# CHAPTER 1:

# INTRODUCTION

The introduction to solar tracking systems provides an overview of the technology and its significance. Solar tracking systems are designed to optimize the capture of solar energy by continuously adjusting the position of solar panels to align with the sun's movement throughout the day. The introduction highlights the growing interest in renewable energy sources and the need for efficient utilization of solar power. It mentions the potential of solar tracking systems to increase the energy output and overall performance of solar panels. Additionally, the introduction may touch upon the various types of tracking mechanisms, control strategies, and technological advancements that have been explored in the field. It sets the stage for the subsequent discussion on the benefits, challenges, and advancements in solar tracking systems.

Renewable energy solutions are becoming popular. Maximizing output from solar system increases efficiency. Maintaining vertical direction between light and panel maximizes efficiency.

## 1.1) PROBLEM STATEMENT

Presently solar panels are of fixed type which lowers the efficiency. Solar panels are stationary and do not follow the movement of the sun.

It can work efficiently only if the presence of the Sun is strong and we all know that the incident of sunlight changes or moves with the time of the day. For fixed solar panels we can't able to get good returns for invested amount

The problem at hand is the sub optimal energy output and efficiency of fixed solar panels due to their inability to adjust their position in accordance with the sun's movement throughout the day.

This limitation hinders the full utilization of solar energy potential and restricts the economic viability of solar power generation.

Existing solar tracking systems face challenges such as high initial costs, mechanical complexity, and maintenance requirements, which impede their widespread adoption and scalability. Furthermore, the lack of standardized design and control strategies limits the compatibility and interoperability of different tracking systems. Addressing these challenges is essential to maximize the energy generation potential of solar panels and promote the sustainable adoption of solar tracking systems. When there is decrease in intensity of light automatically changes its direction to get maximum intensity of light. This system has 40% higher generating power than fixed.

# CHAPTER-2:
# SYSTEM REQUIREMENT

## 2.1) HARDWARE REQUIREMENTS:

### 2.1.1) SOLAR PANEL:

Solar panels, also known as photovoltaic (PV) panels, convert sunlight into electricity through the photovoltaic effect. They consist of semiconductor materials, typically silicon,that absorb photons from sunlight and generate an electric current. This direct current (DC) can be used to power various electrical devices.

**Fig 2.1.1 Solar panel**

## 2.1.2) LDR SENSOR:

LDR (Light-Dependent Resistor) sensors are passive electronic components that change their resistance in response to changes in ambient light levels. As the intensity of light increases, the resistance of the LDR decreases, and vice versa. LDR sensors are commonly used in various applications, such as light detection and automatic brightness control in electronic devices.

