Project Report

Team WattWise Warriors

Course Title: Power Electronics Lab
Course Code: EEE 4504

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Project Name: Sunlight Tracking Solar panel

Theoretical Background:

Solar panels are devices designed to convert sunlight into electrical energy through the photovoltaic effect. This process involves the generation of electric power by harnessing the energy of photons from sunlight. However, the efficiency of solar panels is greatly influenced by the angle and orientation of the panels relative to the sun.

Sunlight tracking systems aim to optimize the orientation of solar panels by continuously adjusting their position to face the sun directly. This dynamic approach enhances energy capture throughout the day, maximizing overall efficiency. Sunlight tracking is particularly beneficial in regions with variable sunlight conditions or during seasons with changing sun angles.

Methodology:

The implementation of the sunlight tracking solar panel involves a multi-step process:

Sunlight Detection: Utilizing light sensors to detect the intensity and direction of sunlight.

Actuation Mechanism: Employing motors or servos to adjust the tilt and azimuth of the solar panel based on the sunlight data.

Control Algorithm: Developing a control algorithm to process sensor data and calculate the optimal position for the solar panel.

Calibration: Fine-tuning the system to ensure accurate and responsive tracking.

Features:

We are planning to build a project named sunlight tracking solar panel in which there will be-

Sunlight Tracking Precision:

Develop a system that accurately tracks the sun's movement using sensors and a microcontroller to determine its position based on the direction of higher intensity of incoming sunlight.

Power Electronics Control:

Implement power electronics components like motors, motor drivers, and diodes ,convertors (buck-boost) to adjust the orientation of solar panels in response to the sun's position.

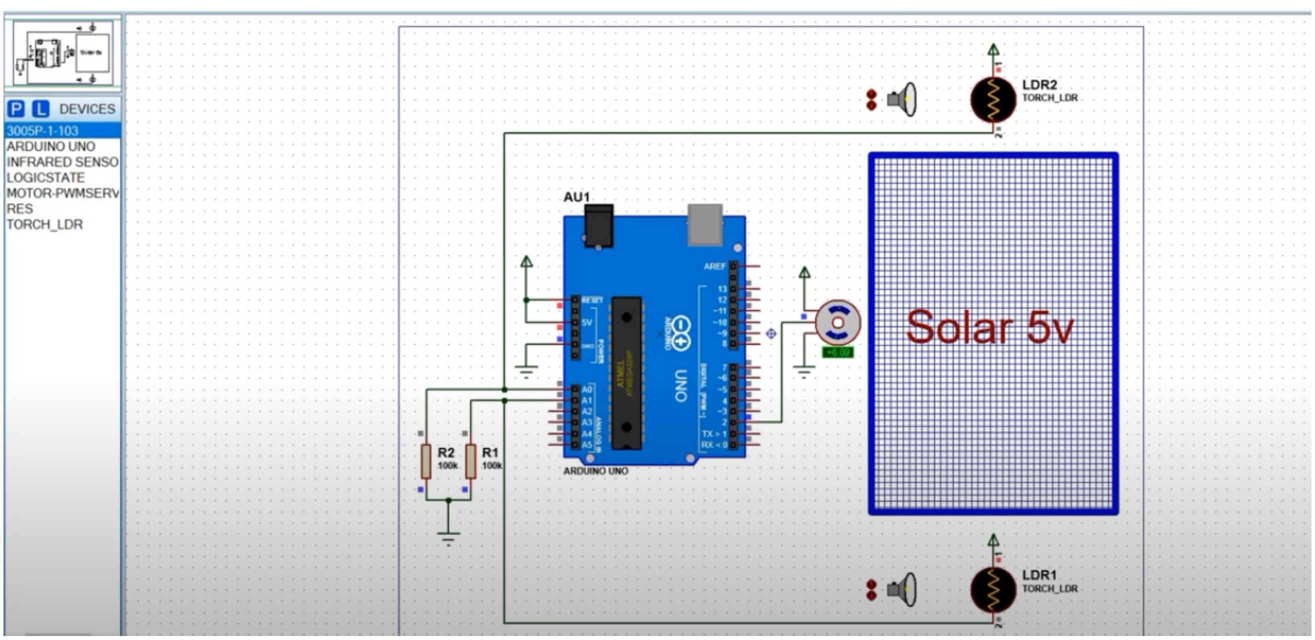
Efficiency Optimization:

Create algorithms for continuously optimizing the solar panel angles to maximize sunlight incidence, enhancing energy output and system efficiency. Since if we can track the incoming sunlight and rotate our solar panel accordingly, it will be able to capture more energy than a static solar panel.

