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 [ijirset@gmail.com](mailto:ijirset@gmail.com)

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# Design, Analysis & Monitoring of Sun Tracking Solar Panel

Mr. Sourabh G. Arasidha, Mr. Atharva A. Tupe, Mr. Abhishek S. Yadav, Mr. Rohit S. Thorat,

Prof. N. M. Kamthe

Department of Mechanical Engineering, Sinhgad College of Engineering, Pune, India

**ABSTRACT:** Solar panel has been used increasingly in recent years to convert solar energy to electrical energy. The solar panel can be used either as a stand-alone system or as a large solar system that is connected to the electricity grids. The earth receives 84 Terawatts of power and our world consumes about 12 Terawatts of power per day. We are trying to consume more energy from the sun using solar panel. In order to maximize the conversion from solar to electrical energy, the solar panels have to be positioned perpendicular to the sun. Thus, the tracking of the sun's location and positioning of the solar panel are important. The goal of this project is to design an automatic tracking system, which can locate position of the sun. The tracking system will move the solar panel so that it is positioned perpendicular to the sun for maximum energy conversion at all time. Our system will output up to 40% more energy than solar panels without tracking systems. Solar panel has been used increasingly in recent years to convert solar energy to electrical energy. The solar panel can be used either as a stand-alone system or as a large solar system that is connected to the electricity grids. We are trying to consume more energy from the sun using solar panel. In order to maximize the conversion from solar to electrical energy, the solar panels have to be positioned perpendicular to the sun.

**KEYWORDS:** Solar Tracker, Monitoring System, Photovoltaic, Renewable Energy

## I. INTRODUCTION

Taking a look at the present scenario it is evident that conventional sources of energy such as coal, natural gas, oil, etc. are at the edge of extinction. Being in mortal combat with time itself to fulfil every demand for energy the demand for these resources for energy has escalated to its zenith. The conventional use of energies due to the burning of fossil fuels like coal, oil and natural gas, the whole environment is getting polluted. The present project, therefore, is orchestrated with components like LDR module, DC Motor, Photovoltaic array etc. according to which while the functioning of, unlike other use of the conventional energies, would not emit any pollution and in turn act as a reservoir of energy taken from the Sun itself. As adumbrated no other energy is more abundant than solar energy as per as its availability and freeness are concerned, utilization of which, compounded with rest of the fact of its conversion into electrical energy. Though it is improbable still it is not impossible as per as tracking of the mother energy is concerned in furtherance to which attempt has been taken through this project to confine every drop of energy from being left out. The DC Motor adjacent with the system with the help of LDR module by measuring the intensity of the sun rays fixed on the upper edge of the solar panel will help the solar panel to revolve around proportionately with the movement of the Sun itself in order to grab and store the maximum amount of energy as it can. In pursuance of such objectivity, this project comes forth into existence.

## II. DESIGN

### Circuit Diagram

The circuit diagram for the Arduino Based Solar Tracker Using LDR & Gear Motor is given below. Assemble the circuit as shown below

