DR BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY

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Mini Project On

"SINGLE-AXIS SOLAR PANEL TRACKER"

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ABSTRACT

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 Arduino UNO.

The system utilised an Arduino UNO to control motion of servo motor, which rotate solar panel in a single axis. The amount of rotation was determined by the Arduino, based on inputs retrieved from 2 light dependent resistors 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.

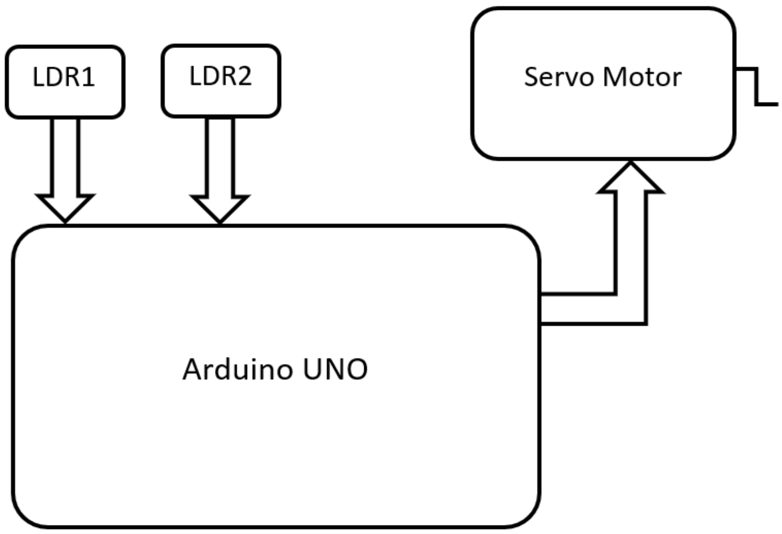
INTRODUCTION

With the unavoidable shortage of fossil fuel sources in the future, renewable types of energy have become a topic of interest for researchers, technicians, investors and decision makers all around the world. New types of energy that are getting attention include hydroelectricity, bioenergy, solar, wind and geothermal energy, tidal power and wave power. Because of their renewability, they are considered as favourable replacements for fossil fuel sources. Among those types of energy, solar energy is one of the most available resources. This technology has been adopted more widely for residential use nowadays, thanks to research and development activities to improve solar cells' performance and lower the cost. According to International Energy Agency (IEA), worldwide capacity has grown at 49% per year on average since early 2000s. Solar energy is highly expected to become a major source of power in the future.

However, despite the advantages, solar PV energy is still far from replacing traditional sources on the market. It is still a challenge to maximise power output of solar based systems in areas that don't receive a large amount of solar radiation. We still need more advanced technologies from manufacturers to improve the capability of solar materials, but improvement of system design and module construction is a feasible approach to make solar power more efficient, thus being a reliable choice for customers. Aiming for that purpose, this project had been carried out to support the development of such promising technology.

One of the main methods of increasing efficiency is to maximise the duration of exposure to the Sun. Tracking systems help achieve this by keeping solar panels aligned at the appropriate angle with the sun rays at any time. The goal of this project is to build a prototype of light tracking system at smaller scale, but the design can be applied for any solar energy system in practice. It is also expected from this project a quantitative measurement of how well tracking system performs compared to system with fixed mounting method.

