PROJECT REPORT

Dual axis solar tracker

TEAM 10(ARMYS)

MEMBERS

1.Yashwanth Gowda G.S. (captain) {physical assembly}

2Arulanandan S {coding and project planning}

3Mohan S {coding and calculations on design}

4.Rajneesh Ajay {circuit designing}

5.Soumik Nayak {circuit designing}

INDEX

OBJECTIVES

The goal of this thesis was to develop a laboratory prototype of a solar tracking system, which is able to enhance the performance of the photovoltaic modules in a solar energy system. The operating principle of the device is to keep the photovoltaic modules constantly aligned with the sunbeams, which maximises the exposure of solar panel to the Sun's radiation. As a result, more output power can be produced by the solar panel. The work of the project included hardware design and implementation, together with software programming for the microcontroller unit of the solar tracker. The system utilised an ATmega328P microcontroller to control motion of two servo motors, which rotate solar panel in two axes. The amount of rotation was determined by the microcontroller, based on inputs retrieved from four photo sensors located next to solar panel. At the end of the project, a functional solar tracking system was designed and implemented. It was able to keep the solar panel aligned with the sun, or any light source repetitively. Design of the solar tracker from this project is also a reference and a starting point for the development of more advanced systems in the future

WORKING PRINCIPLE:

Resistance of LDR depends on intensity of the light and it varies according to it. The higher is the intensity of light, lower will be the LDR resistance and due to this the output voltage lowers and when the light intensity is low, higher will be the LDR resistance and thus higher output voltage is obtained.

Now this will give feedback to the microcontroller using the arduino software(IDE)

The tracker finally adjusts its position sensing the maximum intensity of light falling perpendicular to it and stays there till it notices any further change. The sensitivity of the LDR depends on point source of light. It hardly shows any effect on diffuse lighting condition

MATHEMATICAL MODEL MATHEMATICAL EQUATIONS REQUIRED INVERSE SQUARE LAW

The illumination upon a surface varies inversely as the square of the distance of the surface form the source. Thus, if the illumination at a surface 1 metre from the source is I units, then the illumination at 2 metres will be I/4, at 3 metres will be I/9 and so on. In fact inverse square law operates only when the light rays are from a point source and are incident normally upon the surface. Thus illumination in lamberts/m^2 on a normal plane= Candle power/ (Distance in metres)^2

IMPORTANT PARTS AND FUNCTIONS

ARDUINO UNO--The Arduino Uno is a microcontroller board based on the ATmega328. Arduino is an open source, prototyping platform and its simplicity makes it ideal for hobbyists to use as well as professionals.

LDR -- It is a photo-resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance.

SERVO MOTOR --A DC servo motor consists of a small DC motor, feedback potentiometer, gearbox, motor drive electronic circuit and electronic feedback control loop. It is more or less similar to the normal DC motor. The stator of the motor consists of a cylindrical frame and the magnet is attached to the inside of the frame.

DUAL AXIS MOVEMENT OF SOLAR TRACKER

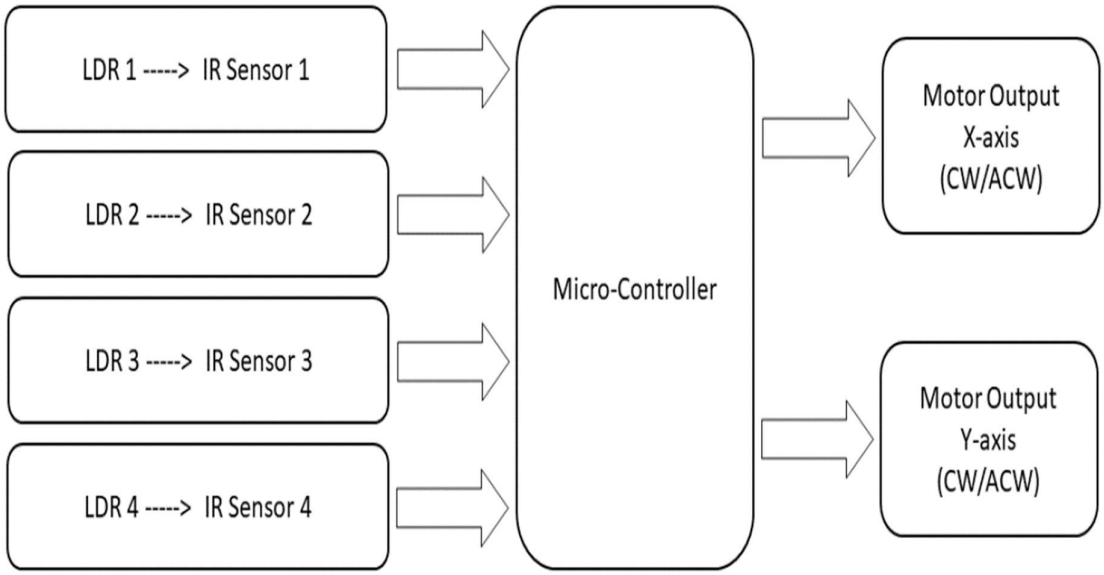
➢ The dual axis solar tracker is device which senses the light and positions towards the maximum intensity of light. It is made in such a way to track the light coming from any direction.

