NEW HORIZON
COLLEGE OF ENGINEERING
New Horizon Knowledge Park, Ring Road, Marathalli
Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

SOLAR TRACKING SYSTEM

A MINI PROJECT REPORT

Submitted by:

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In partial fulfillment for the award of the degree of

Bachelors of Engineering (BE)

In

Electrical & Electronics

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CERTIFICATE

This is to Bonafide that the mini project report entitled **"SOLAR TRACKING SYSTEM"** submitted by **Nischal Dinesh(1NH18EE039), Prajwal(1NH18EE042), Sarthak Das(1NH18EE053)**, Department of Electrical and Electronics Engineering, New Horizon College of Engineering, Bangalore in partial fulfilment for the award of the degree of Bachelor of Engineering, is a record of bonafide work carried out by him/her under my supervision, as per the NHCE code of academic and research ethics.

The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university. The project report fulfils the requirements and regulations of the institution and in my opinion meets the necessary standards for submission.

Project Guide

Mr. Inbasakaran

HOD-EEE

Dr. Mahesh M

ABSTRACT

The overall goal of this project is to create a solar tracking system using Arduino and servo motor. Sun rays can be simultaneously tracked either in vertical axis or in horizontal axis.

Present solar panels are placed at a particular axis or angle and remains stationary which after certain period of time becomes unfunctional due to unavailability of sunlight or different weather conditions. Similar to the equatorial axis principle of telescopes, similar principle is used in solar tracking system. It rotates at an angle with respect to sunlight to achieve uninterrupted supply and maximum efficiency. In this project we will try to track sunrays in both the axis simultaneously, the main control circuit is based on Arduino and servo motors.

We are using Arduino Uno which is a microcontroller and on programming with Arduino C programming along with the help of servo motors, we are we are getting the desired results on the serial window by giving inputs through solar panel.

ACKNOWLEGMENT

With immense pleasure and deep sense of gratitude, I wish to express my sincere thanks to my supervisor **Mr. Inbasakaran**, Professor, Department of Electrical and Electronics Engineering, New Horizon College of Engineering, without her/his motivation and continuous encouragement, this mini project would not have been successfully completed.

I am grateful to the Chairman of New Horizon Educational Institution, **Dr. Mohan Maghnani** for motivating me to carry out research in the NHCE and for providing me with infrastructural facilities and many other resources needed for my project work.

I express my sincere thanks to **Dr.Mahesh.M** HoD, Department of Electrical and Electronics Engineering, New Horizon College of Engineering for his kind words of support and encouragement.

I wish to extend my profound sense of gratitude to my parents for all the sacrifices they made during my project and providing me with moral support and encouragement whenever required.

Date:

Place: Bangalore

By:

Nischal Dinesh

Sarthak Das

Prajwal

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AIM

To create a solar tracker which detects sunrays using LDR and solar panel resulting in maximum output.

OBJECTIVE

To increase the usage of renewable source of energy by creating a solar tracker which can detect sunlight at any angle thus getting result throughout the day from sunrise to sunset.

CHAPTER 1

INTRODUCTION

Energy is a vital and main driving factor in terms of development. With the rise in population the amount of energy utilized, consumed, extracted is also increasing day by day. Oil and coal are one of the often-used raw materials for production and utilization of many products as well as source in many industries. As these resources are limited in nature and are non-renewable, continuous utilization of these tends to decrease in their amount. Subsequently the price of these resources is increasing rapidly and they are on a verge of extinction. In the view of minimizing this issue renewable energy can be used as an alternative solution. These are clean, natural, inexhaustible. One of the best renewable and prominent energy is solar energy.

Solar energy converts light energy into electrical energy with the help of photovoltaic cells. It can be further differentiated into passive and active solar depending on the phenomenon of capturing light and distribution of energy. Out of all solar panels, PV cells are preferred most due to high productivity rate. When rays of sunlight hit the panels, due to photovoltaic effect electrons gets displaced and as they are negatively charged, they get attracted towards silicon thus producing current. As mentioned earlier depending upon the type of material and design the rate of production of energy also varies accordingly. These are environmentally friendly and also improves power quality.

