

Solar Tracker Module with Automated Module Cleaning System

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-----ABSTRACT-----

Solar Tracker with IR Sensor is one of the features innovated to track the light from the sun to increase the efficiency of the solar panel. It provided with an IR sensor to detect the dust and clean it with cooling fan. Sunlight always moves due to the rotation of the sun, certain solar panels are created static. Solar Tracking Robot is made to improve the solar panel efficiency, thus it can catch the sun irradiance and the energy can be stored as a renewable energy. The solution is using the theory and the Arduino's microcontroller to design the product. The method of planning, programming, calculating the cost for the component also taken to ensure the product is good in quality but affordable. In future, we try to make the solar with voltage reading and sensor less with high efficiency.

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I. INTRODUCTION

This project is about the tracking of sunlight using light sensor by actuating the motor to seek the light to increase the efficiency of the solar panel with IR sensor. Generally, the sun rotating the around the earth, the solar panel must move to seek the light. The solar tracker robot was created to track the light by using the light sensor, microcontroller (ARDUINO) and the servo motor to operate the circuit. Besides, the IR sensor was added to remove the dust and increase the efficiency of the circuit. The objectives are to understand the operation of tracking the sunlight by using light sensor and Arduino microcontroller and to improve the efficiency of the solar panel by adding the IR sensor.

A. Problem Statement

“The efficiency of solar cells is only about 22%. The rest of the sunlight that strikes the panel is wasted as heat. More efficient photovoltaic cells have been discovered (up to 43% efficient - see How efficient is solar energy? - but these are still in their experimental phase and are expensive to manufacture).”- written by Solar Power is the future .com [1]. The problem states above, shows that only 22% is efficient. Using the light sensors will increase the efficiency of the solar cell. Instead of that, certain solar panel only moves one axis and need to move dual axes and adding IR sensor for a removing the dust on the solar panel. Thus, the innovation of Solar Tracker with Automated Module Cleaning innovated to help the solar panel achieve its efficiency to absorb the light energy from the sunlight by removing, cooling the panel and tracking the sun light.

II. DISCUSSION AND RESULTS

The discussion of the project is more to the calibration. Solar Tracker with IR Sensor was soldered and tested a few times so that the project can be operated properly. The soldering process takes a few weeks for checking the connection and the continuity. The designing also take time to measure the size of cardboard, the stability and many others.

A. Scope of Work

The source of the project used is 5V maximum to avoid the microcontroller from damage. The LDR will detect the sunlight and actuate the servo motor [2]. Normally, solar panel only absorb the light energy at it places. Then, after the light sensor added to the near solar panel, the servo motor which act as an actuator then moves the solar panel to follow the sunlight. If the dust presence detected on the solar panel [3], the IR sensor will detect it and actuate the cooling fan to remove it and cooling the solar panel [4]. The IR sensor is used to detect dust as an input [5]. Basically, the microcontroller is used to program the circuit and setting the servo

motor. The 330Ω resistors are attached at the LDRs in the circuit to create the resistance [6]. The resistor's value can be determine by the color[7].