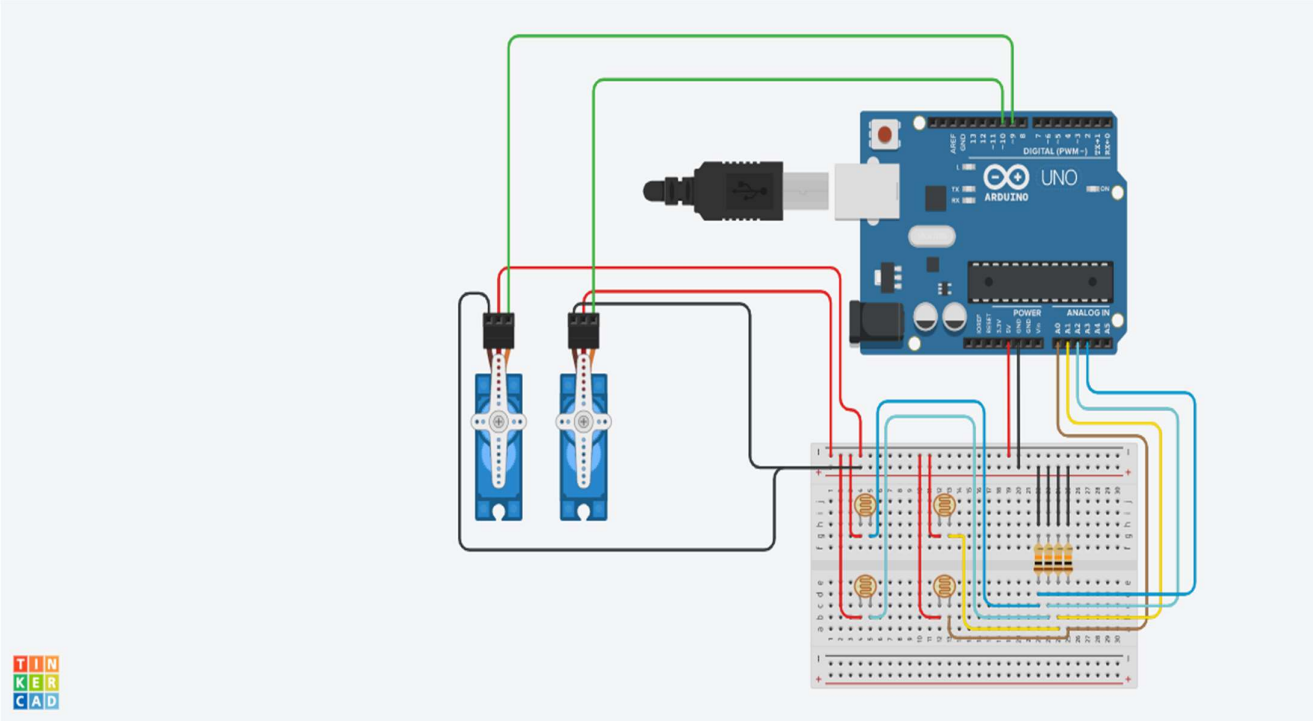
➢ To simulate the general scenario of the Sun's movement, the total coverage of the movement of the tracker is considered as 120˚ in both the directions.

➢ The initial position of both the servo motors are chosen at 90˚i.e, for east-west servo motor as well as for north-south servo motor.

➢ The position of the tracker ascends or descends only when the threshold value is above the tolerance limit.