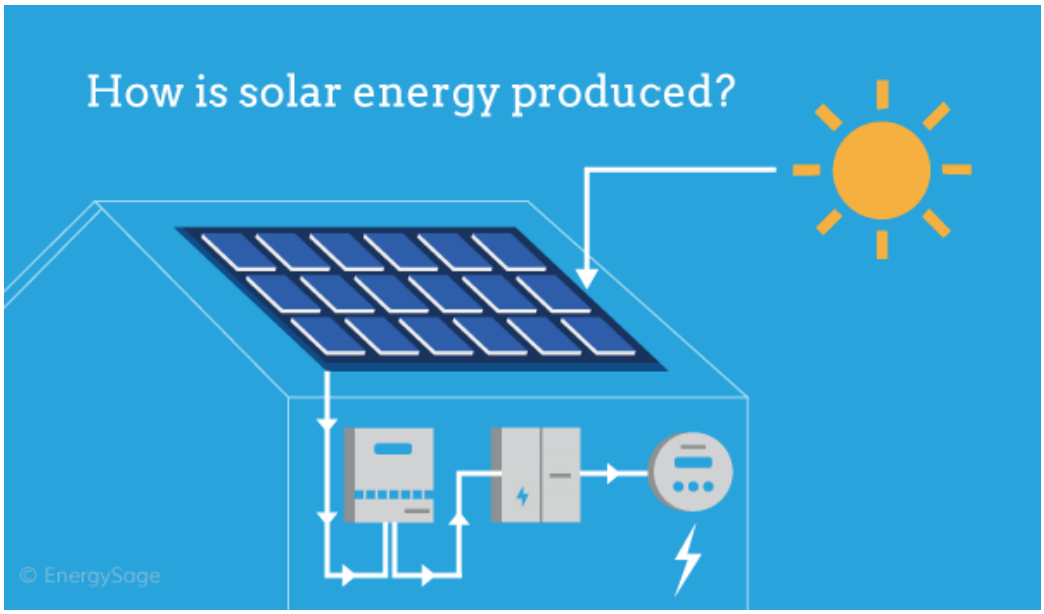

Fig 1.1-Solar energy

Solar trackers are devices that direct the solar panels towards the sunlight in order to maximize or increase the overall productivity of energy as these devices follow the sun throughout the day without any interruption right from sunrise till sunset. Apart from these it is also used in other optical devices too. Solar tracking system follow the principle of astronomical telescope. Depending upon the installation size, latitudes, weather condition these are broadly classified into two types.

- **Single axis solar tracker**: The axis of rotation is either vertical from north to south or horizontal from east to west.

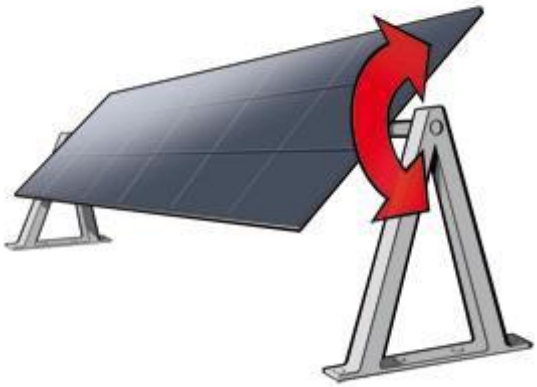

Fig 1.2-Single axis solar tracker

- **Dual axis solar tracker:** The axis of rotation is both in vertical and horizontal axis, rotation takes place simultaneously.

Fig 1.3-Dual axis solar tracker

CHAPTER 2

PROBLEM STATEMENT

The problem which we encounter is currently solar panels are used in fixed and stationary installations. Dure to inability to transport it generates low power. Apart from these multiple solar panels needs to be installed in order to generate enough power which can be expensive. As the solar panels are fixed, they aim directly to run rays only for certain period of time. The better solution for all these above-mentioned problems is solar tracking system. By using this device uninterrupted supply of solar power will be there right from sunrise to sunset which also helps in producing more power and maximum efficiency.

CHAPTER 3

3.1 COMPONENTS REQUIRED

1. Arduino Uno
2. Servo motors
3. Connecting Wires
4. LDR
5. Potentiometer
6. Solar Panel

3.2 COMPONENTS DESCRIPTION

1. Arduino Uno

Arduino is an opensource platform which is used to build various electronic projects. It consists of a circuit board which can be programmable, a kind of microcontroller and software or IDE which runs in the computer, used to write, verify and upload the code to the board. Arduino Uno is based on ATmega28P. For INPUT/OUTPUT it has 14 digital pins out of which 6 pins can be used for PWM (Pulse Width Modulation), 6 analog INPUT pins, a USB connection, a power jack, an ICSP header and a reset button. It supports the microcontroller and can be connected and powered with the help of USB or 5V battery. If hardware is not available there are many online platforms like Tinkercad, Proteus, Eagle etc.

Pin diagram:

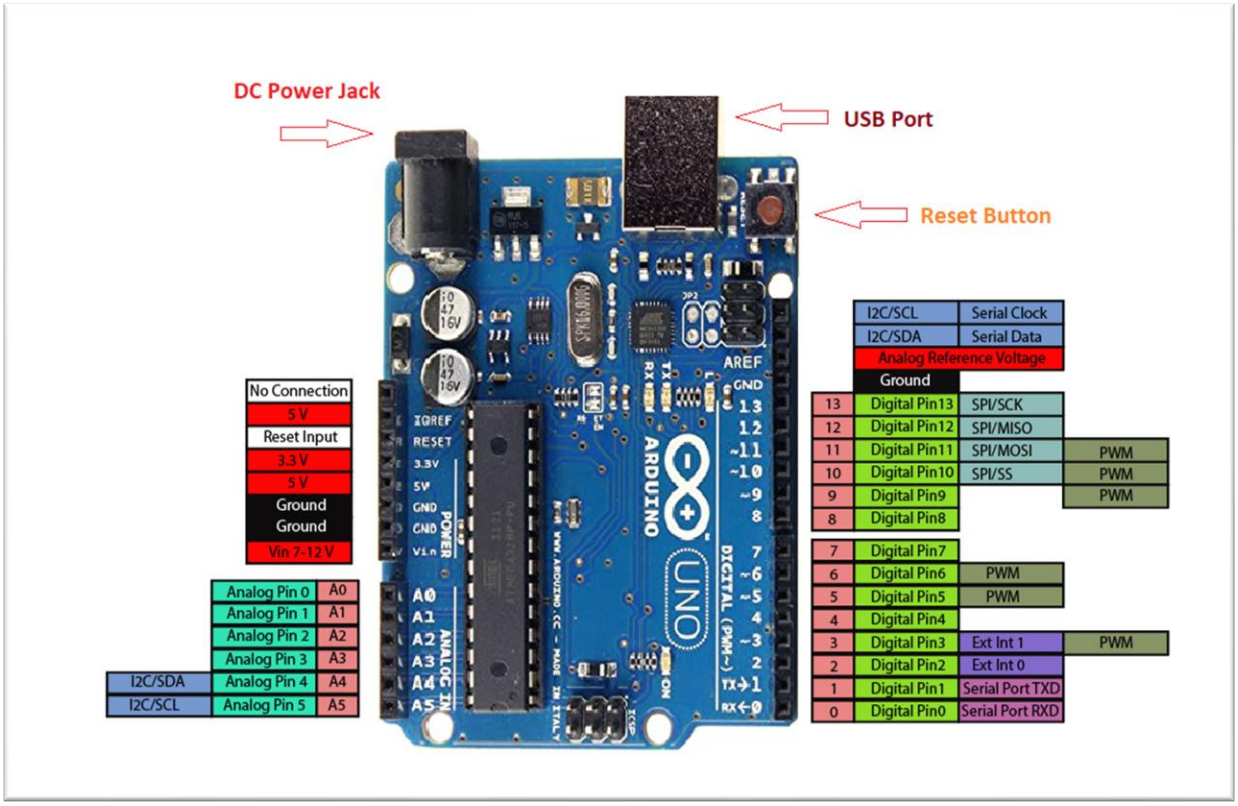

Fig 3.2.1 – Arduino UNO

2. Servo Motor

It is a tiny lightweight motor which has a rotation of 180 degrees having high output power with respect to size. The operating voltage of this motor is 5V at a current of maximum of 100 mA. It is a three-wire interface system which are as follows in the table below. Interfacing of this motor with Arduino is easier when compared to other motor hence it is widely used.

Wire Number	Wire Colour	Description
1	Brown	Ground wire connected to the ground of system
2	Red	Powers the motor typically +5V is used
3	Orange	PWM signal is given in through this wire to drive the motor

Table 3.2.1 – SG90 wiring

Fig 3.2.2 – SG90 servo motor

3. Connecting wires:

Connecting wires acts as a medium for electrical current to flow from one point to the other. In the case of computers and PCBs it is embedded into the circuit boards to carry pulses of electricity. Most wires are made up of copper because it is cheap and is highly conductive.

Fig 3.2.3 – Connecting wires

4. LDR:

Light Dependent Resistor is a photoconductor sensitive to light. The resistance value changes depending upon the intensity of sunlight falling on it. The resistance value is inversely proportional to the magnitude of sunlight. It can also be activated on any light sensitive devices. It has wide range of applications based on types and designs.

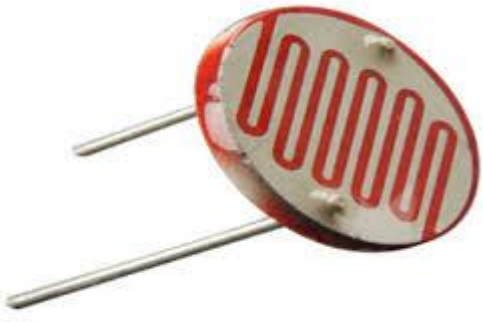

Fig 3.2.4 – Light Dependent Resistor

5. Potentiometer:

Potentiometer is a voltage control device commonly used in all electrical devices for a variety of applications such as signal control, control input in circuits, as a closed loop control in servomechanism or speed control. It is a three wired system with two fixed end and one variable end. The resistance of potentiometers varies from 1K, 2K to up to 1M depending upon the specifications.

Pin No.	Pin Name	Description
1	Fixed End	This end is connected to one end of the resistive track
2	Variable End	This end is connected to the wiper, to provide variable voltage
3	Fixed End	This end is connected to another end of the resistive track

Table 3.2.2 – Potentiometer wiring

Fig 3.2.5 – Potentiometer

6. Solar Panel:

Solar panel is referred as PV module. It is a group or collection or assembly of photo voltaic cells mounted in a particular framework. Sunlight is used as source of energy and electricity is directly generated. When these modules are grouped together it forms a PV Panel. When these panels are grouped together it forms an array. The efficiencies of the panel depend on the type of material used.