User-Friendly Interface:

Design a user interface with manual control capabilities, ensuring ease of use, save up energy in the night time and the ability to configure the system for different applications.

Circuit Diagram in Proteus:



After running the simulation when we give light to LDR1 then the servo motor moves in that direction and when light is given to LDR2 then servo motor moves to that direction , and with the help of servo motor our 5V solar panel will move .With this setup we can continuously optimize the solar panel angles to maximize sunlight incidence, enhancing energy output and system efficiency.

Arduino code:

Select Board

Solar_Tracker.ino

```
#include <Servo.h> //includes the servo library

Servo myservo;

#define ldr1 A0 // set ldr 1 Analog input pin of East ldr as an integer
#define ldr2 A1 // set ldr 2 Analog input pin of West ldr as an integer

int pos = 90; // initial position of the Horizontal movement controlling servo motor
int tolerance = 20; // allowable tolerance setting - so solar servo motor isn't constantly in motion

void setup(){
myservo.attach(2); // attaches the servo on digital pin 2 to the horizontal movement servo motor
pinMode(ldr1, INPUT); //set East ldr pin as an input
pinMode(ldr2, INPUT); //set West ldr pin as an input
myservo.write(pos); // write the starting position of the horizontal movement servo motor

delay(1000); // 1 second delay to allow the solar panel to move to its staring position before comencing solar tracking
}

void loop(){
int val1 = analogRead(ldr1); // read the value of ldr 1
int val2 = analogRead(ldr2); // read the value of ldr 2

if((abs(val1 - val2) <= tolerance) || (abs(val2 - val1) <= tolerance)) {
//no servo motor horizontal movement will take place if the ldr value is within the allowable tolerance
}else {
if(val1 > val2) // if ldr1 senses more light than ldr2
{
pos = pos+1; // decrement the 90 degree poistion of the horizontal servo motor - this will move the panel position Eastward
}
if(val1 < val2) // if ldr2 senses more light than ldr1
```