BLOCK DIAGRAM & EXPLANATION

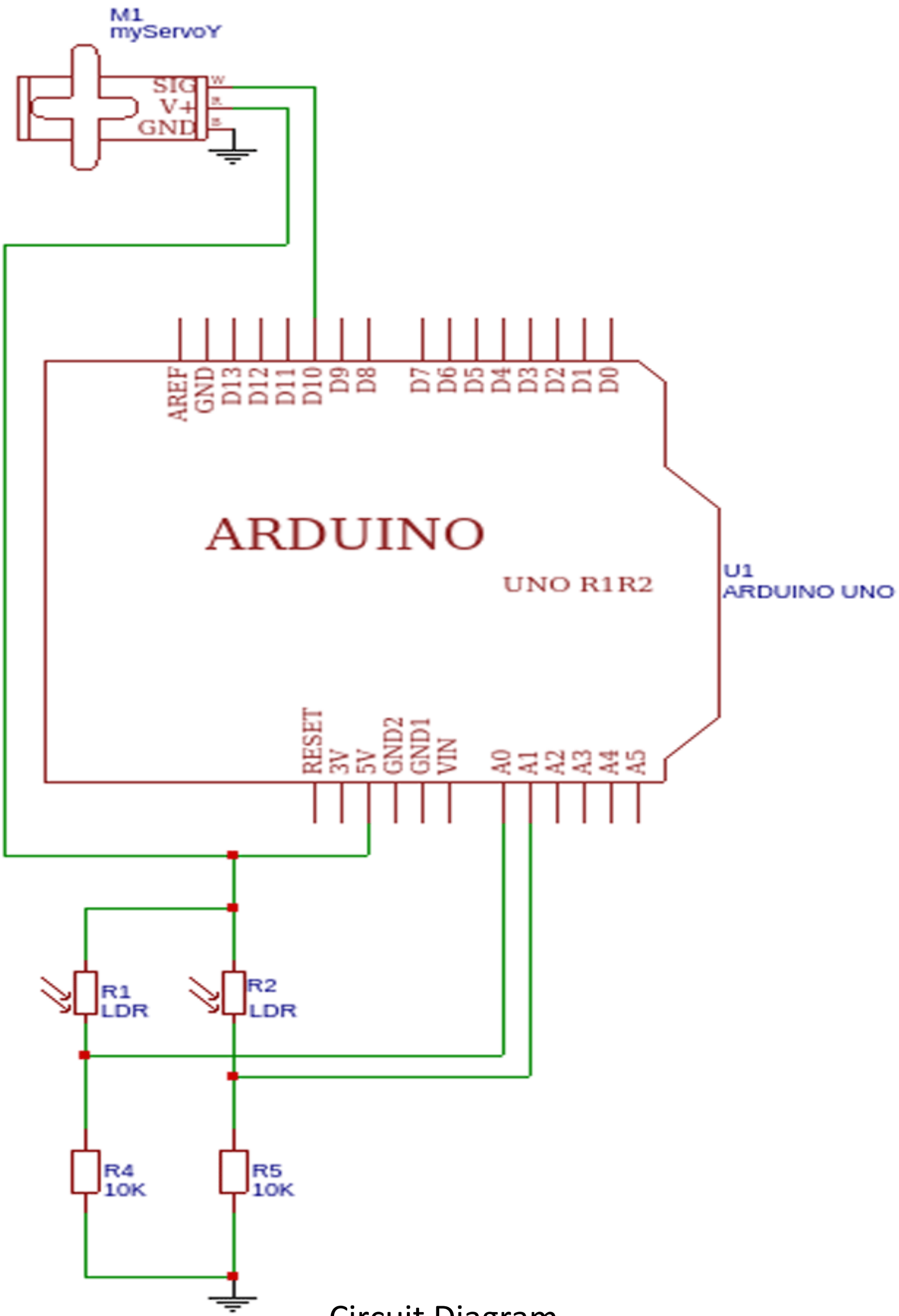


As we see in the block diagram, there are 2 Light Dependent Resistors (LDRs) which are placed on a common plate with solar panel. Light from a source strikes on them by different amounts. Due to their inherent property of decreasing resistance with increasing incident light intensity, i.e. photoconductivity, the value of resistances of all the LDRs is not always same. Each LDR sends equivalent signal of their respective resistance value to the Microcontroller which is configured by required programming logic. The values are compared with each other by considering a particular LDR value as reference. Servo motor is mechanically attached with the driving axle of the other one so that the former will move with rotation of the axle. The axle of the servo motor is used to drive a solar panel. This servo motor is arranged in such a way that the solar panel can move along axis. The Arduino sends appropriate signals to the servo motors based on the input signals received from the LDRs. One servo motor is used for tracking along the axis. In this way the solar tracking system is designed.

CIRCUIT DIAGRAM & COMPONENTS

Components Used:

- Arduino UNO board x 1
- Solar panel x 1
- SG90 servo motor x 1
- LDR sensor x 2
- 10k resistor x 2
- Jumper wires



Circuit Diagram

WORKING OF THE PROJECT

Servo Motor:

Servo motor is used to rotate the solar panel. We are using servo motor because we can control the position of our solar panels precisely and it can cover the whole path of sun. We are using a servo motor that can be operated with 5volt.

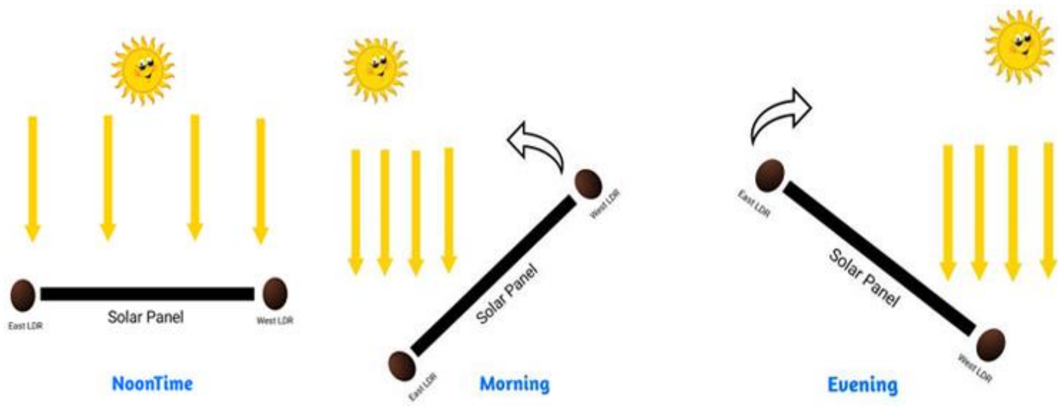
Light Dependent Resistor (LDR):

A light-dependent resistor is made from semiconductor material having light-sensitive properties and hence are very sensitive to light. The resistance of LDR changes according to the light that falls on it and it is inversely proportional to the intensity of light. That is resistance of the LDR will increase at high-intensity light and vice versa.