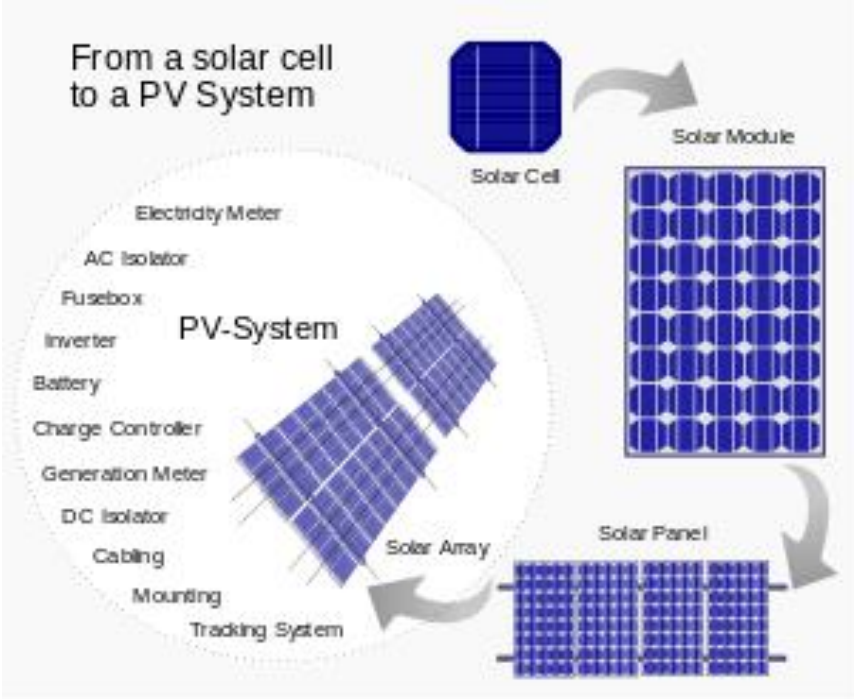

Fig 3.2.6 – Solar Panel

CHAPTER 4

4.1 BLOCK DIAGRAM

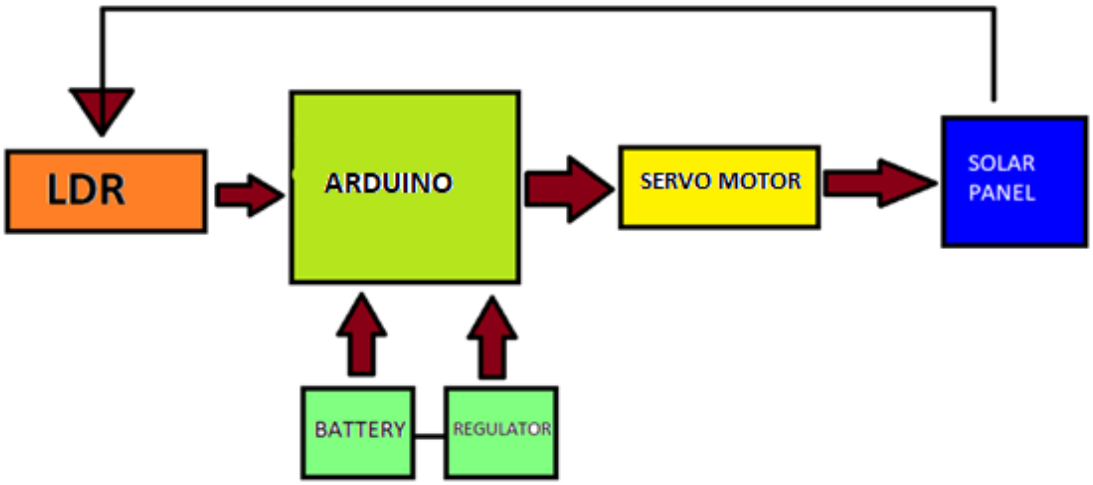

Fig 4.1.1 – Block Diagram

4.2 CONSTRUCTION

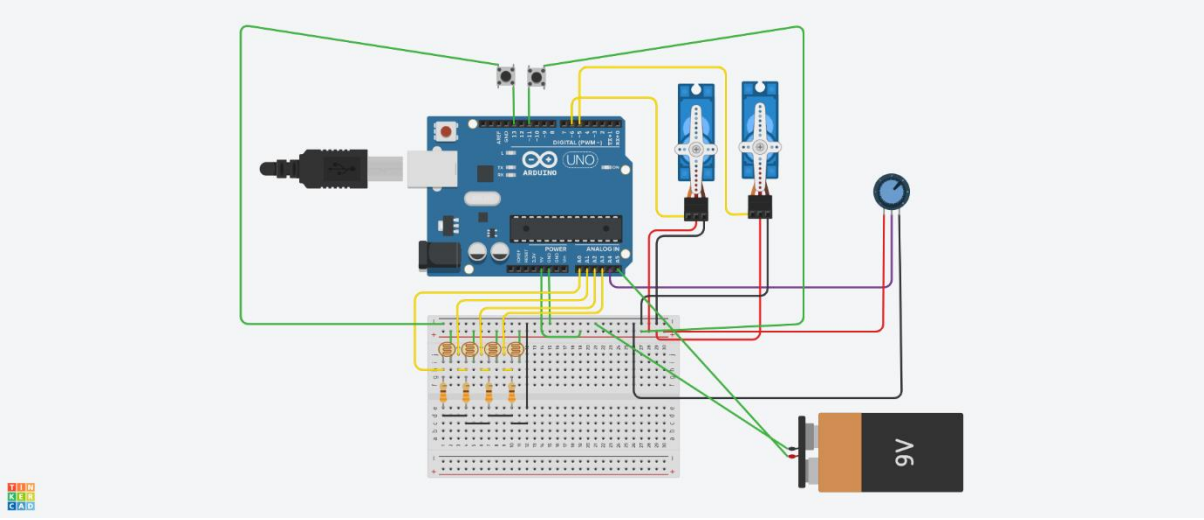

Fig 4.2.1 – Connection Diagram

Above diagram shows the connection of the Solar Tracking System. All the hardware materials used are compact, versatile and cost effective. Both the servo motors are connected to the Arduino at pin 5 and 6 of digital input. The four LDRs are connected simultaneously to four analog pins respectively. A potentiometer is used to rotate the servo motors simultaneously with the help of switch. In order to avoid damage to LDRs, each of them is connected to resistors. The Arduino UNO is connected to PC, supplying an input voltage of a range between 7-12V. This input voltage is used to power the Arduino and the components connected to it.

Jumper wires and breadboard are used to connect all the apparatus to Arduino. Both the Servo motors are mounted on the stand depending upon the axis of the rotation. The last pin A5 is connected to the solar panel from where we can generate all necessary results.

4.3 WORKING

This project on solar tracking system mainly consists of an Arduino UNO microcontroller, servo motors, LDRs, solar panels and potentiometer. Once the program is loaded onto the Arduino using the computer, the computer acts as an input power supply to run the Arduino and the components connected to it. Once the code is entered into the Arduino, the code can be simulated. LDRs are used as sensors which track the sunrays, the data is sent to the Arduino and further helps in rotation of the servo motors.

On simulating, the serial window must be kept open. The servo motors receive signal from Arduino and simultaneous rotations and angular inclination of solar panel takes place. The output is connected to solar panel which can be used to store energy and this stored energy can be further used in various applications. The output voltage, current and power from the solar panel can be obtained on the serial window.

The results can be transferred from serial window to an excel sheet for detailed and more convenient way of representation. Once the direction of sunlight changes accordingly the inclination of solar panel changes.

