Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

J Component Report

Programme : **B.Tech**

Course Title : **Robotics And Its Applications**

Course Code : **CSE3011**

Slot : **D1**

Title: Sun Tracking Solar Panel

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Abstract

Solar energy refers to the energy that is derived from the sun's radiation. The sun is a powerful source of energy that emits light and heat, which can be harnessed and converted into usable energy. The arrangement and modification of a high-capability two-fold turn sun with regard to Arduino are shown in this work. Following the most extreme light and separating the largest power are two goals of this endeavor. The project combines both technological and programming advancement. Servo Motors, an Arduino, and light dependent resistors (LDR) are all included in the equipment portion. A light Dependent resistor (LDR) is a device whose protection depends on the presence of electromagnetic radiation, making them light-sensitive devices. LDRs can detect how much light is shining on them. The sunlight-based board is turned towards the strongest light force using a servo motor, a rotating actuator.This paper explores the idea of a solar panel system that tracks the sun using an Arduino, two LDRs, wires, and a servo motor. The solar panel's efficiency is increased by the system's ability to align it with the position of the sun. The Arduino controls the servo motor, which rotates the solar panel to line it with the sun's position, while the two LDRs are used to detect the position of the sun. In order to optimize the quantity of solar energy that can be turned into electrical energy, the system makes sure that the solar panel is always facing the sun. The paper comes to the conclusion that a sun tracking solar panel system is a worthy investment for people wishing to increase the effectiveness of their solar panel system.

Introduction

Solar energy can be used to power homes, businesses, and even entire cities. Solar panels, also known as photovoltaic (PV) panels, are devices that convert sunlight into electricity. These panels are made up of a series of photovoltaic cells that are connected together. When sunlight hits these cells, it causes a flow of electrons, which can be captured and used as electricity. Solar panels can be installed on roofs, walls, or on the ground, and can generate electricity for homes or businesses. They are becoming an increasingly popular form of renewable energy as they are clean, reliable, and can save money on energy bills over time. Sun-based energy is one of the non-traditional, environmentally friendly power sources with enormous potential for conversion into electricity and is able to meet a significant portion of the world's needs for electrical power. The conversion of solar-derived light into electrical energy is one of the most energizing and challenging inventive processes to date. It is flawless, quiet, and solid, with low maintenance costs and negligible biological effects. Sunlight-based energy is unrestricted, essentially free, and contains no ozone-harming emissions or polluting leftovers. According to various studies, covering 0.16% of the planet with 10% effective solar energy conversion systems would produce 20 TW of energy, about doubling the global use of fossil fuels.

Two LDRs (Light Dependent Resistors) are used in the sun tracking solar panel system to track the sun's position. LDRs are resistors that adjust their resistance in response to light. An LDR's resistance rises in the absence of light and falls when exposed to light. The two LDRs, which are positioned on the solar panel's opposing sides, measure the amount of light that hits them. The Arduino manages the servo motor, which rotates the solar panel to line it with the location of the sun, based on the amount of light measured.The sun tracking solar panel system's Arduino serves as its brain. It accepts input from the LDRs and uses that information to drive the servo motor. A microcontroller board called the Arduino is used to manage numerous electronic gadgets. It is simple to operate, and the Arduino software may be used to programme it. There are numerous input and output pins on the Arduino board that can be utilized to connect to various electronic devices.The solar panel is rotated using the servo motor to put it in line with the sun. A servo motor is a kind of motor that has a fixed range of rotation. By delivering a PWM (Pulse Width Modulation) signal to the servo motor, it may be managed by an Arduino. The servo motor is instructed by the PWM signal at what angle to revolve.

Small-scale solar panel systems can take advantage of the efficient sun tracking solar panel system that uses an Arduino, two LDRs, wires,resistors and a servo motor. The system is a great option for DIY enthusiasts because it is simple to install and programme. In order to optimise the quantity of solar energy that can be turned into electrical energy, the system makes sure that the solar panel is always facing the sun. Overall, if you want to increase the effectiveness of your solar panel system, a sun tracking solar panel system is a great investment.

