ABSTRACT

In this project photovoltaic conversion panel is to be used in an Arduino based solar tracker system. Our aim is to design a dual axis solar tracker system. The sun is tracked by the tracker and its position is changed in such a way that it maximizes the power output. The solar panel is moved by two geared DC motors so that sun's light is able to remain aligned with the solar panel. The operation of experimental model of the device is based on a DC motor which is intelligently controlled by a dedicated drive until that moves a mini photovoltaic panel, the presence of the two simple but efficient light sensors receive signals by a microcontroller. The performance and characteristics of the solar tracker device are experimentally analyzed.

CONTENTS

OBJECTIVE

1.To utilize maximum solar energy through solar panel.
2.Design a system that tracks sunlight for solar panel.
3.Inctrease efficiency and accuracy of the system.

INTRODUCTION

1.SOLAR TRACKER

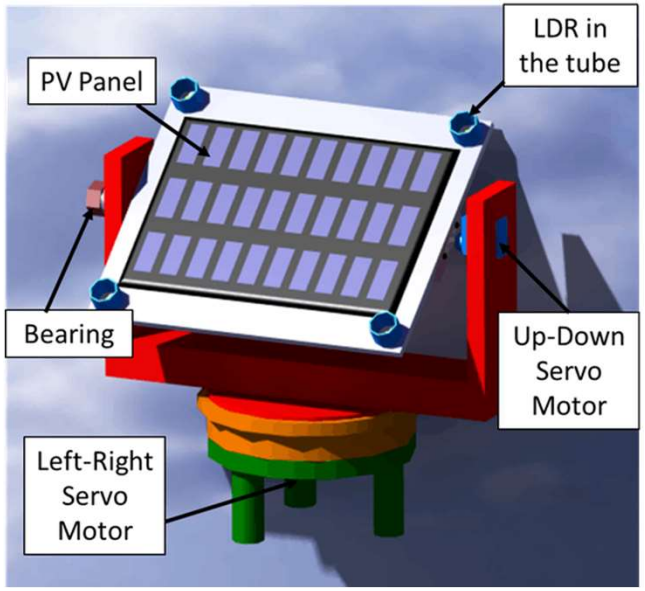
Solar tracking is a mechanism by which we can create a system to tilt the solar panel in the direction of movement of the sun. It is essential to perform sun tracking, in order to enhance the performance of the system. It can result in the collection of more than 30% extra energy from the same collector. Solar tracking system approaches with higher accuracy can be achieved by Single Axis schemes and Dual axis structure.

1.1.Single Axis Solar Tracker

Single Axis trackers have one axis of rotation. There are several possibilities for implementation of Single Axis solar trackers. Which include horizontal single axis trackers (HSAT), horizontal single axis tracker with tilted modules (HTSAT), vertical single axis trackers (VSAT), tilted single axis trackers (TSAT) and polar aligned single axis trackers (PSAT)? The tracking schemes are designed such that maximum beam of radiation over given period of time collected. The use of single axis solar tracker can increase the electricity output as much as 27% to 32%.

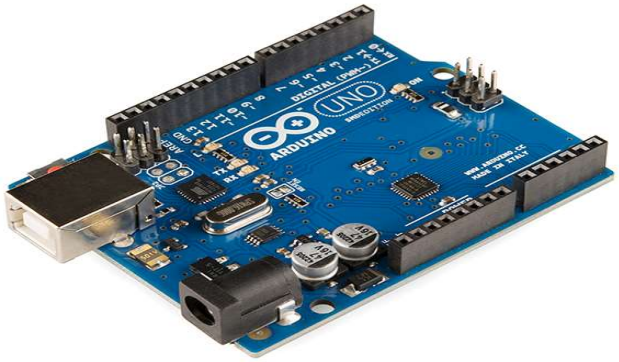
1.2.Dual Axis Solar Tracker

Dual Axis Solar trackers have two degree axis of rotation one is along vertical axis and another is along horizontal axis. It gives maximum solar exposure because of its ability to follow the sun, irrespective of sun position in the sky, dual axis trackers enable the PV panel to align itself in the direction of sun. In dual axis solar tracker vertical axis follows the angular height position of the sun in the sky and horizontal axis follows the east to west movement of the sun. According to, dual axis tracking shows 35% to 40% increase in power output.