SCHEMATIC AND CIRCUIT DIAGRAM





WORK PLAN

13th may : deciding hardware requirements for project

27th may : completed tinkercad simulation for the project

3rd june : decided the physical model for the project

10th june : completed the necessary calculations for the design

14th june: completed physical assembly of the project

HARDWARE COMPONENTS AND COST

Items	**cost**
Arduino uno	Rs. 875
Servo motor	2 * 375 = Rs. 750
Breadboard	Rs. 130
Ldr sensors	Rs. 25
Solar panels	Rs. 800
10 k ohm resistor	Rs. 20
Total	2600

CODING PART

```
#include <Servo.h>

Servo servohori; //horizontal servo(BOTTOM SERVO)
int servoh = 0; //assign servo at 0 degree
int servohLimitHigh = 180; //maximum range of servo is 180 degree(it is variable you can also change)
int servohLimitLow = 10;   //minimum range of servo is 10 degree(it is variable you can also change)

Servo servoverti; //vertical servo(TOP SERVO)
int servov = 0;
int servovLimitHigh = 180;
int servovLimitLow = 10;

int ldrtopr = 1; //top right LDR A1 pin
int ldrtopl = 3; //top left LDR A3 pin

int ldrbotr = 0; // bottom right LDR A0 pin
int ldrbotl = 2; // bottom left LDR A2 pin


 void setup ()
 {
  servohori.attach(10); //horizontal servo connected to arduino pin 10
  servohori.write(0);

  servoverti.attach(9); //vertical servo connected to arduino pin 9
  servoverti.write(0);
  delay(500); //delay
 }

void loop()
{
  servoh = servohori.read();
  servov = servoverti.read();


  int topl = analogRead(ldrtopl); //read analog values from top left LDR
  int topr = analogRead(ldrtopr); //read analog values from top right LDR
```

```
  int botl = analogRead(ldrbotl); //read analog values from bottom left LDR
  int botr = analogRead(ldrbotr); //read analog values from bottom right LDR


  int avgtop = (topl + topr) / 2; //average of top LDRs
  int avgbot = (botl + botr) / 2; //average of bottom LDRs
  int avgleft = (topl + botl) / 2; //average of left LDRs
  int avgright = (topr + botr) / 2; //average of right LDRs

  if (avgtop < avgbot)
  {
    servoverti.write(servov -1);
    if (servov > servovLimitHigh)
     {
      servov = servovLimitHigh;
     }
    delay(8);
  }
  if (avgbot < avgtop)
  {
    servoverti.write(servov +1);
    if (servov < servovLimitLow)
  {
    servov = servovLimitLow;
  }
    delay(8);
  }

  if (avgleft > avgright)
  {
    servohori.write(servoh -1);
    if (servoh > servohLimitHigh)
    {
    servoh = servohLimitHigh;
    }
    delay(8);
```

```
    delay(8);
  }
  if (avgright > avgleft)
  {
    servohori.write(servoh +1);
    if (servoh < servohLimitLow)
     {
     servoh = servohLimitLow;
     }
    delay(8);
  }

  delay(50);
  if(avgright==0)
  {
    if(avgleft==0){
      if(avgtop==0){
        if(avgbot==0){
          while(servoh > servohLimitLow){

            servohori.write(servoh -1);
          }
          while(servov > servovLimitLow){

            servoverti.write(servov -1);}

          delay(50000);
        }
      }
    }

  }

}
```

CALCULATION PART

The required torque by motor = 1.914 kg-cm

Load on vertical servo = 100 g

Load of horizontal servo = 288 g

Power consumption by a servo = voltage*current = 5 * 2 = 10 W

Total power consumption = 20W (2 servos)

Total power produced = 3.6 W (4 panels

INSIGHTS GAINED

Team work-We learned to coordinate among ourselves and work as a team

We learnt how to incorporate everyone into the work and finally perform the task in a time-oriented schedule.

Resource management-We had to use fundamental materials with limited resources

Acquisition of necessary skill set -It lead to a growth of our abilities related to circuits and coding a Arduino.We learnt about the solar panels and their potential to maximise power output.

OBSERVATIONS AND RESULT WHAT WE HAVE OBSERVED....

In this Dual Axis Solar Tracker, when source light falls on the panel, the panel adjusts its position according to maximum intensity of light falling perpendicular to it.

The objective of the project is completed. This was achieved through using light sensors that are able to detect the amount of sunlight that reaches the solar panel. The values obtained by the LDRs are compared and if there is any significant difference, there is actuation of the panel using a servo motor to the point where it is almost perpendicular to the rays of the sun.