Working:

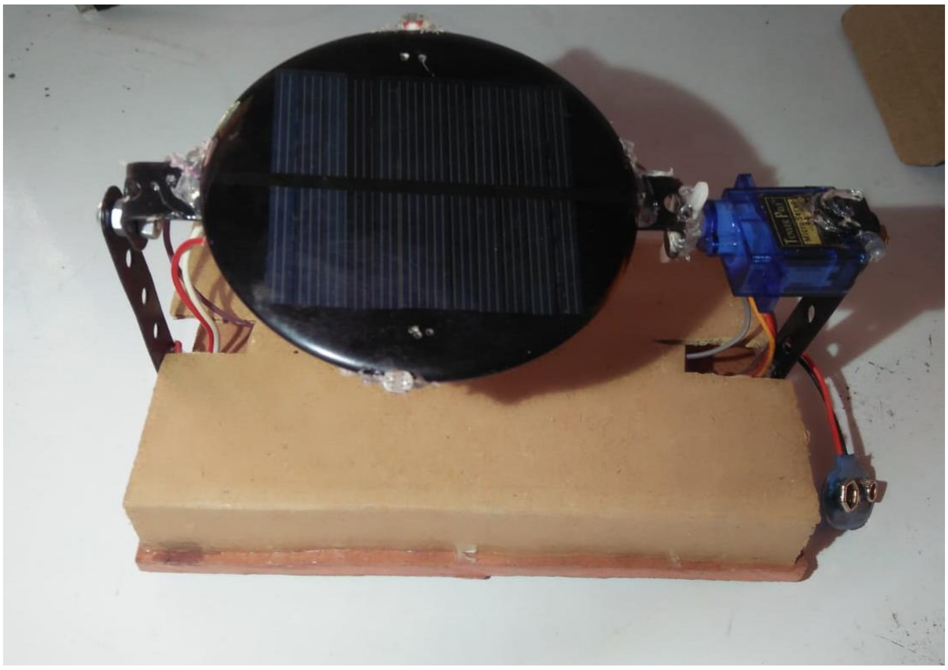
We measure the intensity of light with LDRs using Arduino and compare the intensity of light falling on both LDRs. The LDRs are placed on the edges of the solar panel.

Based on the intensity of light on the LDR, we give the signal to the servo motor to cause the movement. When the intensity of the light falling on the right LDR is more, the panel turns towards the right and if the intensity is higher on the left then the panel slowly turns towards the left side.



Consider a scenario of a beautiful winter morning, the sun rises from east side and therefore it has more light intensity than the west side, so the panel moves towards to east side. Throughout the day it will track the sun and by the evening, sun has moved towards the west, hence it will have more intensity than the east direction so the panel will face the west direction.

OBSERVATIONS & IMAGE OF PROJECT



Observation:

We observe that when the intensity of the sunlight falling on one of the LDR is more than the other LDR, with the use of servo motor the solar panel tilts towards the side where the intensity of the sunlight is more. This also happens when one side is darker; the solar panel tilts towards the other side which has relatively higher intensity of sunlight.

ADVANTAGES & DISADVANTAGES

ADVANTAGES

- Propose solar tracker is cost effective
- Average power gain of solar panel tracking system over normal stationary arrangement is upto 40-50%.
- Less power consumption by internal circuit and motors.
- Ability of tracking sun light at any weather.
- Installation is easy and operates automatically.

DISADVANTAGES

- Monitoring and Maintenance is required.
- A drastic environmental change cannot be tolerated by the equipment

CODE USED FOR THE PROJECT

```
//Include the servo motor library
#include <Servo.h>
//Define the LDR sensor pins
#define LDR1 A0
#define LDR2 A1
//Define the error value
#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(1000);
}

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(80);
}
```

APPLICATIONS, FUTURE SCOPE & CONCLUSION

APPLICATIONS OF SINGLE AXIS SOLAR TRACKING SYSTEM USING ARDUINO

- It can be used for large and medium scale power generations.
- It can also be used for power generation at remote places.
- It may be used as domestic backup power systems.
- It can be used for solar street lightning system.

FUTURE SCOPE:

- Single-axis and dual-axis photovoltaic tracking system, with appropriate control systems, the electrical energy can increase from 22-56%, compared to fixed PV system.
- Combinations of different sensor-based control systems represent the most commonly used control method as well as the most efficient.
- Active tracking systems use electrical drives to move the axis, which can consume a huge amount of electrical energy because of improper control systems. Therefore, it is necessary to optimize the power consumption of electrical drives, which can be done by reducing the number of motor movements.
- Electric motors used in PV tracking applications are exposed to weather conditions and are therefore designed to withstand strong winds, and high temperatures and humidity.

CONCLUSION:

The Single-Axis solar power tracking system was set up and tested using Arduino IDE & ARDUINO code. It is designed according to the circuit to trap the sun in all directions. It has better efficiency and sustainability to give a better output compared to fixed solar panels.

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