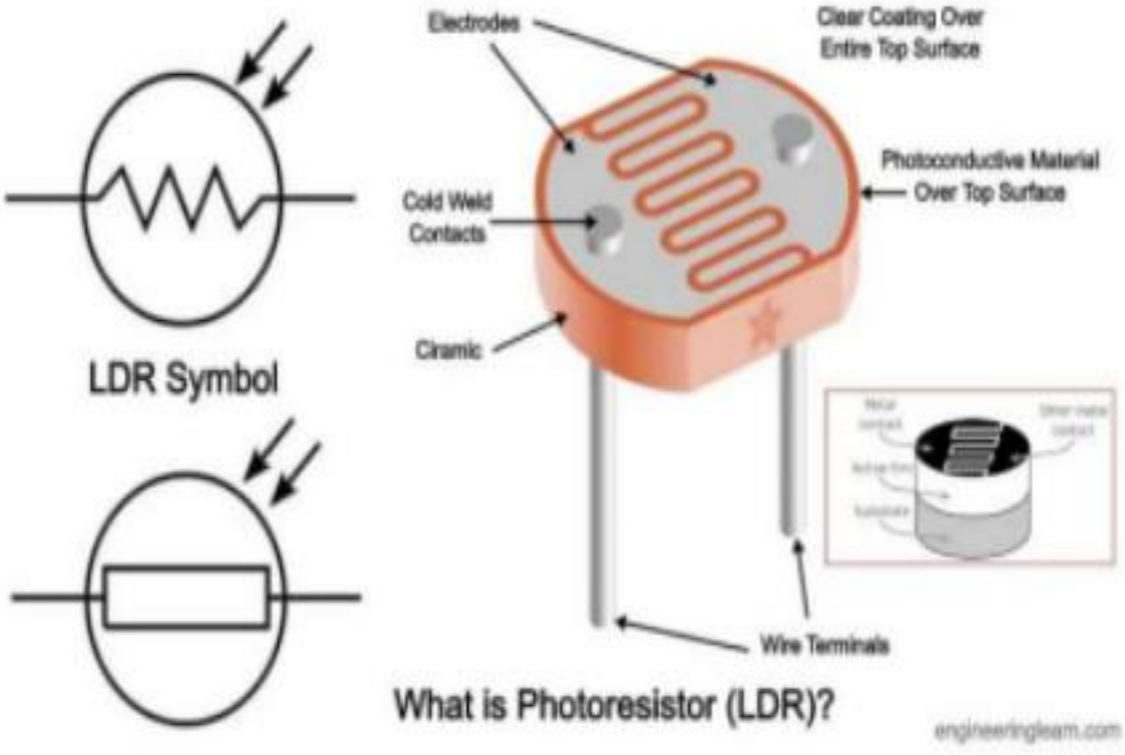


**Fig 2.1.2 LDR SENSOR**

## 2.1.3) SERVO MOTOR:

A servo motor is a type of rotary actuator that uses feedback control to precisely control the angular position of the output shaft. It consists of a motor, gears, and a control circuit. The control circuit receives signals to determine the desired position, and the servo motor adjusts its position accordingly, making it ideal for precise positioning applications such as in robotics, automation, and solar tracking systems.

