Intelligent Solar Tracker Using LDR with a Temperature Alert System

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***Abstract*- Solar power is one of the most important renewable energy resource because it is sustainable and reliable. It has some drawbacks that need to be worked upon, the major one is variation of temperature and illumination that affects the output of solar panel. This project uses solar tracker along with the temperature alert system. Solar tracking system helps panel to produce optimum power for more time by proper orientation and Temperature alert system allows the panel to work under favorable temperature conditions. In order to accomplish this, a microcontroller is suitably programmed to compare the illumination of LDRs and rotate the panel in the direction of sun by stepper motor.**

***Index terms*- arduino uno; LDR; solar tracking system; thinkspeak for IOT; Gmail alert system; LM35**

I.INTRODUCTION

The Sun is the major source of life on earth. The core of the sun consists of immense amount energy. Energy required by us per year is equivalent to energy created by sun per hour or even less. If we are able to harvest even a fraction of energy received by sun, we could solve the major problem of any country. Harvesting optimum energy to store more energy is the major goal of all the country. People are now more inclined towards renewable energy for domestic as well as industrial purpose, more number of people are now install solar panels, heaters and coolers at home. The major barrier in harvesting solar power is irregular illumination and temperature. In order to increase its efficiency a tracking system can be used to align the panel towards sun, this results in approximately 30% increase in energy produced by panel.

This paper describes a project including purpose of this project and specifications of components used in it. It consists of detailed description of all sensors used. The feasibility utility and reliability of the project is discussed.

II. PROJECT DISCRIPTION

A. Solar Tracking system

This project aims at increasing solar panel efficiency by using a tracking system using LDR (light dependent resistor). By placing two LDRs on the two opposite edges of panel and then comparing the intensity of light on both the LDRs, we designed the panel such that it rotate in the direct of the LDR with greater value of illumination. In order to accomplish this we used Arduino UNO and performed coding for it. We were also able to record the value of intensity on each LDR.

B. Gmail Alert system

Solar panels works at maximum efficiency at 25°C temperature, but the atmospheric temperature varies for a wide range. This project used temperature sensor LM35 to measure the atmospheric temperature. We also plotted the temperature variation with time using Thinkspeak.com and created a Gmail alert system. Node MCU is used to store the data of LM35 on cloud. This is a part of IOT, which helps in preparing statistic. The Gmail alert system provides g-mail notification whenever temperature sensed by LM35 is greater than 25°C. Twitter can also be chosen for creating this alert system. If the temperature is greater than 25°C, manually shade can be provided to reduce temperature or water cooling can be used.

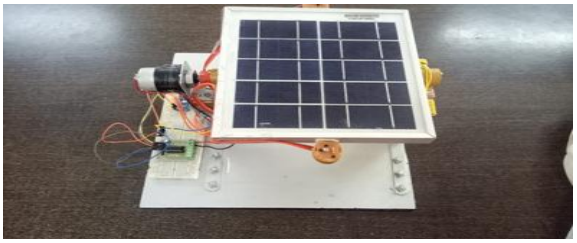


Figure 1. Intelligent Solar Tracker

III. HARDWARE

A.Solar Panel

Solar panel consists of solar cells also called photovoltaic cell. This works on the principal of photovoltaic effect. It converts the light energy falling on it into electricity and heat. Here 5watt, 5volt and 0.8 amp, good efficiency multi-crystalline PV module is used.

B.Arduino

Here Arduino Uno is used which is an open-source microcontroller board based on the Microchip ATmega328P microcontroller. It is basically powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. The board consists of the sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The Arduinoboard consists of 14 digital I/O pins, 6 capable of PWM output, 6 analog I/O pins. It can be programmed with the Arduino Integrated Development Environment, via a type B USB cable. Some other microcontroller can also be used i.e. Arduino Nano and Leonardo. Arduino is generally used to communicate with a computer, or another Arduino board or other microcontrollers. However, the Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The two RX and TX LEDs on the Arduino board are available which will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer. A Software Serial library is there to allow serial communication on any of the Uno's digital pins.