4.4 OUTPUT GRAPH

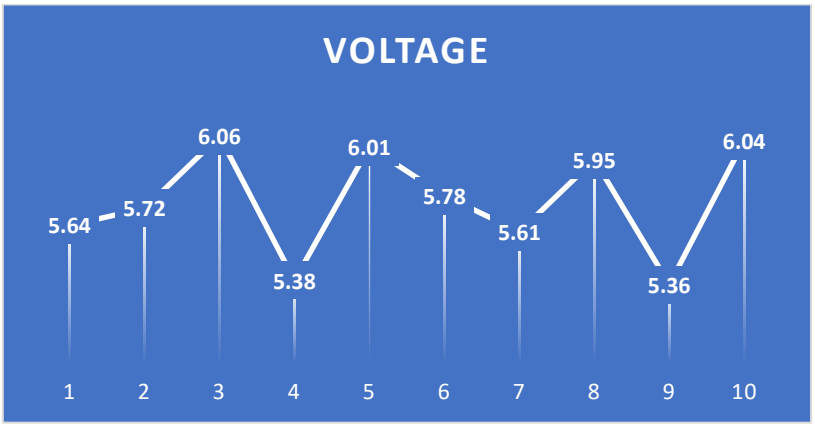

Fig 4.4.1 – Voltage at any instant

Fig 4.4.2 – Current at any instant

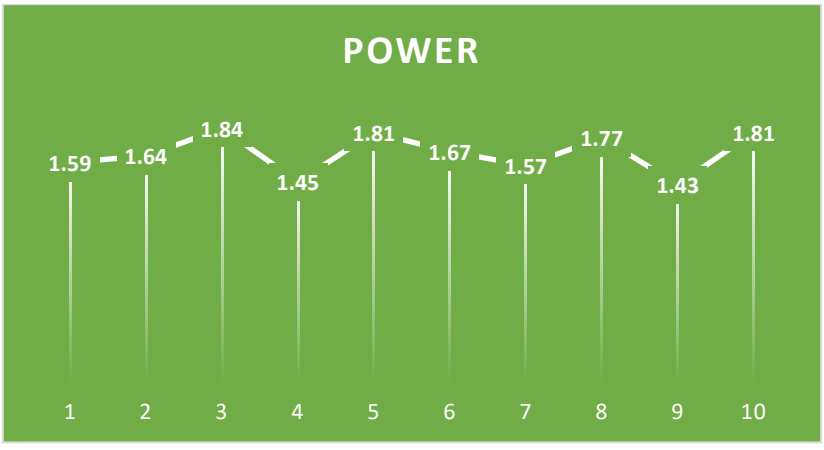

Fig 4.4.3 – Power at any instant

4.5 FLOW CHART

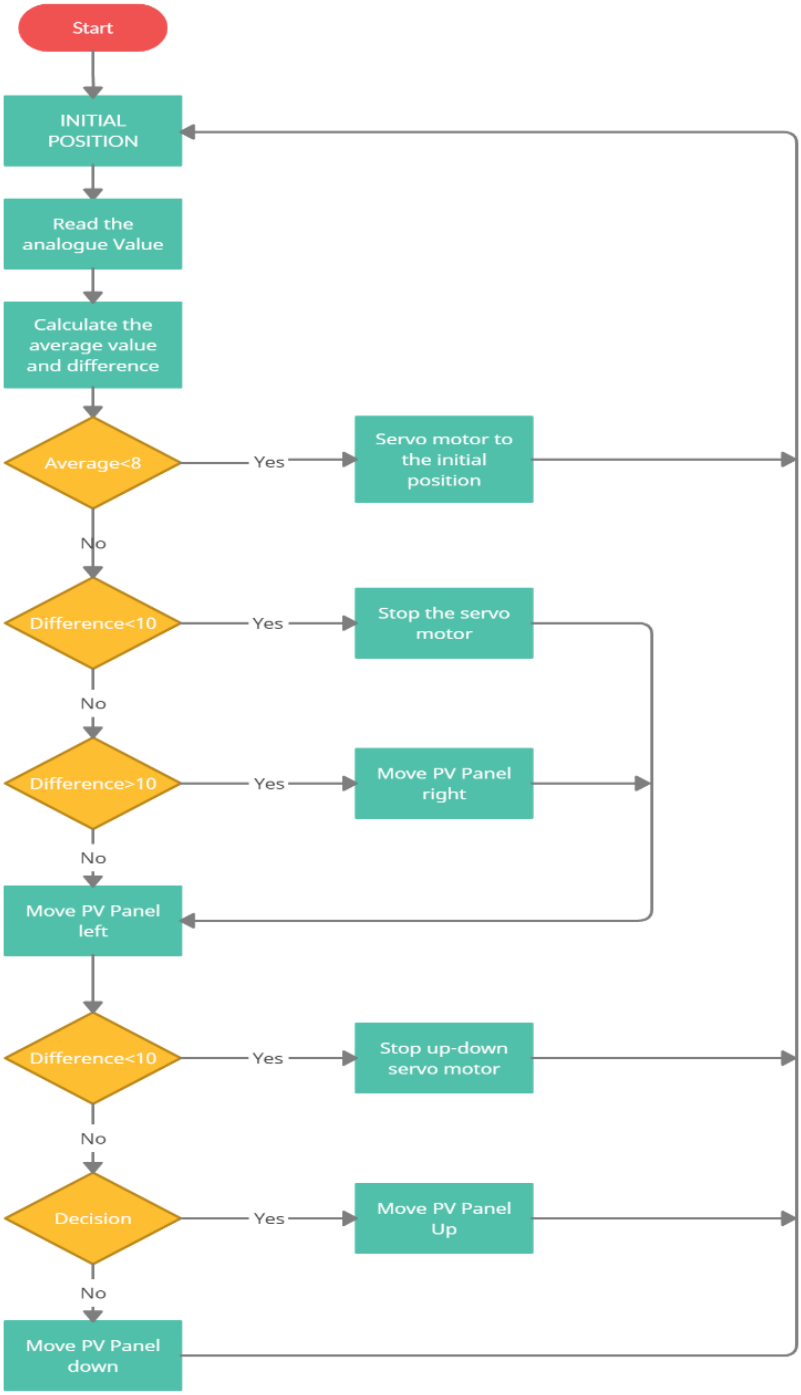

Fig 4.5.1 – Program Flow Chart

4.6 PROGRAM CODE

```
#include <Servo.h>

int mode = 0;
int AXES = 0;
int buttonState111 = 0;
int buttonState222 = 0;
int prevButtonState111 = 0;
int prevButtonState222 = 0;

int ldrtoprightight= 0;
int ldrtoplefteft = 1;
int ldrbotrightight = 2;
int ldrbotlefteft = 3;
int topleft = 0;
int topright = 0;
int botleft = 0;
int botright = 0;

//Declare two different servos
Servo servo_upanddown;
Servo servo_leftright;

int initial_value=10;

void setup()
{
```

```
  Serial.begin(9600);
  Serial.println("DATACLEAR");
  Serial.println("LABEL,t,voltage_v,current_c,power,Mode");

  pinMode(13, INPUT);
  pinMode(11, INPUT);
  pinMode(A4, INPUT);

  servo_upanddown.attach(5);
  servo_leftright.attach(6);
}

void loop()
{
//  pv_power();
char Mode;
    float volt = analogRead(A5)*5.0/1023;
    float voltage_v = 2*volt;
    float current_c = voltage_v/20;
    float power = voltage_v*current_c;
    Serial.print("DATA,TIME,");
    Serial.print(voltage_v);
    Serial.print(",");
    Serial.print(current_c);