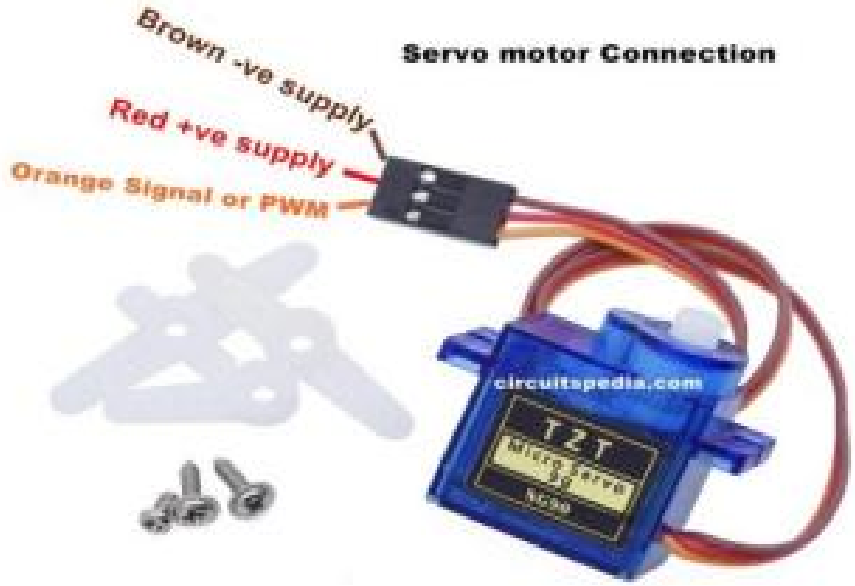


**Fig 2.1.3 Servo Motor**

## 2.1.4) ARDUINO UNO:

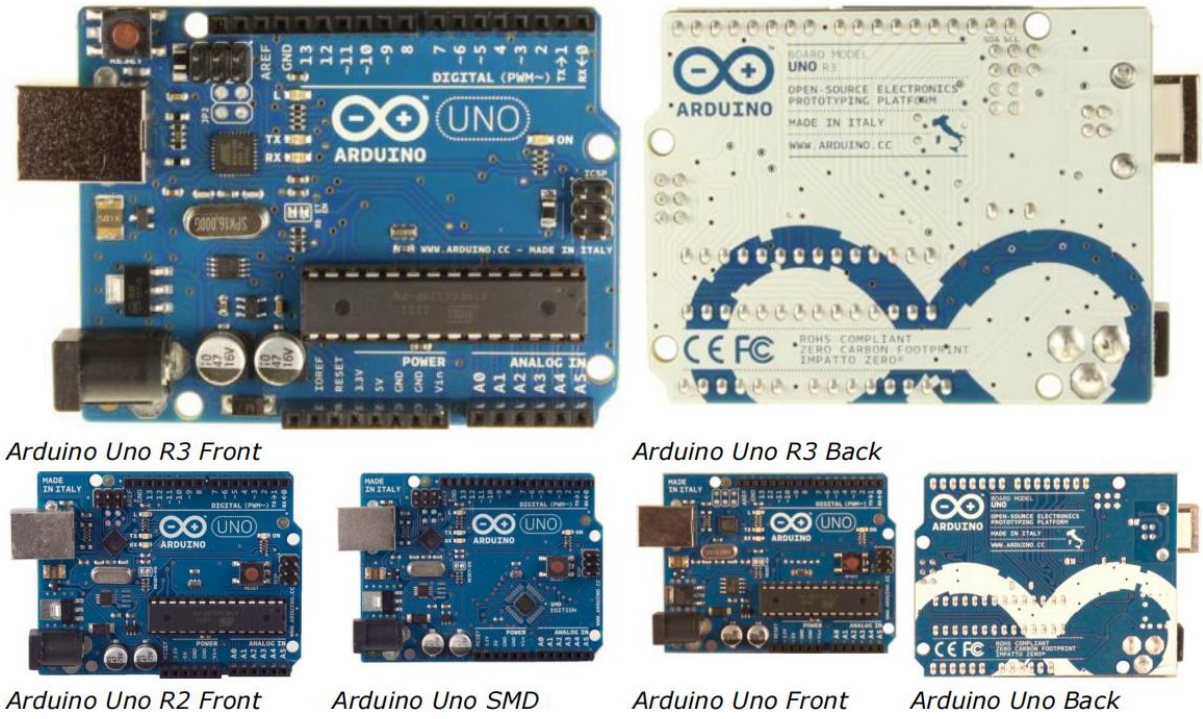


**Fig.2.1.4 Arduino-Uno**

It is a micro-controller board based on the AT mega 328.It has 14 digital input-output pins ,6 analog inputs ,16MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with a AC-to DC adapter or battery to get started.

The Arduino Uno can be powered via USB connection or with an external power supply. The power source selected automatically. External power can come either from an AC-DC adapter or battery. The adapter can be connected by plugging a 2.1mm center positive plug into the board's power jack.

## 2.1.5) JUMPER WIRES:

Jumper wires are wires with a connector at both ends and are suitable for interconnecting components in a breadboard, prototype, or test circuit. They connect components without soldering. If you want to build your own circuits, jumper wires are the way to go. Read on to learn more. Below are a few things to look for in jumper wires. The first is how they work.

Jumper wires are valuable tools for electrical wiring because they are ideal for diagnostics and modification of circuits. Ensure electrical safety while using this equipment. High-voltage and low-voltage circuits require extra caution. You should also know the types of connectors you need for a given purpose. You may use bare wire ends to connect circuit points if you have steady hands. For these purposes, the male end has a protruding pin.

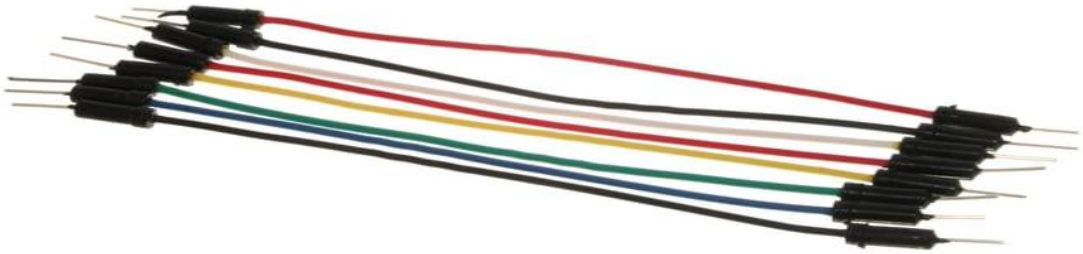

**Fig 2.1.5 JUMPER WIRES**

## Uses:

Jumper wires are handy tools for electronic prototyping. The connector pins on one end connect two points without soldering. They are generally used with breadboards and prototyping tools such as Arduino. Because they come in various colors and tiny they are a versatile and necessary component for electronic projects. Make sure you have enough jumper wires before starting your next project.

There are two types of jumper wires: male-to-male and female-to-female. Both are ideal for interconnecting two electrical or electronic components. Despite their names, male-to-male jumper wires serve a crucial role in electronics. These wires are ideal for breadboards, prototyping units, and other applications. Listed below are some of the most common uses for male-to-male jumper wires.