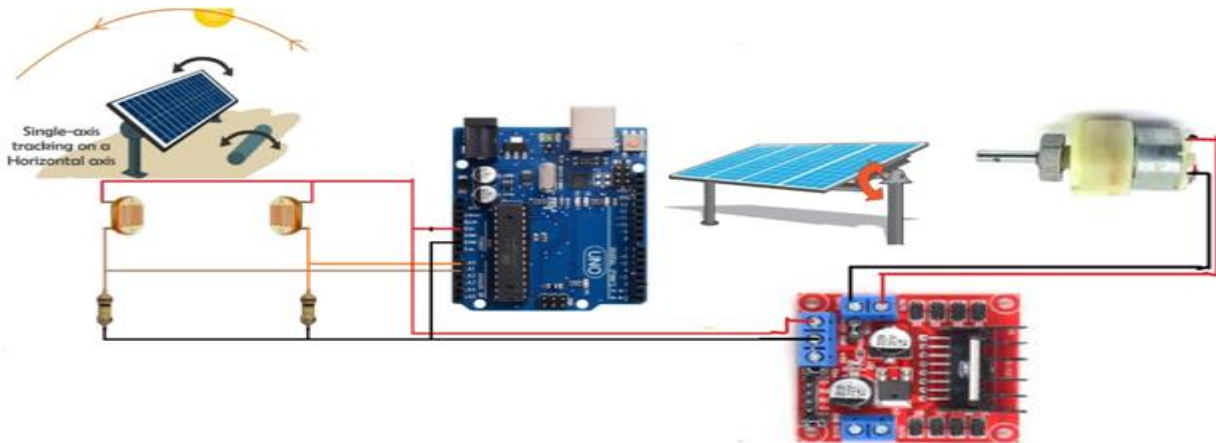


Fig.1.1 circuit diagram

The Solar Panel Tracker is designed to follow the sun movement so that maximum light intensity hits on the solar panel, thus increasing the power efficiency. We have designed a single-axis solar tracking system. In this system, the whole solar panel moves from east to west in a day to point in the direction of the sun. The use of a solar tracker circuit in the field of energy production will increase its efficiency. This system can also be successfully implemented in other solar energy-based projects like water heaters and steam turbines.

**Working of the Project:**

Two LDR's (Light Dependent Resistor) LDR1 & LDR2 are connected to Analog pins of the Arduino. A solar plate is attached in parallel to the axis of the servo motor and both the sensors are kept on the solar plate as shown in the figure above.

The design & the arrangement is done in such a manner that the movement of the sun is from LDR1 to LDR2, as shown in the image below.

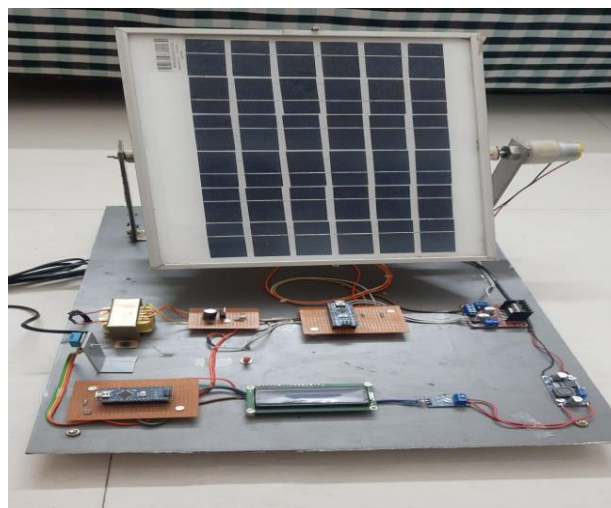


Fig.1.2 Working diagram

There are three cases that are to be followed:-

**Case 1: Sun is in the left side**

Light on LDR1 is high because the shadow of barrier falls on LDR2 so solar plate moves clockwise.

**Case 2: Sun is in right Side**

Light on LDR2 is high because the shadow of barrier falls on LDR1 so solar plate movie anticlockwise.

**Case 3: Sun is in the Center**

Light on both LDR's is equal so, plate will not rotate in any direction. The principle of the solar tracking system is done by Light Dependant Resistor (LDR). Four LDR's are connected to Arduino analog pin AO to A4 that acts as the input for the system. The built-in Analog-to-Digital Converter will convert the analog value of LDR and convert it into digital. The inputs are from analog value of LDR, Arduino as the controller and the DC motor will be the output. LDR1 and LDR2, LDR3 and LDR4 are taken as pair. If one of the LDR in a pair gets more light intensity than the other, a difference will occur on node voltages sent to the respective Arduino channel to take necessary action. The DC motor will move the solar panel to the position of the high intensity LDR that was in the programming