2.Arduino

Arduino is the type of microcontroller. The purpose of microcontroller is to control the position of motor. so At mega 328p microcontroller is used. Arduino consist of 6 analog inputs and 14 digital i/o ports out of them 6 acts as pwm signals. In addition to this it consist of 16 MHZ crystal oscillator, a USB cable through which program is dumped. And Arduino get powered by the power jack. Advantages of Arduino is low cost, robust construction and platform independent.



3.Solar Panel

Solar energy is the photovoltaic cell which convert light energy received from sun into electrical energy. The name behind “solar” panel is they grab high powerful energy emitted from the sun. The solar panel finds its applications in street lights , domestic and industrial areas.

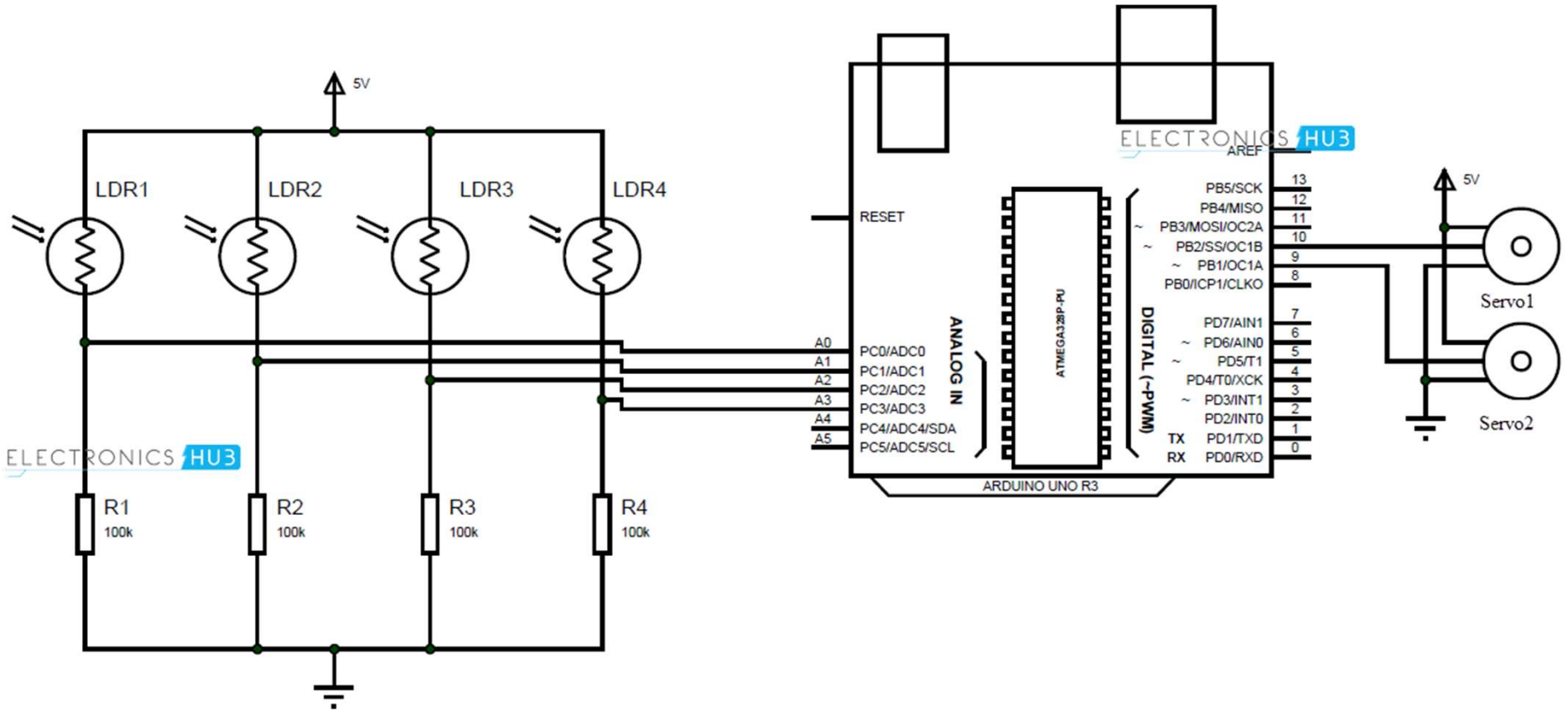
4.Servo Motor

Servo motor Servo motor is three wired dc motor which works on the principal of servo mechanism. servo motor can rotate upto maximum angle of 180degrees. In our proposed project 4.8V motor is used. Since it is dual axis system two servo motors are used for east-west and north-south directions respectively. Servo motors are powered by PWM output received from the Arduino.