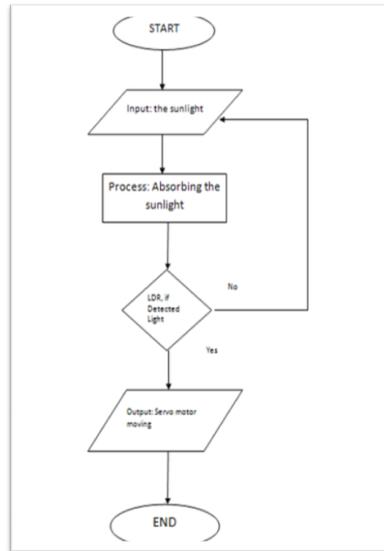


Figure 1: The flow Chart

B. The Coding and Flowchart

The coding is transferred to the ArduinoUNO as a programmer to operate the circuit [8]. The flow chart shows the process of detecting the light. If the LDR detect the light, the servo motor will be actuated and moves due to the position coded in the coding. The circuit of solar tracker have closed loop block diagram [9]. The on and off switch is attached to the prototype to reduce the battery energy [10]. IR sensor will detect the dust on the solar panel. If there is a dust on the solar panel, the dc cooling fan will be actuated to remove the dust and at the same time act as a cooler to the solar panel to reduce the power loss due to excess heat interruption. The program code is as below:

```

#include <Servo.h> // include Servo library

Servo horizontal; // horizontal servo
int servoh = 90; // stand horizontal servo

Servo vertical; // vertical servo
int servov = 90; // stand vertical servo

// LDR pin connections
// name = analogpin;
int ldr1t = 0; //LDR top left
int ldr1r = 1; //LDR top right
int ldr1l = 2; //LDR down left
int ldr1d = 3; //ldr down right

void setup()
{
  Serial.begin(9600);
  // servo connections
  // name.attach(pin);
  horizontal.attach(10);
  vertical.attach(11);
}
  
```

The potentiometer in the circuit is used to adjust the speed of the servo motors by adjusting the resistance [11]. The LDR have the 10MΩ to 50MΩ resistance, thus the resistance was used to detect light and actuate the servo motors [12]. The angle of rotation for each servo motor is 0° to 180° for horizontal and vertical so that the servo can back to their normal position. Based on the theory of IR sensor, noted that the transmitter sensor reflected 90° on the plane. IR led keeps transmitting IR infrared rays by the adjustment of potentiometer in the module. When some object comes in the infrared range, the IR waves hits the object and comes back at some angle. The Photo diode next to IR led detects that IR infrared rays which got reflected from the object [13]. The position of the IR Sensor should be put on top of the solar panel. If the IR sensor detects a dust, the dc cooling motor turns on [14]. This shows that it is suitable for obstacle avoidance and detection of motion. The figure below shows the circuit of Solar Tracker.

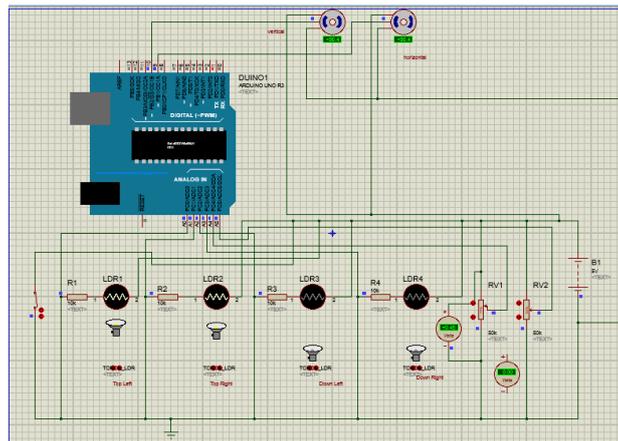


Figure 2: The circuit of Solar Tracker

IR sensor has limited distance range. Due to the experiment it only can detect the dust not more than 12 cm on the plane. The conclusion is the range of detection of IR sensor module is from 2cm up until 10cm. When the IR sensor module connected to the dc cooling fan, the IR sensor detected the obstacle in front of the sensor. It is used because it is light and easily attached to solar panel. When the dust detected on range 2cm up until 10cm, the dc cooling fan moves. It stop when it more that 10cm. When the distance of obstacle at 2cm from the IR sensor, the LED light up.



Figure 3: The solar tracker prototype with automated module cleaning system

The distance (cm)	DC Cooling Fan Respond
2	ON
4	ON
6	ON
10	ON
12	OFF

Table 17: DC cooling fan respond

It shows that the obstacle was in front of the sensor. Based on the concept, the transmitter will detect and transmit the signal 90° while receiver will receive and transmit signal to the LED.

III. CONCLUSION

Based on the project done, the understanding about of the operation of solar tracker robot on tracking the sunlight by using light sensor with Arduino microcontroller was achieved. In addition, the efficiency of the solar panel can be improved by adding the IR sensor. The recommendation of this project is by creating the sensor less solar panel and voltage reader to reduce cost and increase the efficiency of the product. The sensor less solar panel needs no sensing material but only needs the coding to moves the solar panel. Furthermore, the display of the voltage may inform the technician or engineer what should be done to increase or decrease the value power needed. This is because in general solar power generates small 10kW less based on the size. In future recommendation, the suggestion is adding the charger and voltage reader so that the solar energy can be used and not wasted.

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