    Serial.print(",");
    Serial.print(power);
    Serial.print(",");
```

```
 buttonState111 = digitalRead(13);
 if (buttonState111 != prevButtonState111) {
  if (buttonState111 == HIGH) {

    if (mode == 1) {
      mode = 0;
    } else {
      mode = 1;
    }
  }
 }
 prevButtonState111 = buttonState111;
 delay(50);

 if (mode == 0) {
  Mode='M';
  Serial.println(Mode);
  manualsolartracker();
 } else {
  Mode = 'A';
  Serial.println(Mode);
  automaticsolartracker();
  }
}

void automaticsolartracker(){

   //capturing analog values of each LDR
   topright= analogRead(ldrtoprightight);
```

```
topleft= analogRead(ldrtoplefteft);
botright= analogRead(ldrbotrightight);
botleft= analogRead(ldrbotlefteft);


int averagetop = (topright + topleft) / 2;
int averagebottom = (botright + botleft) / 2;
int averageleft = (topleft + botleft) / 2;
int averageright = (topright + botright) / 2;


int differencelev = averagetop - averagebottom;
int differenceazi = averageright - averageleft;



 if (abs(differenceazi) >= initial_value){
  if (differenceazi > 0) {
   if (servo_leftright.read() < 180) {
     servo_leftright.write((servo_upanddown.read() + 2));
   }
  }
  if (differenceazi <  0) {
   if (servo_leftright.read() > 0) {
     servo_leftright.write((servo_upanddown.read() - 2));