## 2.2) Software Requirements:

**2.2.1) Arduino IDE**: -

This software is used to dump the program into Arduino UNOC Language is used as coding language to rotate solar panel.

## PROGRAMMING:

The Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno from the **Tools > Board** menu (according to the microcontroller on your board).

The ATmega328 on the Arduino Uno comes pre-burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol.

We can also bypass the boot loader and program 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.

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

# CHAPTER 3:
# IMPLEMENTATION

## 3.1) Code Snippets:

```
/Include the servo motor library
#include <Servo.h>
//Define the LDR sensor pins
#define LDR1 A0
#define LDR2 A1
//Define the error value. You can change it as you like
#define error 10
//Starting point of the servo motor
int Spoint =  90;
//Create an object for the servo motor
Servo servo;

void setup() {
//Include servo motor PWM pin
  servo.attach(11);
//Set the starting point of the servo
  servo.write(Spoint);
  delay(500);
}

void loop() {
//Get the LDR sensor value
  int ldr1 = analogRead(LDR1);
//Get the LDR sensor value
  int ldr2 = analogRead(LDR2);
```

```
//Get the difference of these values
  int value1 = abs(ldr1 - ldr2);
  int value2 = abs(ldr2 - ldr1);

//Check these values using a IF condition
  if ((value1 <= error) || (value2 <= error)) {

  } else {
    if (ldr1 > ldr2) {
     Spoint = --Spoint;
    }
    if (ldr1 < ldr2) {
      Spoint = ++Spoint;
    }
  }
//Write values on the servo motor
  servo.write(Spoint);
  delay(100);
}
```

### 3.2) CIRCUIT DIAGRAM:

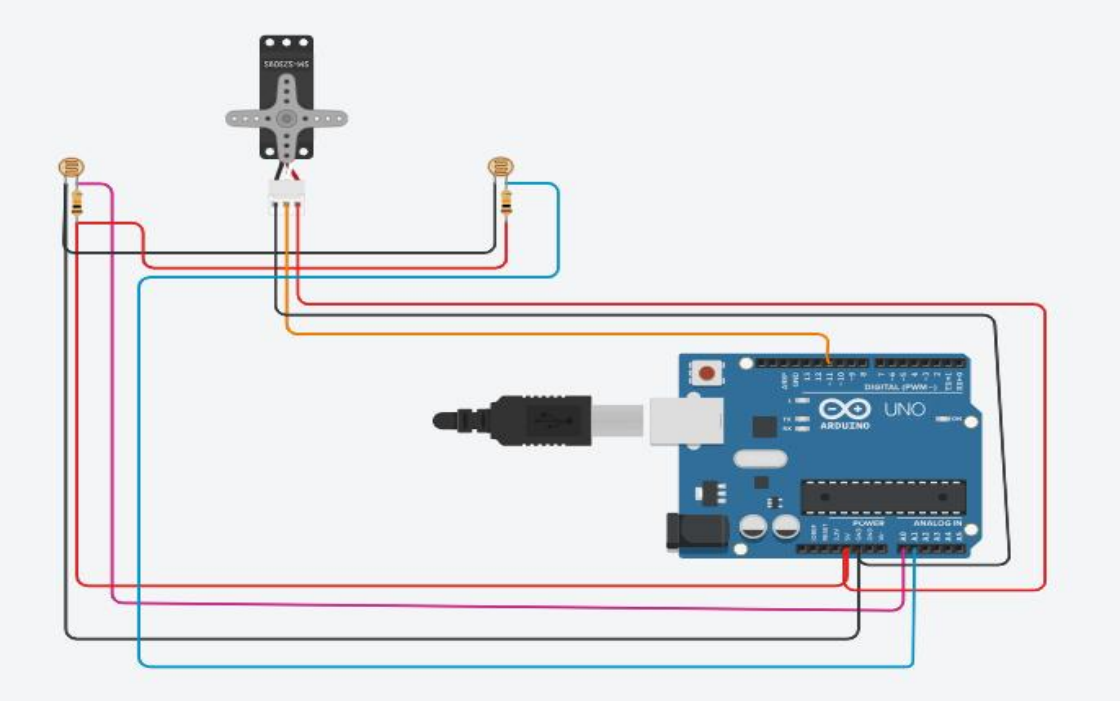


**Fig 3.2.1 Circuit Diagram**

We are using two light dependent register (LDR) Sensor placing at sides of the Solar panel. This sensor detects the light intensity and it gives analog input to the Arduino. In an Arduino, compares the light intensity of the two LDR sensors. In which LDR has more intensity in that direction Arduino gives output command to servo motor the motor rotates to direction where the light intensity is more

