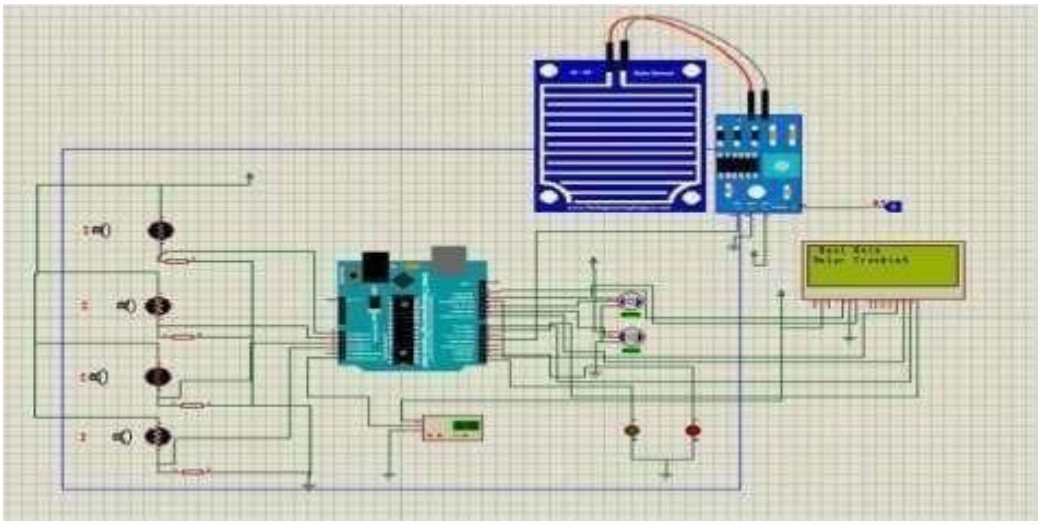


Fig 3.17: Proteus Circuit Setup

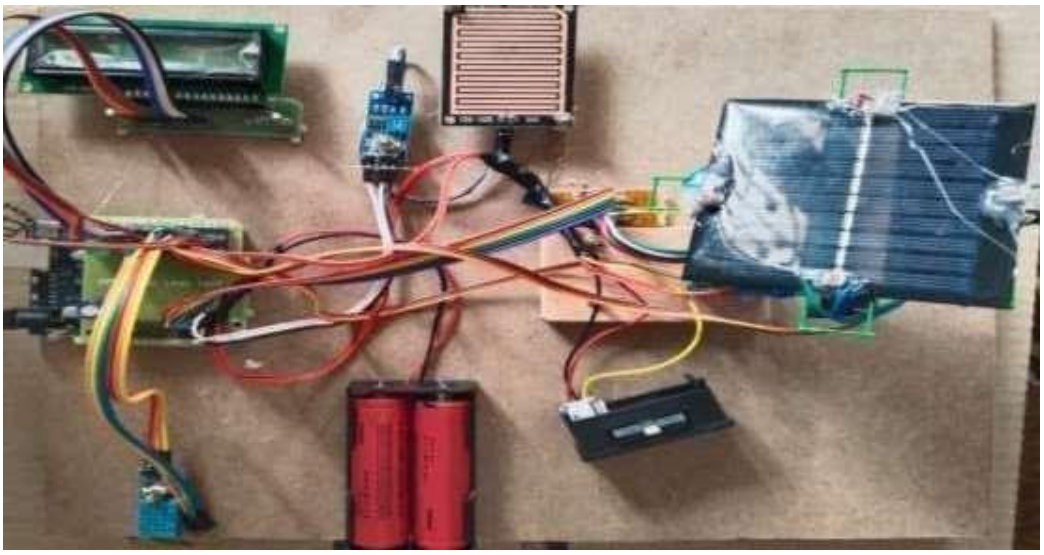


Fig 3.18: Experimental setup

## Advantages of Proposed System

Dual-axis solar tracking with weather monitoring has several advantages:

- **Increased Energy Production:** By using dual-axis tracking, solar panels can follow the sun's movement more accurately and efficiently, resulting in higher energy production. This can increase the overall efficiency of the solar panel system.
- **Improved Weather Monitoring:** With weather monitoring, solar panels can adjust their position according to the weather conditions. This means that during periods of high winds, the panels can be tilted to reduce wind resistance, thereby reducing the risk of damage. Similarly, during periods of heavy rain or snow, the panels can be tilted to prevent damage or ensure that they continue to operate efficiently.
- **Longer Lifespan:** Dual-axis solar tracking can extend the lifespan of solar panels by reducing stress on the panels. By adjusting the angle of the panels, the stress on the panels is reduced, which can help to prevent cracks or other damage that could reduce the lifespan of the panels.
- **Reduced Costs:** While the initial cost of installing dual-axis solar tracking with weather monitoring may be higher than traditional fixed solar panels, the increased energy production and longer lifespan of the panels can result in significant cost savings over time. Additionally, the ability to adjust the panels based on weather conditions can reduce the risk of damage, which can also result in cost savings

## Disadvantages of Proposed System

While dual-axis solar tracking with weather monitoring offers many benefits, there are also some potential disadvantages to consider:

- **Higher Initial Cost:** Dual-axis solar tracking systems with weather monitoring can be more expensive to install compared to fixed solar panel systems. The added cost of the tracking system and weather sensors can increase the upfront cost of the system.
- **Increased Maintenance:** The addition of a tracking system and weather sensors may increase the complexity of the solar panel system, which could require more maintenance over time. The sensors may need calibration or cleaning, and the tracking system may require periodic maintenance or repair.
- **Energy Consumption:** The dual-axis tracking system requires energy to operate, which can offset some of the energy savings that come from increased efficiency. Additionally, the added energy consumption can increase the overall carbon footprint of the system.
- **Limited Efficiency Improvements:** While dual-axis tracking can improve the

efficiency of solar panels, the amount of improvement may be limited in certain regions.

- **Complexity:** Dual-axis solar tracking with weather monitoring systems can be more complex than fixed solar panel systems, which may require additional training and expertise to design, install, and maintain.

## Applications of Proposed System

Dual-axis solar tracking with weather monitoring has a wide range of applications, including:

- **Residential Solar:** Homeowners can use dual-axis solar tracking to increase the energy efficiency of their solar panel systems. By following the sun's movement more precisely, the system can generate more energy, reducing energy costs and improving sustainability.
- **Commercial Solar:** Dual-axis solar tracking can also be used in larger commercial solar panel installations, such as those on factories, warehouses, or office buildings. The increased efficiency can help reduce energy costs and carbon emissions, making it an attractive option for many businesses.
- **Agriculture:** Dual-axis solar tracking systems with weather monitoring can be used in agriculture to power irrigation systems, pumps, and other equipment. The system can be installed on farms, vineyards, or other agricultural properties to generate renewable energy and reduce energy costs.
- **Remote Locations:** Dual-axis solar tracking can also be used in remote locations that are not connected to the grid. By generating their own energy, these locations can reduce their dependence on traditional energy sources and increase their energy independence.
- **Disaster Relief:** Dual-axis solar tracking with weather monitoring can also be use in disaster relief efforts. In situations where power grids are down or damaged