   }
  }
}
```

```
    if (abs(differencelev) >= initial_value){
     if (differencelev > 0) {
      if (servo_upanddown.read() < 180) {
       servo_upanddown.write((servo_leftright.read() - 2));
      }
     }
     if (differencelev <  0) {
      if (servo_upanddown.read() > 0) {
       servo_upanddown.write((servo_leftright.read() + 2));
      }
     }
   }
 }

void manualsolartracker(){
  buttonState222 = digitalRead(11);
  if (buttonState222 != prevButtonState222) {
    if (buttonState222 == HIGH) {

     if (AXES == 1) {
      AXES = 0;
     } else {
      AXES = 1;
     }
    }
  }
  prevButtonState222 = buttonState222;
```

```
  delay(50);
  if (AXES == 0) {
    servo_leftright.write(map(analogRead(A4), 0, 1023, 0, 180));
  } else {
    servo_upanddown.write(map(analogRead(A4), 0, 1023, 0, 180));
  }
}
```

4.7 HARDWARE PICTURE

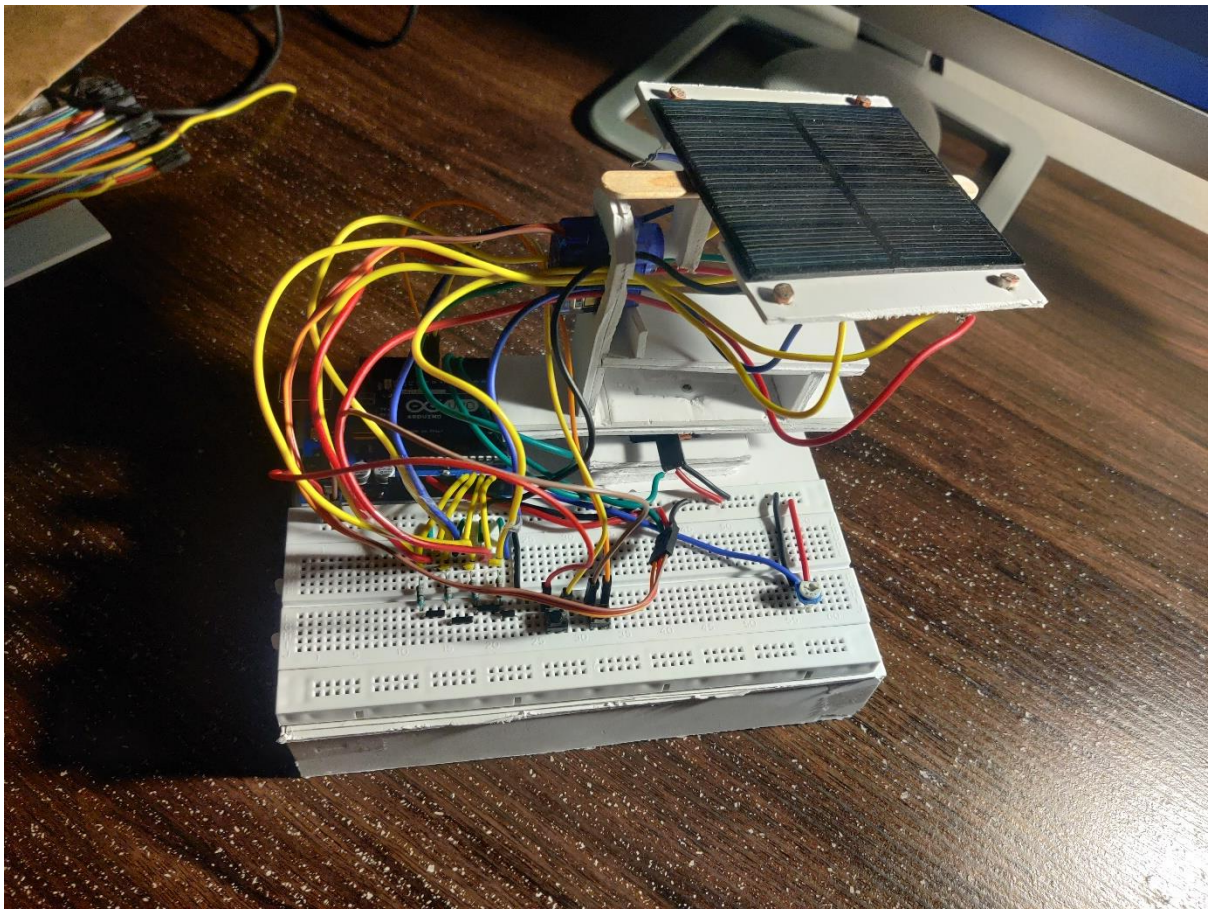

Fig 4.7.1 – Project Model

CHAPTER 5

RESULT

As we can see the solar panel is able to orientate themselves towards sunlight continuously without any interruption. The horizontal axis of rotation and vertical axis of rotation happens simultaneously. As long as the circuit is functioning, electrical energy is continuously drawn from the solar panel and subsequent power is generated simultaneously.