Literature Review

1) The Implementation and Analysis of Dual Axis Sun Tracker System to Increase Energy Gain of Solar Photovoltaic

The usage of dual axis sun tracker systems for solar photovoltaic (SPV) generation is discussed in this work. By adjusting the SPV panels to maintain a perpendicular incident angle with the sun's position, energy gain can be increased dramatically by up to 60%. This system consists of two servo motors for each of the actuator's vertical and horizontal axes, an Arduino microprocessor, and four LDR sensors. The LDR sensors locate the sun, and the microprocessor analyses the information to tell the actuator to move the SPV panels appropriately. The effectiveness of SPV production could be greatly increased by the use of this approach.

2) Dual axis solar tracker with IoT monitoring system using arduino

By creating a dual-axis solar tracker system with IOT monitoring and using an Arduino Uno as the primary controller, it increases the efficiency of solar panels. Two servo motors spin the solar panel in accordance with the light source being detected, and four LDRs are utilised to detect sunlight and its maximum intensity. Between the device and the IOT monitoring system, a website that saves data, the system uses a WIFI ESP8266 device as an intermediary. The results demonstrate that the two-axis solar tracking system provides greater power, voltage, and current when compared to a single-axis sun tracker. Overall, the created technology has the potential to increase solar energy systems' efficiency and can greatly increase the amount of electricity generated from sunlight.

3) An accurate and efficient solar tracking system using image processing and LDR sensor

In order to increase the effectiveness of solar panels by continuously rotating them in the direction of the sun, a methodology for an autonomous solar tracker is proposed in this study. The suggested system overcomes the shortcomings of conventional solar tracking systems that only rely on light-dependent resistors by combining sensors and image processing to increase accuracy and efficiency. The technology makes use of image processing software to analyse the sun's image and adjust the solar panel as necessary. The methodology combines hardware and software, making it appropriate for managing a solar power plant's many solar panels. Overall, the suggested system delivers increased precision and effectiveness while optimising the amount of power needed for the production of renewable energy.

4) Solar Tracker Robot using microcontroller

This project intends to build and construct an autonomous Solar Tracker Robot (STR) to track maximum light intensity and optimise solar energy conversion. A digital compass, sensors, servo motors, and a microcontroller (PIC16F877A) are the essential parts of the robot. The robot has two modified DC servo motors to return it to its starting position and two Light Dependent Resistors (LDR) to detect sunlight. The MPLAB IDE version 8.30 is used to programme the robot. The Fluke 1750 power quality recorder is used to analyse the effectiveness of solar energy conversion. The STR can optimise solar panel power conversion, increasing their efficiency and suitability for use as renewable energy sources, by tracking the maximum light intensity.

5) A simple and low-cost active dual-axis solar tracker

In this paper, a practical dual-axis solar tracker (DAST) solution that can follow the sun's path is shown. The DAST's dual-axis mechanism tilts the PV panel using two servo motors in accordance with the peak amount of sunlight detected by LDR sensors installed in the PV panel's four corners. Using a virtual instrument based on Excel that operates in real-time, the effectiveness of the DAST prototype is assessed. According to experimental findings, the smart DAST generates 36.26% more energy than a fixed panel. The suggested DAST can increase the effectiveness of solar panels because it is simple to apply and doesn't require a detailed understanding of sun tracking technology or electronic engineering.

6) Automatic Dual Axis Sun Tracking System using LDR Sensor

This study introduces a dual-axis solar tracker and photovoltaic cell distributed solar energy producing system. The solar tracker is made to actively follow the sun while adjusting the solar panel's location to provide the most power. Sensors, microcontroller-driven control circuits, geared DC motors with bearing arrangements, and supports are all components of the tracking system. Two geared DC motors are used to move the solar panel, ensuring that the solar panel is always towards the sun for best efficiency. The performance of solar panels can be considerably increased by this effective solar energy gathering technology, increasing its usefulness for distributed solar energy generation.

7) Modeling and Research of Automatic Sun Tracking System on the bases of IoT and Arduino UNO

This article discusses a Proteus software-based IoT-based system for autonomous modelling of solar panels. The system makes use of automatic sun tracking technology, which modifies the sun's rays' angle of descent on the solar panel's surface to maximise energy output. Designing self-propelled driving equipment for maximum energy output and simulating the power system on the Proteus software environment are both steps in the modelling process. To make sure that it moves in proportion to solar radiation while satisfying load requirements, the automatic solar tracking system is examined. This article offers helpful insights into the design and modelling of the IoT-based automatic solar tracking system, which is a potential technology for increasing the effectiveness of solar energy generation.