# CHAPTER-4

## 4.1) APPLICATIONS:

- Solar water heating
- Solar Drying For Agriculture
- Solar Electrical Power Generation
- Solar cooking
- Solar Outdoor lighting system
- Solar Green House
- Solar Pumping
- Solar skins
- Solar at night
- Portable solar power

- **Solar water heating:**

Solar water heating is becoming an eco-friendly alternative to traditional water heater. Active water systems in solar water heating include direct circulation systems and indirect circulation systems. Additionally it is commonly used in hotels, hospitals and more.

- **Solar Drying for Agriculture:**

Using solar energy to dry agriculture and animal products improve airflow and fruit quality, protecting sensitive agricultural products from harsh sunlight and preventing low moisture.

- **Solar Electric Power Generation:**

Photovoltaic cells generate electricity through direct sunlight. There are various electrical benefits to using solar electric power generation, such as reliability, low maintenance costs, durability, and eco-friendly.

- **Solar Cooking:**

As the energy market faces continued risks with fuel supply, solar cooking is becoming more necessary. Unfortunately fuels such as coal, kerosene, and cooking gas are

quite scarce. The flat plate solar cooker reduces heat loss in convection through an airtight box.

- **Solar Outdoor lighting system:**

It also generates adequate electricity for outdoor landscapes. each solar outdoor lighting system comes with a rechargeable battery and can now operate throughout the night.

- **Solar Green Houses:**

It keeps harmful external elements away from plants, bringing positive CO2 air inside instead. Glass or plastic also covers the green house to maintain control indoor temperatures and provides an idea growing environment for plants year-round.

- **Solar Pumping:**

It uses water to increase irrigation and power. this solar energy application is most efficient during the harvest season and warmer seasons when crops will require more water.

- **Solar skins:**

Solar skins are customizable designs that camouflage into solar panel systems. instead of having the look of traditional solar panels on our roof, solar skins can protect an advertisement or any custom image of our choosing on to the solar panels

- **Solar at night:**

Solar panels cannot operate at night because they require direct sunlight. However, a new solar panel is currently in development. this night time solar panel uses infra red light to store energy during the day and operates a large power grid at night, serving as huge innovation for the energy market.

- **Portable Solar Power:**

Portable solar PV charges are light weight, environmentally friendly, and can keep many electronic devices charged at moment's notice.

## 4.2) ADVANTAGES:

Trackers generate more electricity than their stationary counterparts due to increased direct exposure to solar rays. this increase can be as much as 10 to 25% depending on the geographic location of the tracking system.

There are many different kinds of solar trackers, such as single-axis and dual-axis trackers, all of which can be the perfect fit for a unique lob site.

Installation size, local weather, degree of latitude and electrical requirements are all important considerations that can influence the type of solar tracker best suited for a specific solar installation.

Solar trackers generate more electricity in roughly the same amount of space needed for fixed-tilt systems, making them ideal for optimizing and usage

In certain states, some utilities offer Time of Use (TOU) rate plans for solar power, which means the utility will purchase the power generated during the peak time of the day at a higher rate. In this case, it is beneficial to generate a greater amount of electricity during these peak times of the day. using tracking system helps maximize the energy gains during these peak time periods.

Advancements in technology and reliability in electronics and mechanical have drastically reduced long-term maintenance concerns for tracking systems

# CHAPTER- 5:

# RESULT

The solar tracking system has surpassed expectations, delivering a substantial increase in energy production compared to fixed solar panel configurations. The ability to precisely align the panels with the sun's movement ensures optimal sunlight exposure and maximizes energy generation potential. The system's dynamic tracking capability has significantly improved overall efficiency. By continuously adjusting the panel angles, it maximizes the absorption of solar radiation, resulting in a higher conversion rate and improved energy output. Its ability to increase energy production, improve efficiency, extend operational hours, adapt to seasonal variations, and contribute to environmental sustainability showcases its immense value as a renewable energy solution. The results affirm the system's effectiveness and highlight its potential for widespread adoption in the pursuit of a greener and more sustainable future.