# CHAPTER-IV

# RESULTS

## 4.1 PROTEUS SIMULATION

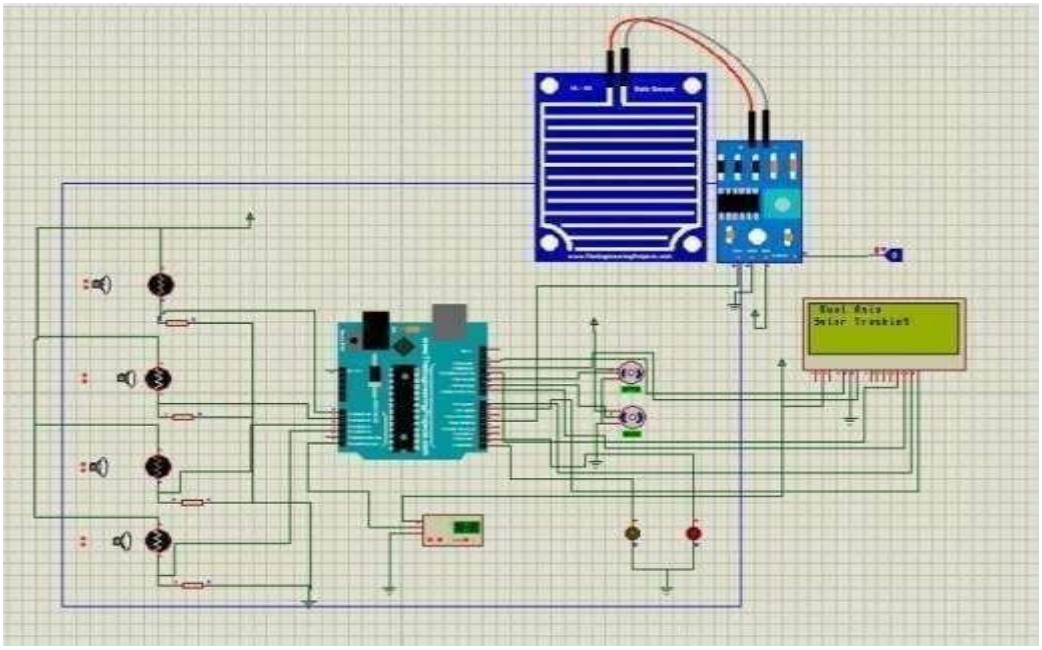



Fig 4.1: Output Proteus Simulation

### 4.1.1 SERVO MOTOR WORKING

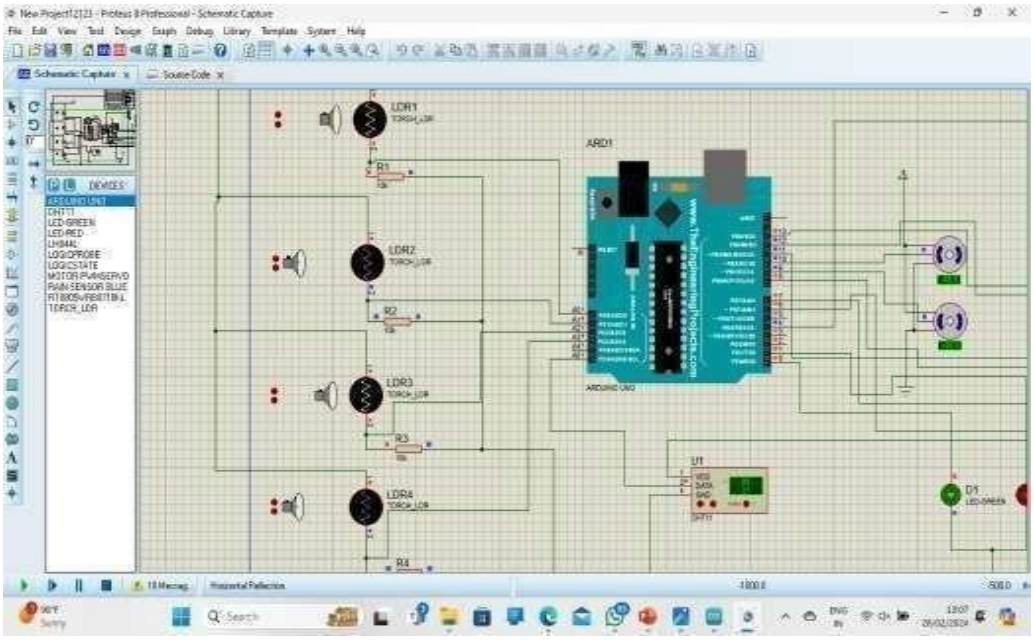



Fig 4.1.1 Servo motor working

### 4.1.2 TEMPERATURE AND HUMIDITY VALUES

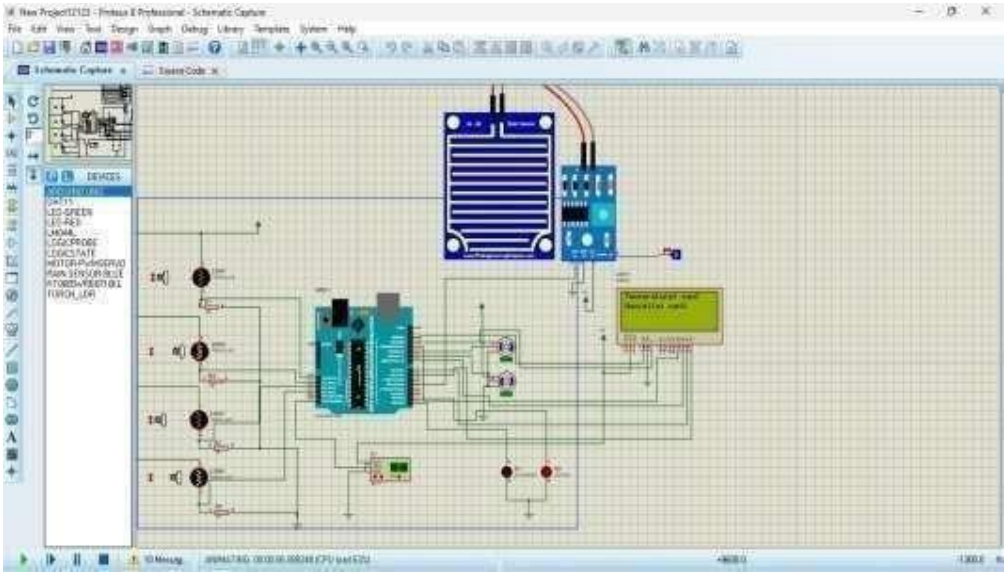