### III. SYSTEM CIRCUIT DIAGRAM

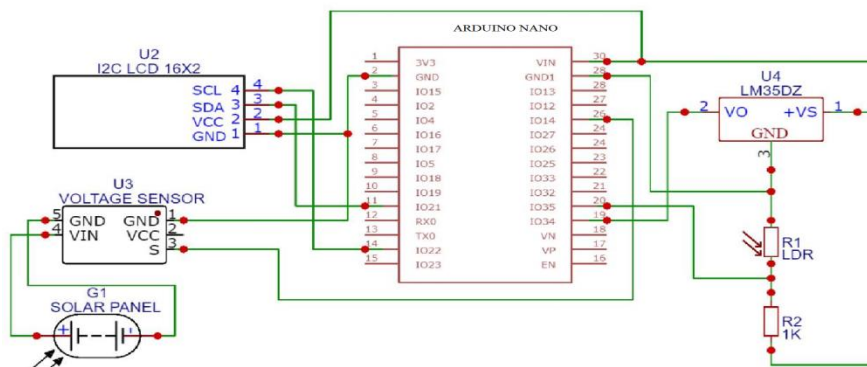


Fig.3.1 Circuit Diagram

### IV. MAJOR SOFTWARE REQUIRED

#### I. Arduino Software (IDE) :

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. For latest software refer to link. <https://www.arduino.cc/en/Main/Software>

#### II. How to use Arduino IDE Tool

##### Steps for using Arduino IDE:

##### Step 1: Get an Arduino board and USB cable:

In this tutorial, we assume you're using an Arduino Uno You also need a standard USB cable (A plug to B plug): the kind you would connect to a USB printer, for example.

##### Step 2 : Download the Arduino environment:

(<https://www.arduino.cc/en/Main/Software>) Get the latest version from the download page. When the download finishes, unzip the downloaded file. Make sure to preserve the folder structure. Double-click the folder to open it. There should be a few files and sub-folders inside.

##### Step 3 : Connect the board:

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either the USB connection to the computer or an external power supply.

If you're using an Arduino Diecimila, you'll need to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it's on the two pins closest to the USB port. Connect the Arduino board to your computer using the USB cable. The green power LED (labelled PWR) should go on.

##### Step 4 : Install the drivers:

Installing drivers for the Arduino Uno or Arduino Mega 2560 with Windows7, Vista, or XP

**Step 5: Launch the Arduino application:**

Double-click the Arduino application. (Note: if the Arduino software loads in the wrong language, you can change it in the preferences dialog. See the environment page for details.

**Step 6: Open the blink example**

Open the LED blink example sketch: File > Open > Temp\_and\_humid.ino

**Step 7: Select your board:**

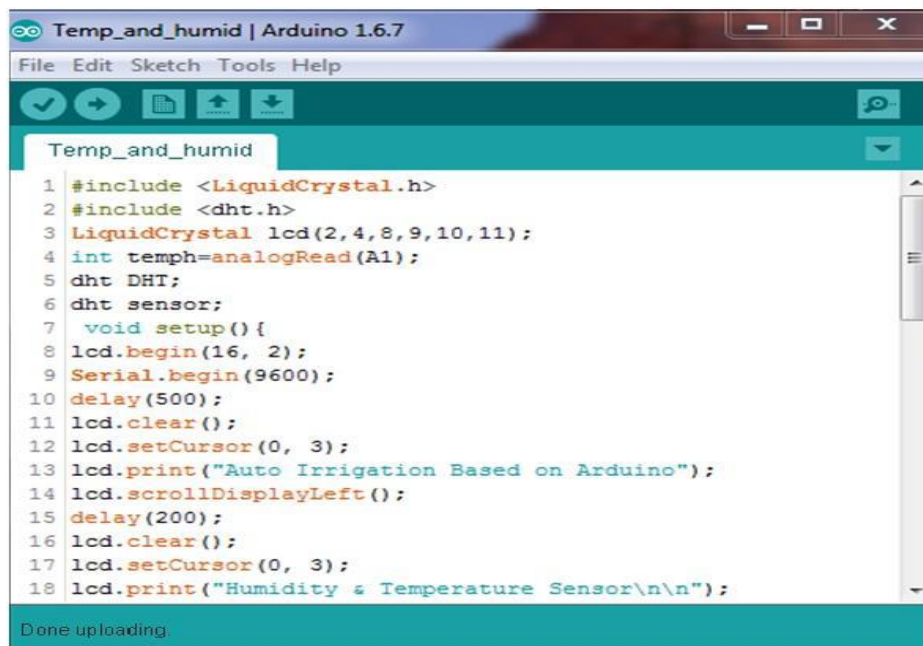
You'll need to select the entry in the Tools > Board menu that corresponds to your Arduino.