8) Sun Tracking System with Microcontroller 8051

In order to maximise the amount of power generated by solar panels, this paper outlines the construction of a sun tracking system. Both automatic and manual tracking techniques are used by the system, with the former depending on LDR sensors and the latter on a programme referred to as "sun tracking software." Solar panels, a stepper motor, an 8051 microprocessor, physical structure, and software make up the system's architecture. The tracking system is more affordable and convenient than adding more solar panels. Also given are the system's approach and actual image. The necessity of sun tracking for improving solar panel efficiency is emphasised in the article, as well as the advantages of combining automatic and manual tracking techniques.

9) Design and Implementation of a Sun Tracker with a Dual-Axis Single Motor for an Optical Sensor-Based Photovoltaic System

The need for renewable energy sources has grown as a result of the depletion of non-renewable energy sources and worries about global warming. Sun trackers can increase the electricity generation of photovoltaic (PV) systems, which are a viable renewable energy source. In order to achieve reliable system performance, this work suggests a novel design for a dual-axis solar tracking PV system that makes use of feedback control theory, four-quadrant light dependent resistor (LDR) sensors, and straightforward electrical circuits. For solar tracking, the system uses a dual-axis AC motor and a standalone PV inverter. A technical advancement that offers a straightforward and efficient design is the control implementation. A scaled-down laboratory prototype is used to prove the scheme's viability, and experiments are used to demonstrate the Sun tracker's efficacy.

10) Design of two axes sun tracking controller with analytically solar radiation calculations

The design and analysis of photovoltaic (PV) systems for effective and practical operation are the main topics of this study. The study comprises practical testing of a two-axis sun tracking system and a stationary system, as well as theoretical analysis of solar radiation and angle of incidence. The theoretical data was found to be in agreement with the experimental findings when a prototype system was built and modified to work with a 4.6 kW PV system. The study offers insights into the variables that affect the performance of solar systems, and as such, it is a useful manual for the design and operation of future PV power plants. The findings of this study can be applied to improve PV system efficiency and expand the use of solar energy.

Existing Work

- The article "Design and Implementation of a Solar Tracking System Using LDR Sensors and a Servo Motor" was written by M.S. Rahman and others. In this work, a sun tracking system was created utilizing LDR sensors and a servo motor, and the system's energy economy and tracking precision were assessed.

- The article "Design and Implementation of Sun Tracking Solar Panel System Using Arduino and LDR Sensors" was written by S. R. Patel and others. This study created a solar monitoring system with Arduino and LDR sensors and assessed how energy-efficient it was.

- Ashwin Kumar and collaborators' "Design and Development of Sun Tracking Solar Panel Using LDR Sensors and Servo Motors" This study suggested a sun tracking system that makes use of servo motors and LDR sensors and showed how it might increase the energy efficiency of solar panels.

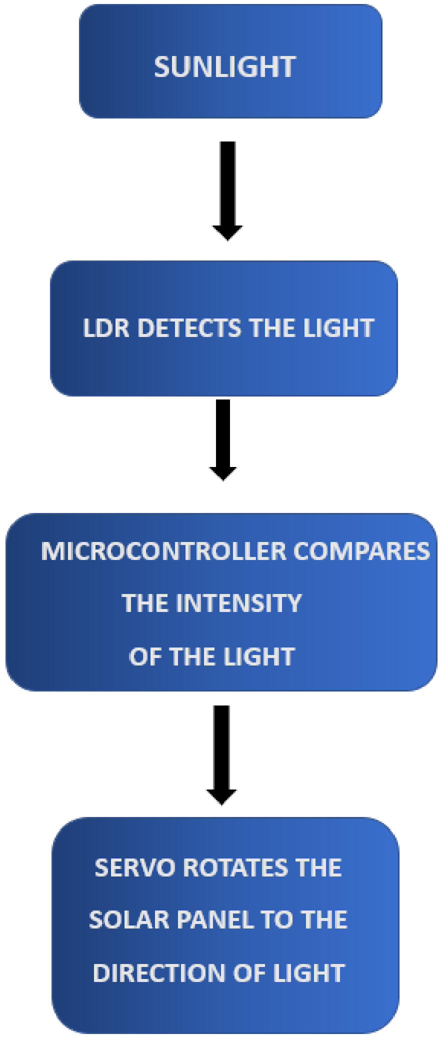
- R.S. Waghmare et al.'s "Development of a Solar Tracking System Using Arduino and LDR Sensors" This study suggested a sun tracking system that makes use of Arduino and LDR sensors and showed how it may boost solar panels' energy output.