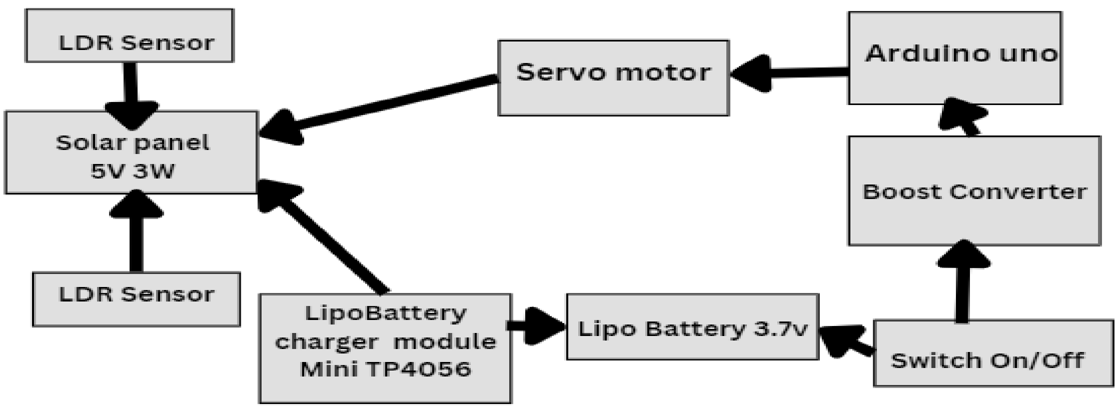
Select Board

Solar_Tracker.ino

```
pinMode(ldr2, INPUT); //set West ldr pin as an input
myservo.write(pos); // write the starting position of the horizontal movement servo motor

delay(1000); // 1 second delay to allow the solar panel to move to its staring position before comencing solar tracking
}

void loop(){
int val1 = analogRead(ldr1); // read the value of ldr 1
int val2 = analogRead(ldr2); // read the value of ldr 2

if((abs(val1 - val2) <= tolerance) || (abs(val2 - val1) <= tolerance)) {
//no servo motor horizontal movement will take place if the ldr value is within the allowable tolerance
}else {
if(val1 > val2) // if ldr1 senses more light than ldr2
{
pos = pos+1; // decrement the 90 degree poistion of the horizontal servo motor - this will move the panel position Eastward
}
if(val1 < val2) // if ldr2 senses more light than ldr1
{
pos = pos-1; // increment the 90 degree position of the horizontal motor - this will move the panel position Westward
 }
}

if(pos > 180) {pos = 180;} // reset the horizontal postion of the motor to 180 if it tries to move past this point
if(pos < 0) {pos = 0;} // reset the horizontal position of the motor to 0 if it tries to move past this point
myservo.write(pos); // write the starting position to the horizontal motor
delay(50);

}
```

The provided Arduino code initializes a solar tracking system using the Servo library. It begins by defining pin assignments for two Light Dependent Resistors (LDRs) representing the East and West directions, and sets initial values for variables such as the servo motor position (pos) and a tolerance threshold (tolerance). The setup function configures the servo and LDR pins, positions the servo, and introduces a delay to allow the solar panel to stabilize. In the main loop, it reads analog values from the LDRs, checks if the difference between them exceeds the defined tolerance, and adjusts the servo position accordingly. The servo movement is determined by the relative light intensity sensed by the LDRs, ensuring the solar panel aligns with the direction of maximum sunlight. The servo position is constrained within limits, and a delay is added to control the rate of adjustment.

Block Diagram:



This block diagram shows the interconnection between the components used in the project.servo motor is connected with arduino which actually controls the rotation of solar panel according to light. Lipo battery is charged with the solar panel and with the boost converter it converts to 5v and gives power to arduino uno.and there is a on/off connected which make it easier for the user to control when they want to turn on and off the system.

Flow Chart:

Initialize System: Set up the system, including attaching the servo motor, configuring pin modes, and setting the initial servo position

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Read LDR Values: Use the Arduino to read the analog values from the East and West LDRs.

Check Tolerance within Range?: Determine if the difference between LDR values is within the predefined tolerance range.

No Movement (Stay in Tolerance): If within tolerance, do not adjust the servo motor, and loop back to read LDR values.

Compare LDR Values and Adjust Servo Position: If outside tolerance, compare LDR values and adjust the servo position accordingly (East or West).

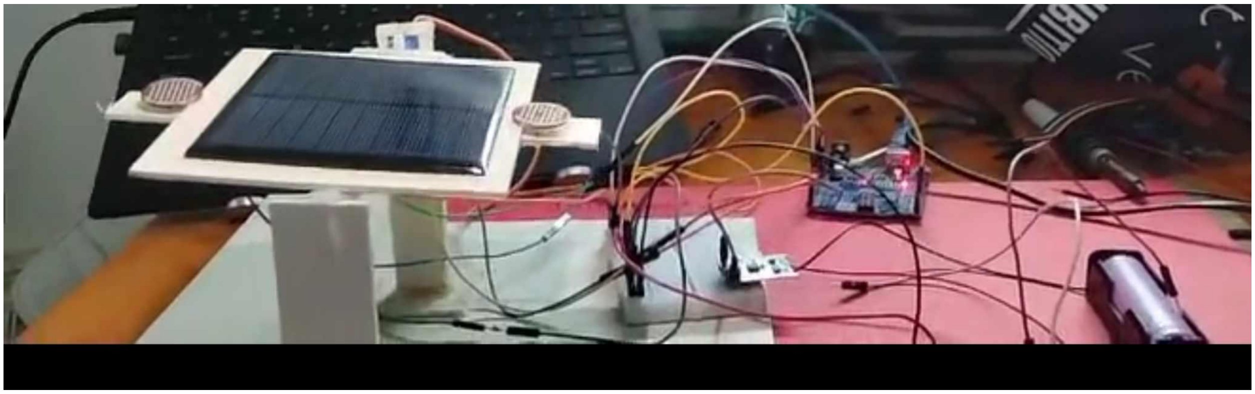
Limit Servo Position: Ensure that the servo position is within specified limits (0 to 180 degrees).