**Step 8: Select your serial port :**

Select the serial device of the Arduino board from the Tools | Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu; the entry that disappears should be the Arduino board. Reconnect the board and select that serial port.

**Step 9 : Upload the program:**

Now, simply click the "Upload" button in the environment. Wait a few seconds - you should see the RX and TX leds on the board flashing. If the upload is successful, the message "Done uploading." will appear in the status bar.



```
Temp_and_humid
1 #include <LiquidCrystal.h>
2 #include <dht.h>
3 LiquidCrystal lcd(2, 4, 8, 9, 10, 11);
4 int tempH=analogRead(A1);
5 dht DHT;
6 dht sensor;
7 void setup() {
8   lcd.begin(16, 2);
9   Serial.begin(9600);
10  delay(500);
11  lcd.clear();
12  lcd.setCursor(0, 3);
13  lcd.print("Auto Irrigation Based on Arduino");
14  lcd.scrollDisplayLeft();
15  delay(200);
16  lcd.clear();
17  lcd.setCursor(0, 3);
18  lcd.print("Humidity & Temperature Sensor\n\n");
```

Done uploading.

**V. RESULT**

Solar trackers are instruments which will be used to increase the amount of solar energy collected via PV systems via constant tracking of the position of the sun across the sky throughout the day. These methods are aesthetically attractive, environmentally friendly and are progressively becoming cost-efficient with the growth of the computer systems as well as control systems technologies. The integrated features bring these techniques appropriate as green and enormous scale domestic and industrial power generation processes. In this article, different types of STS are summarized on their designs, thermal and electrical performances as well as the factors influencing the heat loss during operation. Based on ideas of energy collection and the sun tracking techniques, ST can be divided into two categories viz. active types and passive types. These two major types of STS can, in turn, be divided into many other different categories based on a number of parameters such as the number of axes, the tracking directions and methods among others. Inactive STS, single/double-tracking modes are used. Each of these systems presents their own advantages; the double-axis STS provide better power stratifications while single axis processes are cheaper and less complex the comparison between the energy returns of both tracking methods (single and double) with the fixed traditional PV



systems open that the sun tracking system's energy return is always higher than that of the traditional fixed PV panels. Although the double-axis tracking systems give better energy return when compared to other types of systems; the literature indicates that they suffer from high energy losses during their operation due to auxiliary units and moving joints. Serious problems occur when any of the sensors is shaded up since this phenomenon can cause an asymmetrical control signal leading to the malfunction of the entire system.

Fig No. 5.1 Result Table

TIME	TEMPERATURE	LIGHT INTENSITY	VOLTAGE
09.00 AM	36.1	148	18.2
09.30 AM	37.2	155	18.8
10.00 AM	37.8	158	19.1
12.30 PM	41.1	199	19.2
02.00 PM	43.1	205	19.3
03.00 PM	44.4	240	19.6
04.00 PM	38	175	18.8
05.00 PM	36.1	170	18.2
06.00 PM	28	155	17.5

Based on Summer Condition weather analysis we tested our solar whole day in summer weather condition and founded out output and results obtained by taking readings on the monitor system is mounted on model with help on Arduino software we have programmed our requirement in such as Temperature output, Lightening Intensity, Voltage obtained according to tracking Condition.