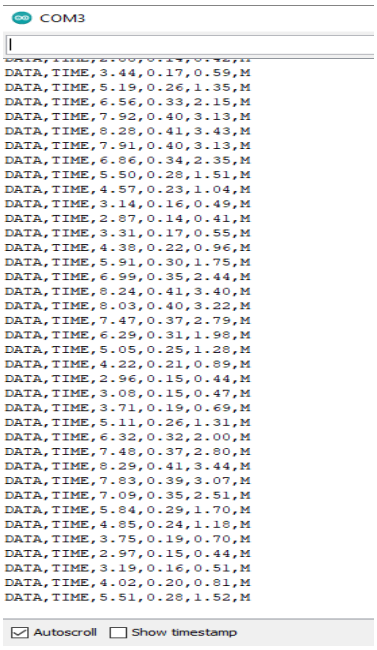

Fig 5.1-Result

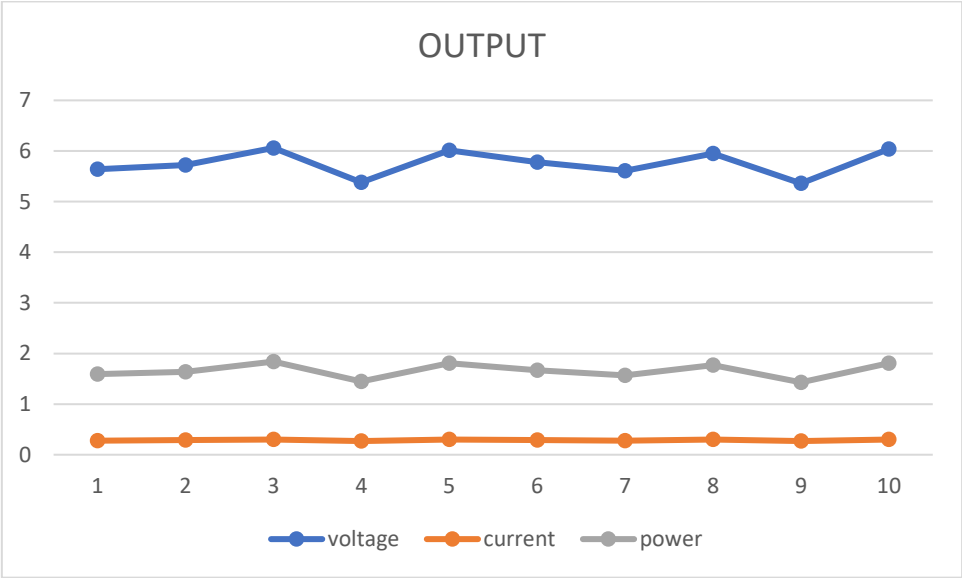

Fig 5.2-Graphical representation

CHAPTER 6

APPLICATIONS

There are a variety of areas where our project can be extensively used:

- These are used in photovoltaic panels, lenses to reflect towards sun continuously without any interruption in order to provide maximum efficiency.
- For medium and large-scale power applications solar tracking system can be used in more cost-effective way.
- Power supply and manufacturing in remote areas where supplying power lines is difficult.
- Especially in residential areas when due to structure or architecture of houses the roof becomes unfit for installations or requires multiple fixed panels to be placed.
- Commercial applications, manufacturing industries requires uninterrupted supplies of electricity which can be obtained with solar tracking system.

REFERENCES

The following data for the project has been gathered from a number of sources. A list of few of the sources are

World Wide Web:

- "What Is an Arduino? - Electronics for You" https://www.electronicsforu.com/arduinobasics-schematics
- " Solar Trackers Guide – Types (Passive, Single Axis, Dual Axis (2 axis), Price and Uses" https://www.greenworldinvestor.com/2011/07/06/solar-trackers-guide-types-passivesingle-axisdual-axis-2-axisprice-and-uses/
- "Light Dependent Resistor (LDR) or Photoresistor (What is it?)" https://www.electrical4u.com/light-dependent-resistor-ldr-working-principle-of-ldr/
- "USING THE SG90 SERVO MOTOR WITH AN ARDUINO" https://www.electronics-lab.com/project/using-sg90-servo-motor-arduino/

Book:

- Exploring Arduino: Tools and Techniques for Engineering Wizardry: by Jeremy Blum
- Sun Tracking and Solar Renewable Energy Harvesting: Gerro Prinsloo, Robert Dobson