C. LDR

This Project uses two Light Dependent Resistors (also known as a photo resistor or LDR) is a device whose resistivity is a function of the incident electromagnetic radiation and is inversely proportional to intensity of light therefore, they are light-sensitive devices, photoconductors, photoconductive cells or simply photocells. LDR is made up of high resistance semiconductor materials. The code in arduino is done such that it compares the values of two LDRs and rotate panel through stepper motor in the direction of LDR of greater value.

TIME(24 hr)	LDR1(east)	LDR2(west)
8	410	407
9	415	413
10	428	426
11	458	457
12	508	508
13	498	501
14	476	478
15	451	453
16	430	432

Table 1. Reading of LDR

D. LM35

In order to sense the temperature the LM35 is used, this is an integrated circuit sensor that can be used to measure temperature with an electrical output which is proportional to the temperature (in °C). It requires only 60micro amps and possess low self-heating. Any external calibration or trimming is not required and maintains an accuracy of +/-0.4°C at room temperature and +/-0.8°C over a range of 0°C to +100°C.This is more accurate than a using a thermistor. Since its sensor circuitry is sealed therefore not affected by oxidation. The LM35 generally generates a higher output voltage therefore output voltage does not need to be amplified. The LM35 produces an output voltage that is directly proportional to the Celsius temperature with the scale factor is .01V/°C. In this project LM35 senses temperatures, this is connected to the arduino. Thinkspeak.com is used to plot a temperature v/s time plot and provides a notification on g-mail if temperature exceeds 25°C.

E. Stepper motor and motor driver

This project uses 100rpm stepper motor with I293d dual bridge driver. Here there is a need of mechanical power for step by step rotation of panel and stepper motor is an electromechanical device it converts electrical power into mechanical power. Stepper motor is a synchronous electric motor that can divide a full rotation into a number of steps. It is brushless and has stator has 8 poles, and the rotor has 6 poles. The stepper motor works on the principal of operation for magnets to make the motor shaft turn a precise distance on electricity pulse supply. The 24 rotor steps to make one complete revolution require 24 pulses of electricity, orone electricity pulse to motor, moves the rotor by 15°.

L293D is a 16-pin IC to control a set of two motors simultaneously in any direction is a typical Motor

driver or Motor Driver IC which allows DC motor to drive on either direction. It means thata single L293D IC can control two motor. Dual H-bridge Motor Driver integrated circuit (IC) is used in this project. It costs around 70 Rupees (INR).

F. Node MCU

Node MCU is an open source LUA based firmware which is a combination of microcontroller and Wi-Fi module, developed for ESP8266 Wi-Fi chip. Node MCU firmware includes ESP8266 Development board/kit i.e. Node MCU Development board, by exploring functionality with ESP8266 chip. Here it is required for compiling the LM35 reading on think speak. Node MCU consist of ESP8266 Wi-Fi enabled chip. The ESP8266 is a low-cost Wi-Fi chip used for uploading data on cloud developed by Espressif Systems with TCP/IP protocol. It costs around 450 Rupees (INR).