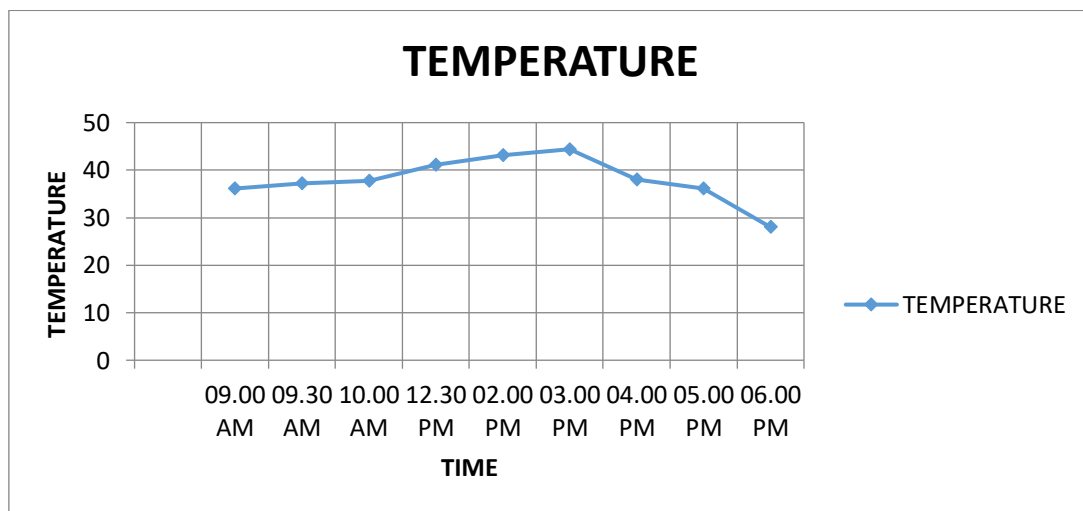


Fig 5.2 Temperature Graph of Solar Tracking system

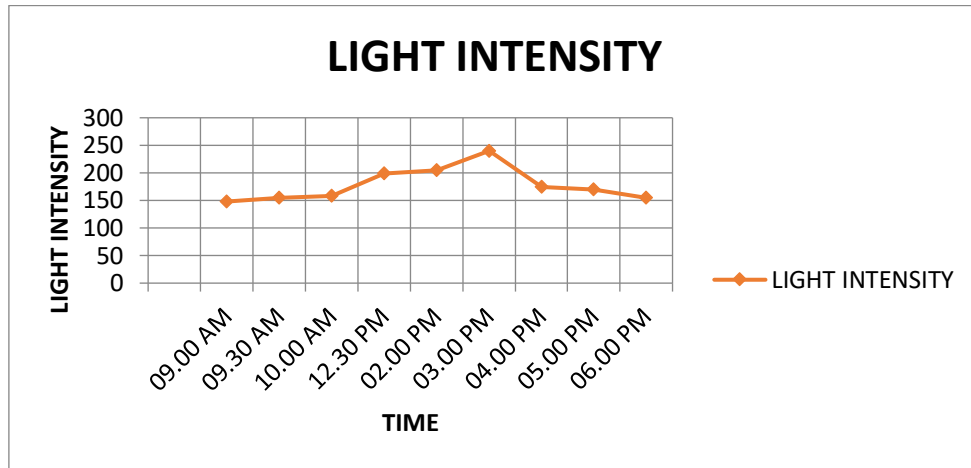


Fig 5.2 Intensity Graph of Solar Tracking system

## VI. CONCLUSION AND FUTURE WORK

Implementing Renewable Energy technologies is one recommended way of reducing the environmental impact. Because of frequent power cut it is important to use renewable energy and monitoring it. Monitoring guides the user in analysis of renewable energy usage.

This system is cost effective. The system efficiency is about 95%. This enables the efficient use of renewable energy. The temperature sensor helps to analysis the storage of the solar energy. Thus it is reducing the electricity issues. This project can be further enhanced, by using the results of this current project, i.e. the monitored values obtained are helpful in predicting the future values of the parameters considered. Prediction of the amount of solar energy will be stored in the battery. The data stored in cloud can also be analyzed using the Mat Lab. The CSV file from the cloud is taken for analysis in R. The web application can be developed for interaction with the end user; the user can also predict values of the future events. In the same way we can go for android application also. During the prediction two or more models can be used for same dataset, to find the accuracy of each model.

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