Fig 4.1.2 Temperature and humidity readings

### 4.1.3 RAIN DETECTION

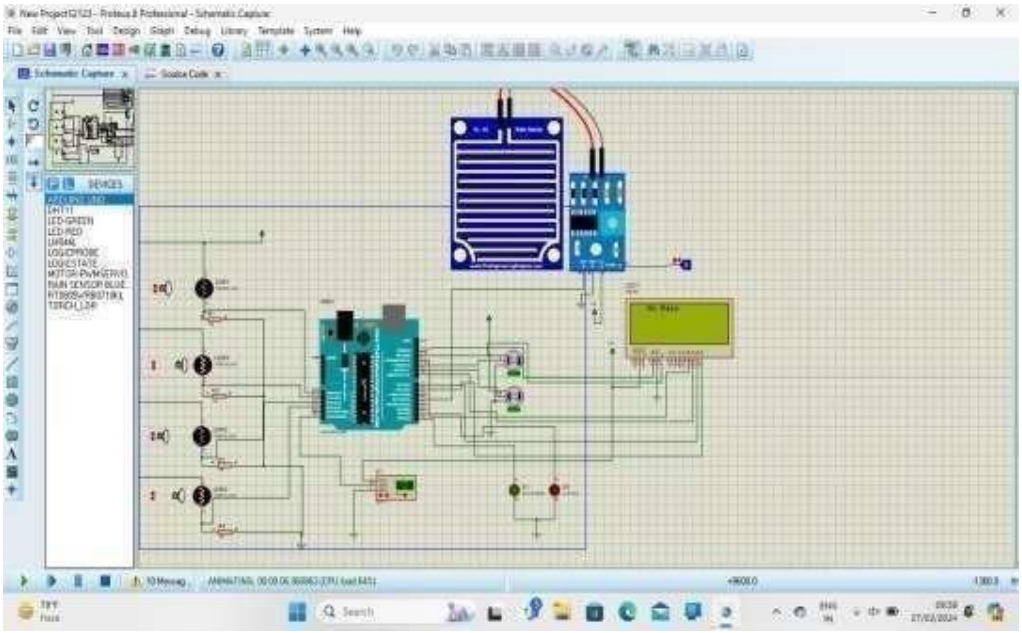


Fig 4.1.3 When there is no rain it is displayed on LCD display and red led glows

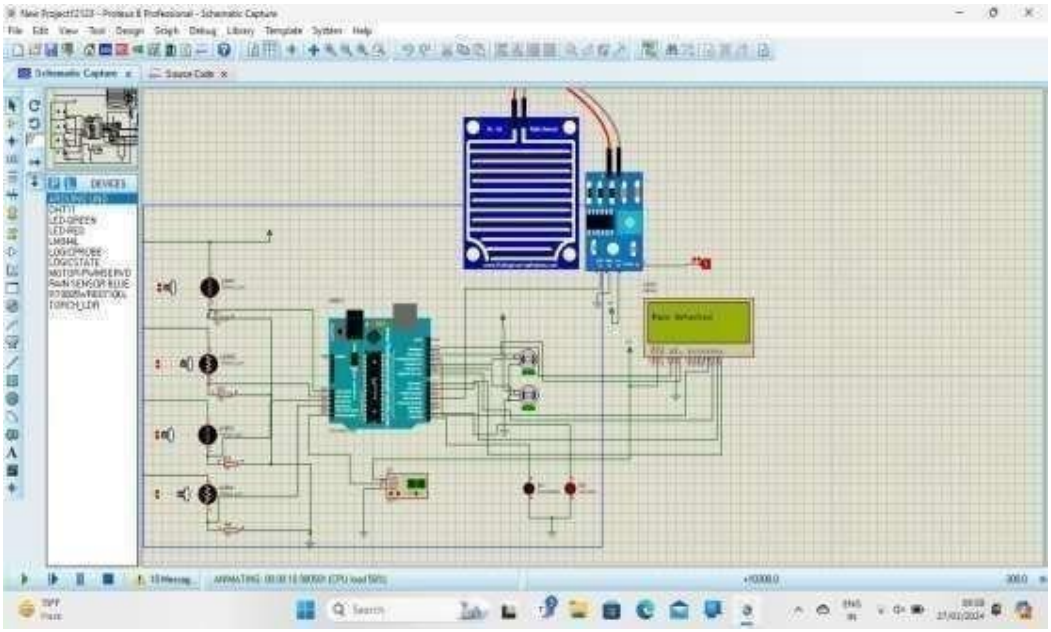