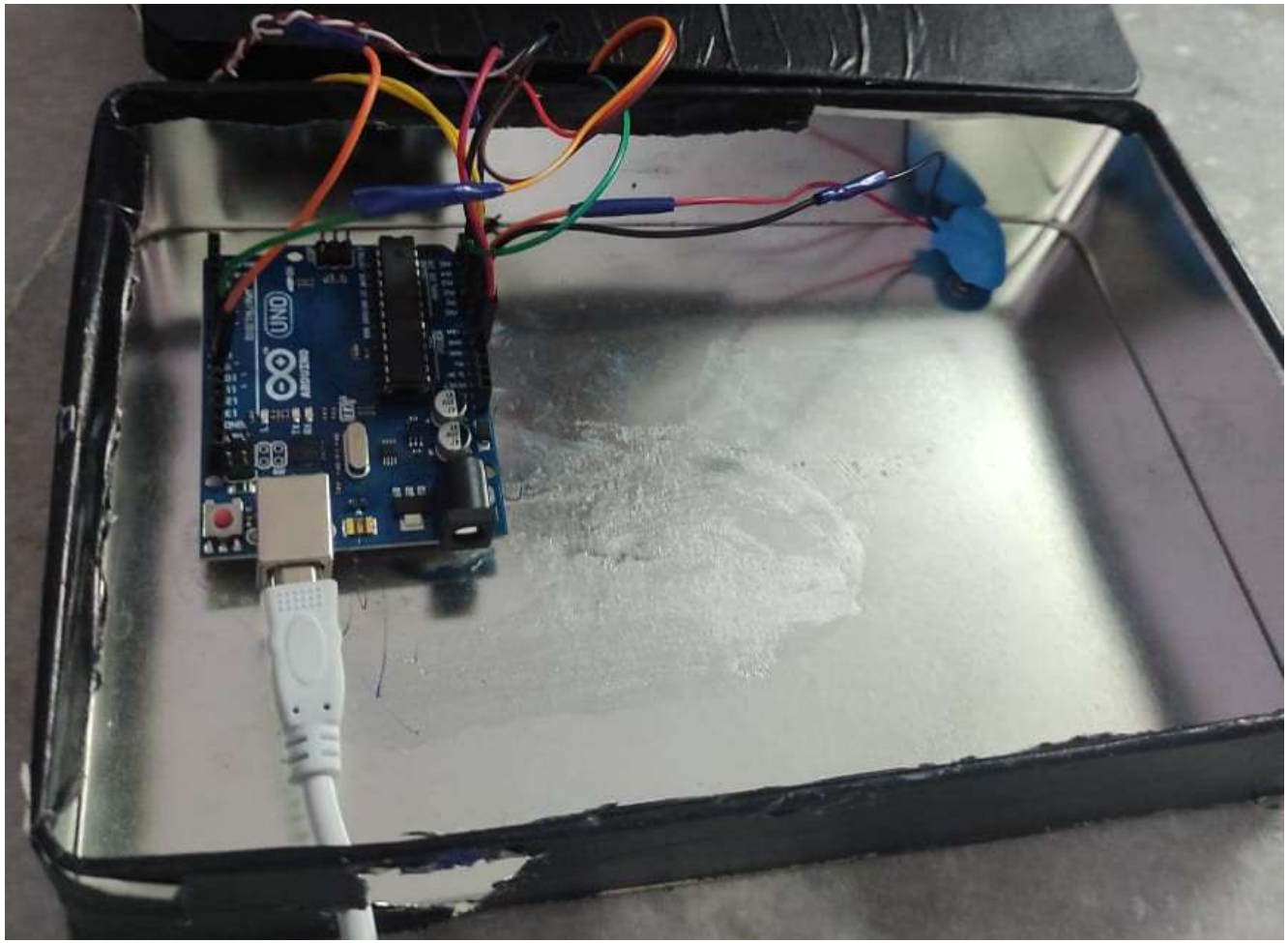
5.Light Dependent Resistor(ldr)

Ldr are also named as photo conductors (or) photo resistors. Which works on the principal of photo conductivity. ldr resistance decrease with increase in light intensity and vice versa. Ldr s are mainly used for sensing purpose in order to catch the solar energy and provide analog input to arduino.