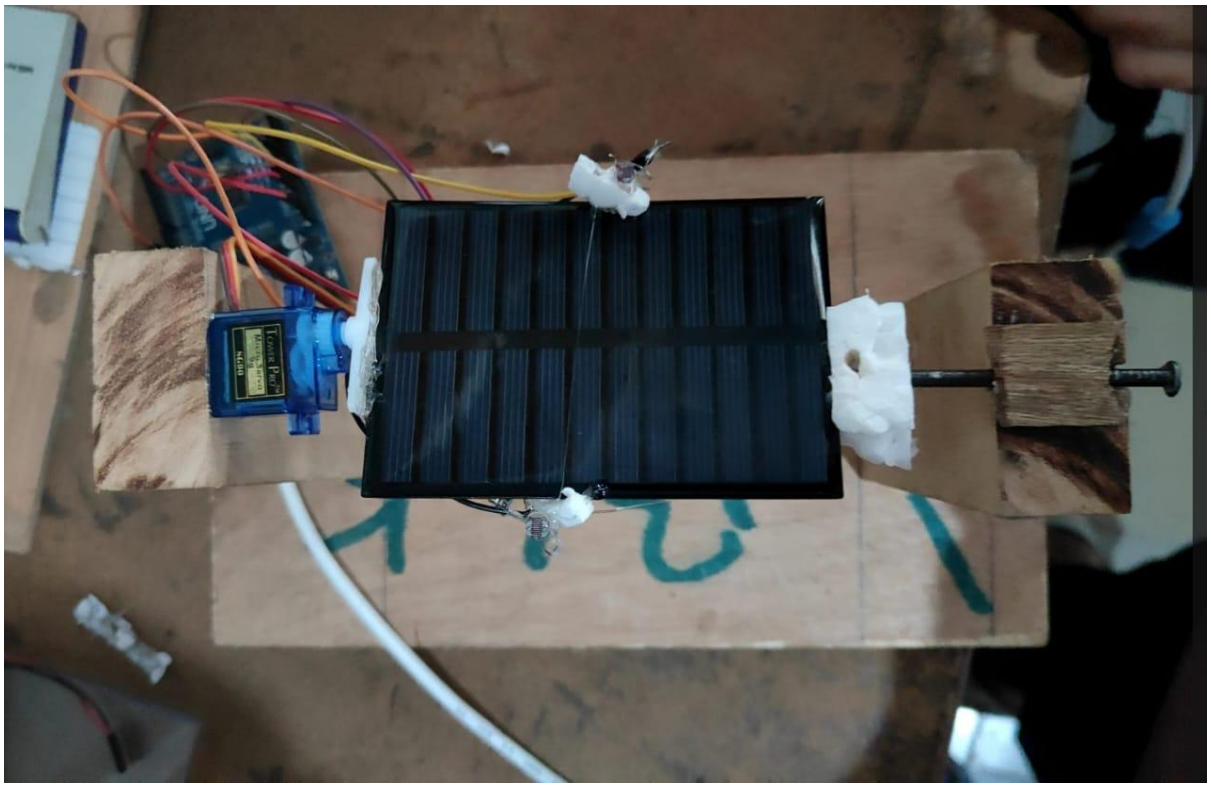

**Fig-5.1.1 Project Model**

# CHAPTER-6:

# CONCLUSION:

The invention of Solar Tracking System helps us improve the performance of PV solar system in a simple way. Used relative method of sunlight strength. Established a model of automatic tracking system to keep vertical contact between solar panels and sunlight. Improved the utilization rate of solar energy and efficiency of photovoltaic power generation system.

The solar tracking system, based on sunlight intensity, has demonstrated significant advantages for solar energy generation. By continuously monitoring and adjusting the panel position based on real-time sunlight intensity, the system optimizes energy production and efficiency. It ensures that solar panels are always oriented to receive maximum sunlight, thereby maximizing energy output. The system's ability to adapt to changes in sunlight intensity throughout the day enhances its effectiveness in capturing available solar radiation. This feature contributes to increased energy generation and improved performance of solar power systems. The utilization of sunlight intensity as a guiding factor underscores the system's efficacy in harnessing renewable energy and promoting sustainable practices. Overall, the solar tracking system based on sunlight intensity proves to be a valuable

Technology for enhancing solar energy production and reducing reliance on non-renewable energy sources.

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