Fig 4.1.4 When there is rain it is displayed on LCD display and the green led glows

## 4.2 OUTPUT OF DUAL AXIS SOLAR TRACKER

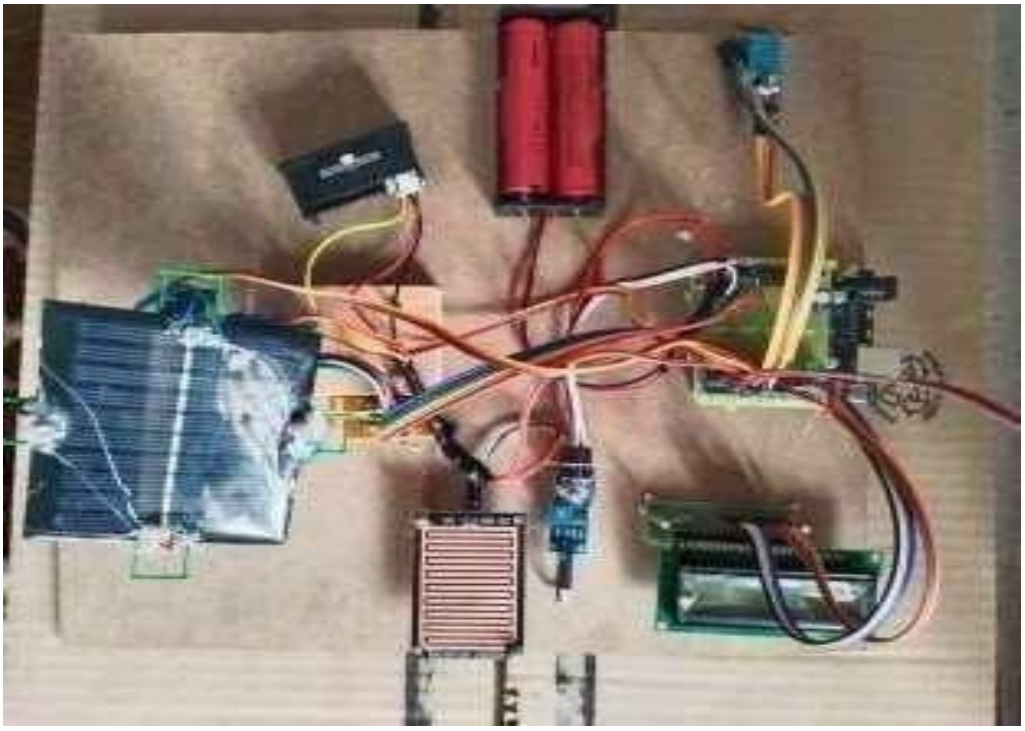


Fig 4.2: Output Setup

Thus, Experiment outcomes of the system were performed by placing it inthe roof top. This output voltage is collected from 8:00 AM to 6:00PM.