DUAL AXIS SOLAR TRACKER CIRCUIT DIAGRAM



DUAL AXIS SOLAR TRACKER CIRCUIT DIAGRAM



COMPONENTS REQUIRED TO MAKE DUAL AXIS SOLAR TRACKER

1.Arduino Uno
2.4 LDR
3.4-10k ohm Resistor
4.2-Servo Motor
5.Solar Panel
6.Jumper Wire
7.Breadboard

FABRICATION PROCESS

Electrical Fabrication consisting of electrical design i.e. making PCB, soldering, is making connection correctly etc.

Various Tools & Equipment Needed For Fabrication

Soldering wire

Paste Flux

Soldering Iron

Wire Cutter

Screwdriver Set

Electric Glu Gun

WORKING PRINCIPLE

The proposed tracking system tracks sunlight more effectively by providing PV panel rotation along two different axis.
The tracker is composed of four LDR sensors, two stepper motors and PIC microcontroller. A pair of sensors and one motor is used to tilt the tracker in suns east-west direction
and the other pair of sensors and the motor which is fixed at the bottom of the tracker is used to tilt the tracker in the suns north-south direction.
Two stepper motors are all in use in this system. Upper panel holder stepper motor tracks the sun linearly and base stepper motor tracks the parabolic displacement of the sun. These stepper motors and sensors are interfaced with a microcontroller .The microcontroller gives the command to the motors on the basis of sensors input. LDR sensors sense the light and sends signal to microcontroller.

APPLICATION

1.It can be used for large and medium scale power generations.
2.It can also be used for power generation at remote places.
3.It may be used as domestic backup power systems.
4.It can be used solar street lightning system.
5.It may be used in water treatment technologies and solar heating.

ADVANTAGES AND DISADVANTAGES OF DUAL AXIS SOLAR TRACKING SYSTEM USING ARDUINO

ADVANTAGE

1. Trackers generate more electricity than their stationary counterparts due to increased direct exposure to solar rays.
2. Solar trackers generate more electricity in roughly the same amount of space needed for fixed-tilt systems, making them ideal for optimizing land usage.
3.Advancement in technology and reliability in electronics and mechanics have drastically reduced long term maintenance concerns for tracking systems.
4.Ability of tracking sun light at any weather.
5.Average power gain of solar panel with dual axis tracking system over normal stationary arrangement is upto 40-50%.

DISADVANTAGE

1. Solar trackers are slightly more expensive that their stationary counterparts, due to the more complex technology and moving parts necessary for their operation.
2.Trackers are a more complex system than fixed racking.
3. Dual-axis tracker projects also require an additional focus on company stability and bankability.
4.Monitoring and maintenance is required.
5.A drastic environmental change cannot be tolerated by the equipment.