Research Gap

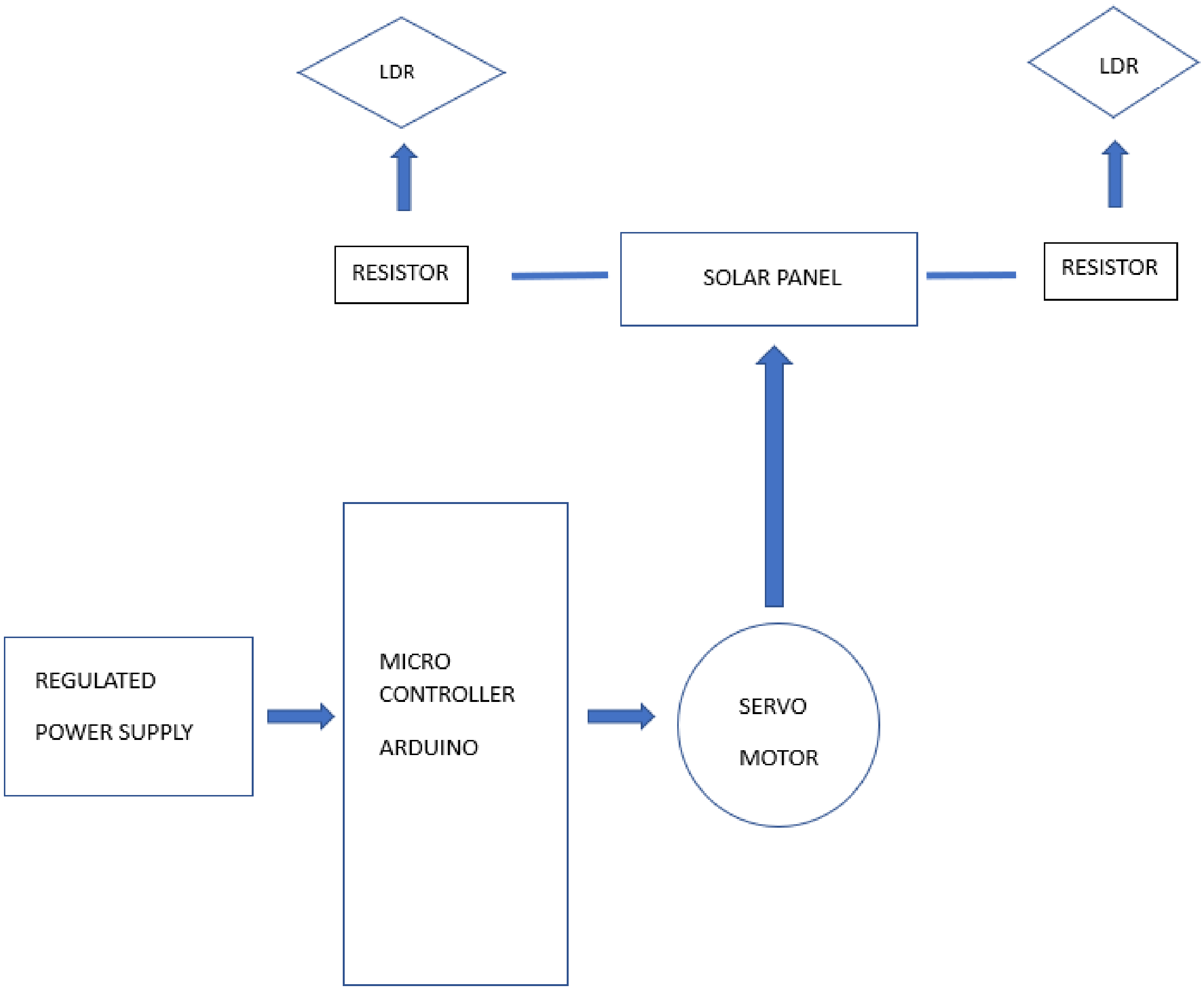
The lack of research into the efficacy and applicability of this technique for improving solar panel performance accounts for the research gap for sun tracking solar panels employing LDR sensors and servo motors. While earlier research has shown the potential advantages of sun tracking systems, there is a dearth of studies that concentrate explicitly on the employment of LDR sensors and servo motors as the movement control system for solar panels.