The table which is shown above indicates the output values at different time intervals. As we know dual axis solar tracker is more productive than single axis solar tracker, comparison of output voltages of both the tracking methods is done.

| S. No. | Time(Hrs.) | Without tracking (V) | With tracking (V) |
|---|---|---|---|
| 1. | 08.00 AM | 1.24 | 1.73 |
| 2. | 10.00 AM | 1.31 | 2.24 |
| 3. | 12.00 PM | 1.54 | 2.32 |
| 4. | 02.00 PM | 1.61 | 2.57 |
| 5. | 04.00 PM | 1.36 | 2.34 |
| 6. | 06.00 PM | 1.14 | 1.09 |

Table 4.1 :Observations of Solar Tracking

## 4.3 WORKING OF LCD AND OUTPUT OF WEATHER SENSOR


Fig 4.3: Output Setup in LCD


Fig 4.3.1:Title Indication


Fig 4.3.2: Output of Temperature and Humidity

| Time (Hrs) | Temperature (°C) | Humidity (%) |
|---|---|---|
| 13:00 | 41 | 53H |
| 16:00 | 39 | 80 H |

Table 4.2 : Output of DHT11 Sensor

## 4.4 OUTPUT OF RAIN DROP SENSOR


Fig 4.4.1: Output of Without Rain


Fig 4.4.2: Output of With Rain

## 4.5 OUTPUT OF DIGITAL VOLTMETER


Fig 4.5: Output of Digital Voltmeter

## 4.6 OUTPUTS OF LDRS


Fig 4.6.1: Output of LDR1


Fig 4.6.2: Output of LDR2


Fig 4.6.3: Output of LDR3


Fig 4.6.4: Output of LDR4

## CHAPTER-V

# CONCLUSION

# AND

# FUTURE SCOPE

## 5.1 CONCLUSION

As solar energy is considered one of the main sources of energy in the near future, In this project, a simple and concise overview of the solar tracking mechanism to improve the solar gain energy, also the costs of the solar tracker operation and cost maintenance is relatively low. In this project, Design and implementation of solar tracker with four axes that use in motor satellite dish to track the sun accurately and use LDR sensor to determine the intensity of falling sunlight and found that the solar tracking system is more effective than the fixed solar panel. The energy gained from the solar panel with the dual tracker exceeds 35% of the energy gained from the fixed solar panel, In analyzing the data, the energy gained from the solar tracker is mostly in the morning and in the evening because at noon time there is little difference and this proves that the fixed solar panel is efficient during noon time only. The dual-axle solar tracking system is efficient as it can be placed anywhere and ensure a high energy gain.

## 5.2 FUTURE SCOPE

Fabrication of Microcontroller using ASIC concepts: The number of wires can be greatly reduced by directly if a customized PCB is made upon which all the resistors can be directly soldered. This also eliminates the use of a Breadboard which was used to make all the external connections.

Design Improvements: With the current design, it can be seen that the controller circuit rotates along with the panel. This was done to avoid tangling of wires. A better design may be realized in which only the panel rotates and all other parts are stationery.

Mounting of the panels: In our designs, the panels a mounted on a horizontal shaft supported strongly at both ends. We can mount the panels directly onto a motor placed at the center of the panel-Base in order to provide East-West movement. This reduces the weight and effective cost of the project.

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2) “Implementation of a Prototype for a Traditional Solar Tracking System" by Nader Barsoum, published in the 2009 Third UK Sim Euro- pean Symposium on Computer Modeling and Simulation.
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Z. Chen, A. W.-C. Fu, and D. W. Cheung, “Enhancing effectiveness of outlier detections for low density patterns”, in Advances in Knowledge Discovery and Data Mining. Berlin, Germany: Springer, 2002, pp. 535– 548.
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6) Poulek, V. (1994): Testing the New Solar Tracker with Shape Memory Alloy Actors. Proceedings of the Conference Record of the IEEE Photovoltaic Specialists Conference.
7) Falah I Mustafa, Sarmid Saikh 9th IREC Date Added to IEEE Xplore: 24 May 2018.
8) 2008 International Conference on Information Management, Innovation Management and Industrial Engineering Added to IEEE Xplore: 06 January 2009

# APPENDIX

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**Declaration**

I hereby declare that all the details furnished above are true to the best of my Knowledge.

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| Intermediate | Narayana Junior college | 2020 | Board of Intermediate Education | 91 |
| SSC | Prathibha Educare | 2018 | School of Secondary Education | 9.8 |

**Declaration**

I hereby declare that all the details furnished above are true to the best of my Knowledge.

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