ARDUINO CODE

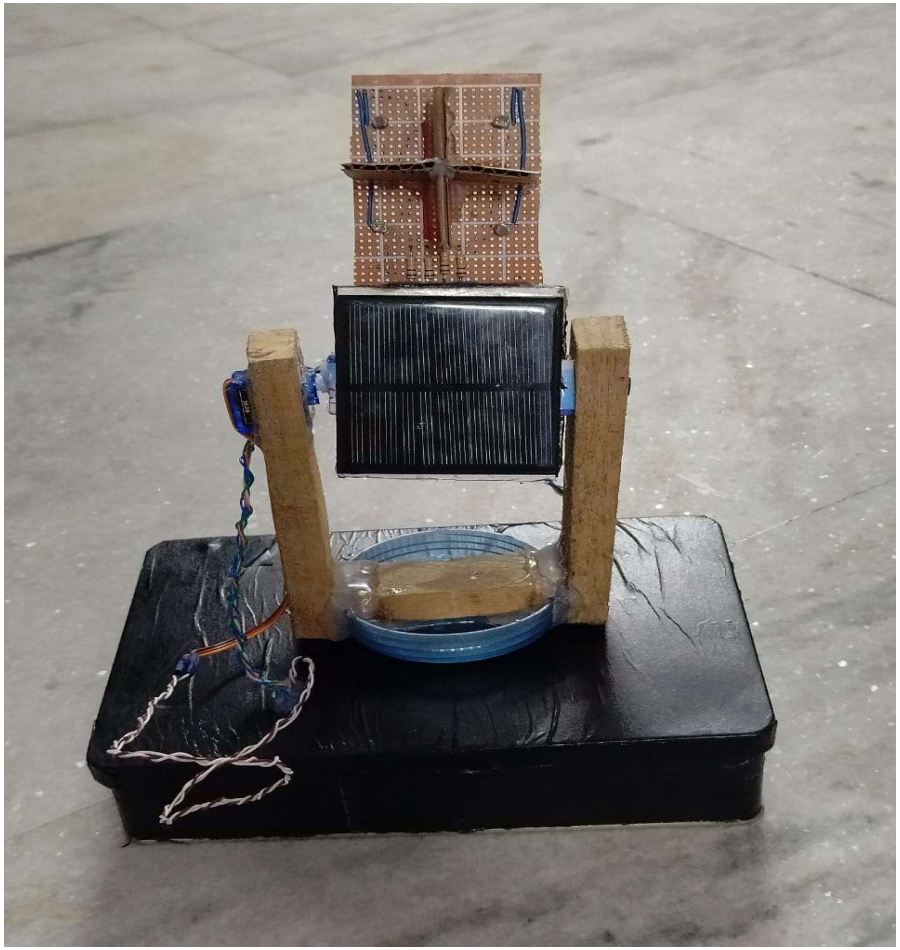
```
#include <Servo.h>
 Servo servohori;
 int servoh = 0;
 int servohLimitHigh = 160;
 int servohLimitLow = 60;
 Servo servoverti;
 int servov = 0;
 int servovLimitHigh = 160;
 int servovLimitLow = 60;
 int ldrtopl = 2;  //top left
 int ldrtopr = 1;  //top right
 int ldrbotl = 3;  // bottom left
 int ldrbotr = 0;  // bottom right
 void setup ()
 {
      servohori.attach(10);
      servohori.write(60);
      servoverti.attach(9);
      servoverti.write(60);
      Serial.begin(9600);
      delay(500);
 }
```

```
void loop()
{
  servoh = servohori.read();
  servov = servoverti.read();
  int topl = analogRead(ldrtopl);
  int topr = analogRead(ldrtopr);
  int botl = analogRead(ldrbotl);
  int botr = analogRead(ldrbotr);
  int avgtop = (topl + topr) ;  //average of top
  int avgbot = (botl + botr) ;  //average of bottom
  int avgleft = (topl + botl) ;  //average of left
  int avgright = (topr + botr) ;  //average of right
  if (avgtop < avgbot)
 {
    servoverti.write(servov +1);
    if (servov > servovLimitHigh)
      {
          servov = servovLimitHigh;
       }
    delay(10);
 }
 else if (avgbot < avgtop)
```

```
{
   servoverti.write(servov -1);
   if (servov < servovLimitLow)
 {
     servov = servovLimitLow;
 }
 delay(10);
}
 else
{
    servoverti.write(servov);
}
 if (avgleft > avgright)
 {
     servohori.write(servoh +1);
     if (servoh > servohLimitHigh)
{
    servoh = servohLimitHigh;
 }
 delay(10);
}
 else if (avgright > avgleft)
```

```
{
   servohori.write(servoh -1);
   if (servoh < servohLimitLow)
{
   servoh = servohLimitLow;
}
delay(10);
}
else
{
   servohori.write(servoh);
}
 delay(50);
}
```

EXPERIMENTAL SETUP



CONCLUSION

The proposed dual axis solar tracker automatically tracks position of sun and maximize the solar power with help of arduino. As compared to single axis, dual-axis system provide high abundant electrical energy output when compared to the fixed mount system. The Dual axis tracker is having more efficiency. The main aim of this work is to develop two axis solar tracker system that uses four sensors(ldr s) to predict the sun position.

REFERENCES

[1] Berberi, P., S. Thodhorjani, P. Hoxha, and V. Muda. 2013. Photovoltaics: between a bright outlook and uncertainty.
[2] Chakraborty, S., P. K. Sadhu, and N. Pal. 2015. Technical mapping of solar PV for ISM- an approach
[3] M.D.Singh and Khanchandani: “Power Electronics
[4] www. arduino.cc
[5] C. Hua and C. Shen (1998) Comparative study of peak power “ tracking techniques for solar storage system’’, Applied Power Electronics Conference and Exposition, vol. 2, pp. 679-685.
[6] Chin, C.S., Babu, A. and McBride, W. (2011) Design, Modeling and Testing of a Standalone Single Axis Active Solar Tracker Using MATLAB Renewable Energy, 36, 3075-3090.