More investigation is also required to determine whether it is feasible to use this technology in practical settings, taking into account factors like cost, toughness, and upkeep requirements. Additionally, comparative studies are required to assess how well LDR sensor and servo motor-based sun tracking systems compare to other well-known techniques, such as GPS-based tracking.

Flow Idea


SUNLIGHT
LDR DETECTS THE LIGHT
MICROCONTROLLER COMPARES
THE INTENSITY
OF THE LIGHT
SERVO ROTATES THE
SOLAR PANEL TO THE
DIRECTION OF LIGHT

Architecture Proposed

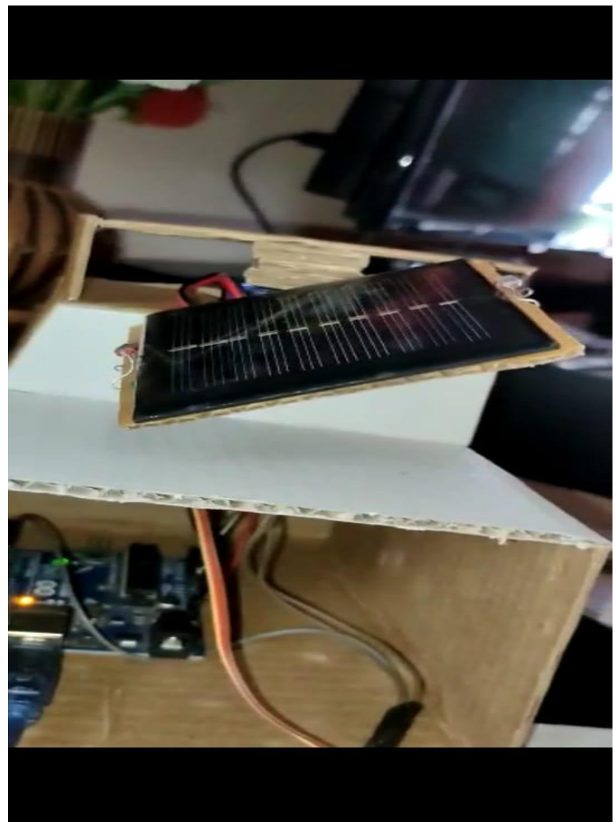


Codes

```
#include <Servo.h>      //including the library of servo motor
Servo myservo;
int initial_position = 90;
int LDR1 = A1;          //connect The LDR1 on Pin A0
int LDR2 = A0;          //Connect The LDR2 on pin A1
int error = 5;
int servopin=3;         //You can change servo just makesure its on arduino's PWM pin

void setup() {
  myservo.attach(servopin);
  pinMode(LDR1, INPUT);
  pinMode(LDR2, INPUT);
  myservo.write(initial_position);   //Move servo at 90 degree
  delay(2000);
  Serial.begin(9600);
}

void loop()
{
  int R1 = analogRead(LDR1); // read  LDR 1
  int R2 = analogRead(LDR2); // read  LDR 2
  int diff1= abs(R1 - R2);
  int diff2= abs(R2 - R1);

  if((diff1 <= error) || (diff2 <= error)) {

  } else {
    if(R1 > R2)
    {
      initial_position = --initial_position;
    }
    if(R1 < R2)
    {
      initial_position = ++initial_position;
    }
  }
  myservo.write(initial_position);
  delay(100);

  if(initial_position >= 180) {
    initial_position = 180;
  }
```

```
 if(initial_position <= 0) {
   initial_position = 0;
 }
 Serial.println(initial_position);
}
```

Screenshots



Conclusion

Overall, there is a lot of potential for the sun tracking solar panel system to be used in renewable energy applications, particularly in remote locations or in off-grid installations. Future studies might concentrate on enhancing the system's performance and design, as well as investigating the usage of additional sensors or control systems to better optimise solar energy production.

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