IV. BLOCK DIAGRAMS

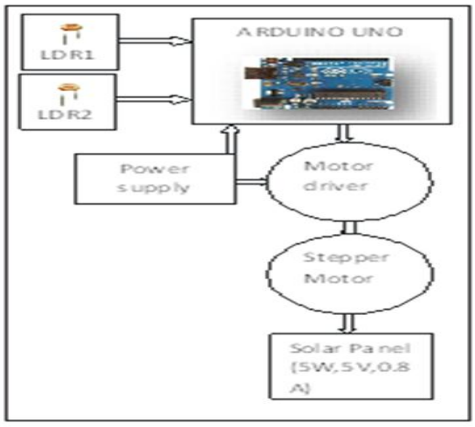


Figure 2. Block Diagram of solar tracking system

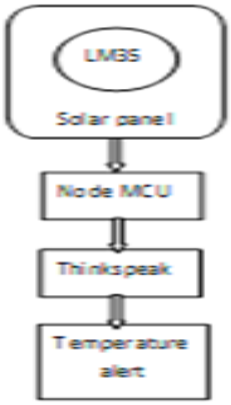


Figure 3Block diagram of temperature alert system

V. OBSERVATIONS

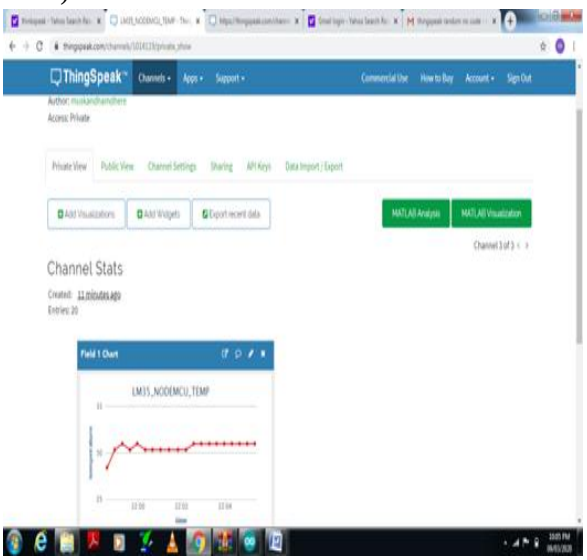
Time(24 hours)	Power(watts)	Voltage(volts)	Current(ampere)
9	0.616	5.6	0.11
10	1.602	8.9	0.18
11	2	10	0.2
12	3.375	12.5	0.27
13	4.416	13.8	0.32
14	4.05	13.5	0.3
15	2.86	11	0.26
16	1.28	8	0.16

Table 2. Reading of solar panel withou tracking

Time(24 hours)	Power(watts)	Voltage(volts)	Current(ampere)
9	2.76	12	0.23
10	3.375	13.5	0.25
11	3.92	14	0.28
12	4.23	14.1	0.3
13	4.65	15	0.31
14	3.64	14	0.26
15	3.25	13	0.25
16	2	10	0.2

Table3. Reading of solar panel with tracking

Observations are taken by placing the designed system in open area. The following tables (table 2 and 3) show the output power, voltage and current of the panel under normal and tracking condition respectively. The diagram (Fig.) below is a screenshot of thinkspeak plot of temperature sensor LM35 which is placed over panel. It gives notification on Gmail as the temperature is above 30°C(this is a sample prototype therefore 30°C is taken as threshold value otherwise 25°C should be taken).



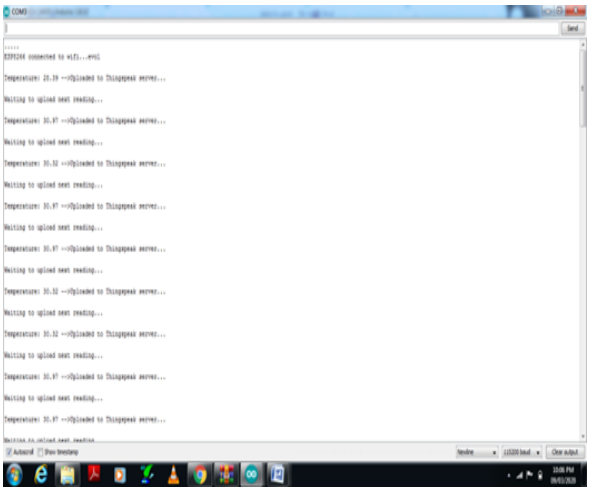


Fig. 2. ThingSpeak plot for temperature sensor LM35

VI. CONCLUSION AND FUTURE SCOPE

This is a small scale prototype project aims at improving solar panel efficiency by tracking location of sun and creating a little automated design to control variation of parameters. This can be implemented on a large scale with more sensors like raindrop sensors, humidity sensors etc. Further customized action plans can be feed into microcontroller for different conditions. In this in way, in a broader vision this can implemented to reduce human efforts and increase output energy and efficiency.

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