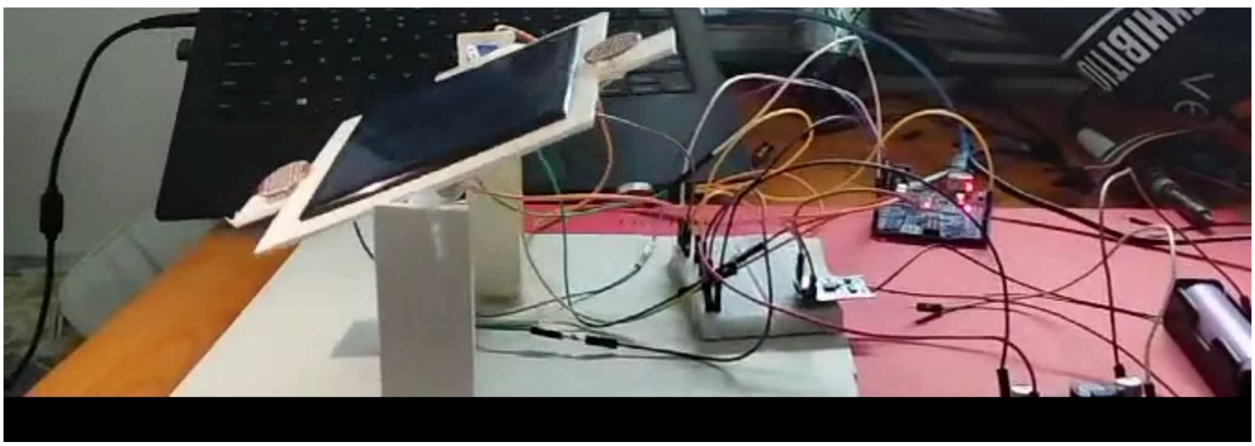
Set Servo Position and Delay: Update the servo position and introduce a delay for smoother operation.

Loop (Repeat): Repeat the process by going back to reading LDR values.

End: Finish the process when desired.

Hardware setup and project output:





Analysis:

The implemented sunlight tracking solar panel project, utilizing a servo motor controlled by an Arduino with two Light Dependent Resistors (LDRs), demonstrated effective performance.

The servo motor responded accurately to changes in LDR values, ensuring smooth adjustments. The system dynamically tracked the sun throughout the day, promptly adapting to sudden changes in light conditions.Tolerance management minimized unnecessary servo movements during minor fluctuations, contributing to overall system efficiency.

Boost converter was used that will convert 3.7v to 5v and that is connected with arduino uno.

The system proved durable against environmental conditions, and user-friendly aspects were considered.

Future scope:

Precision and Accuracy:

Explore technologies or sensors that offer higher precision and accuracy in tracking the sun's position. This could involve the use of more advanced sensors or machine learning algorithms to improve the responsiveness of the system.

Dual-Axis Tracking:

Extend the tracking capability to dual-axis, allowing the solar panel to adjust both horizontally and vertically. Dual-axis tracking provides more precise alignment with the sun throughout the day and during different seasons.

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Remote Monitoring and Control:

Implement remote monitoring and control features. This could involve integrating the system with IoT (Internet of Things) platforms, allowing users to monitor and control the solar panel's position remotely through a web or mobile interface

Integration with Smart Grids:

Explore integration with smart grid technologies to contribute excess energy back to the grid, creating a more interconnected and sustainable energy ecosystem.

Discussion:

In conclusion, the sunlight tracking solar panel project showcases a promising approach to optimizing solar energy capture. The successful hardware implementation and analysis revealed notable strengths in responsiveness, stability, and efficiency. However, several challenges and future opportunities are evident.

We have faced challenges during the hardware implementation of the project for perfect precession of sunlight tracking , due to different components problems such as buck converter, lipo battery charger module which was hampering our progress.but after debugging the output.

Lastly , the sunlight tracking solar panel project not only demonstrates effective energy optimization but also presents a foundation for continued refinement. By addressing challenges and embracing future opportunities, this project has the potential to contribute significantly to the evolution of sustainable solar energy systems.