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Implementation of Dual-Axis Solar Tracking System with Remote Monitoring

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Abstract: *Solar energy is one of the renewable energy resources, which satisfies the energy demand in our country. So utilizing this energy in an efficient way can help in meeting this demand in our country. This paper describes a dual axis solar tracking system, which helps in obtaining the maximum intensity of the solar energy, by making the solar panel perpendicular to the rays of the sunlight. This perpendicular position is made through the servo motor. Proper arrangement of LDRs further increases the efficiency, by tracking the sun completely. Feedback facility provided to the users allows them to monitor the system from anywhere.*
Keywords: *solar energy, dual axis tracking system, solar panel, LDR, servo motor*

I. INTRODUCTION

As we know sun is a one of the most important resource in this world Humans nowadays feel uncomforted about the global warming situation This kind of situation bring a lot of issues, that they should have to think it through the positive way. The best way to reduce this global warming is to reduce the electrical voltage utilization and change to voltage source like wind, rain, tides, sunlight and geothermal heats. So the engineers try to create a new device that can convert the thermal energy to an electrical energy like solar panel for sunlight energy wind turbines for wind energy water turbines.

The large magnitude of solar energy available makes it a highly appealing source of electricity. The problem that still exists is the device that has been invested by an engineer. For example, the solar panel that many of the users use is rotated in only one direction. If the sun located at the direction that is not perpendicular to the solar panel, the power that will be generated is low compared to the when the sun located exactly perpendicular to the solar panel. Since the sun rotates from east to west, the highest power can be generated by the solar panel is when the solar panel is located perpendicular to the sun. So the power that can be use in the night day is quite short.

There are many problems that can occur in the previous type of solar tracking system. The problem that we can see here is the solar panel that is used here is only in one way direction. Because of this problem, the power generated here is low.

The second problem is the price for the solar tracking system is very expensive for the people use more power than usual because they are in need to install more than one panel to produce enough power. So, objective of this project is to fix this problem that occurs here. This solar tracking system can detect a 180 degree of rotation. So, here this solar panel that generates power are very high compared to when the solar panel can only stay in one direction.

So, the people don't have to install more than one solar panel to generate enough power. One solar panel is enough to produce a lot of power. Solar tracking system project had been widely employed by the other giant company like BP Solar, Yingli Green Energy, Kyocera, Q-Cells, Sanyo, Sharp Solar, Solar World, Sun Power, and Suntech. Now, many people use solar energy as an alternative power because it's free and renewable. Nowadays the payment charge for an electricity had been increasing rapidly because the increasing of gas price. Many researchers are trying to find an alternative energy to replace the gas.

One of the alternative energy resource that we can use is photovoltaic energy. In solar photovoltaic's, solar light is actually converted into electricity. Photovoltaic, now the biggest use of solar power around the world, is explained below: Sunlight is made up of photons, which are the small particles of energy. These photons gets absorbed by and are passed through the material of a solar cell or solar PV panel. The photons 'agitate' the electrons that are found in the material of the PV cell.

As they start to move, these are 'directed' into a current. Technically, this is electricity - the movement of electrons along a path. Solar panels are made of silicon which convert sunlight into electricity. Solar energy are used in a number of ways, primarily to power homes that are inter-tied or interconnected with the grid.

II. METHODOLOGY

This project is mainly focused to design and build the prototype of solar tracking system that will be the basic structure to build the realistic solar tracking system. Therefore, this prototype will cover the scope as followed.

Solar panel moves 30° at one step and total movement that this system can do is 180° which is done,

- Using micro-controller
- Using servo motor (pin 9).
- Using Light Dependant Resistor (LDR) or Photo-resistor as a sensor.
- Using sensors (photo resistor) to detect and compare the solar intensity of light.

Fig.1 shows the block diagram of the dual axis solar tracking system

A. Arduino Uno

The microcontroller unit used in this project is Arduino uno which is a platform for prototyping interactive objects using electronics. It has of both hardware and software. Arduino is based on the Atmel AVR CPUs and being deployed in many of the projects, ranging from sensors networks to robotic submarines.

Fig.2 shows the Arduino Uno and its pin configuration. It has 14 digital input/output pins,six analog inputs, a sixteen MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything that is needed to support the microcontroller; simply connecting to a computer with a USB cable battery to get start.

The voltage across R1 is the output voltage and this is the analog input to the microcontroller unit (MCU) Arduino. For different light intensity the output voltage will be different.

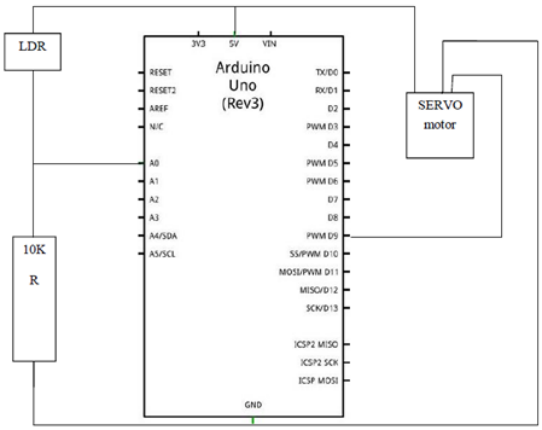

Fig.1 Block Diagram of dual axis tracking system

Lighting control system is one most important part in departmental store. Here photoresistor is used to determine the light intensity and PIR sensor is used detect human body. It shows the light controlling circuit. Here one part of the LDR is connected to the 5v and another point is connected to the resistor R1 in series

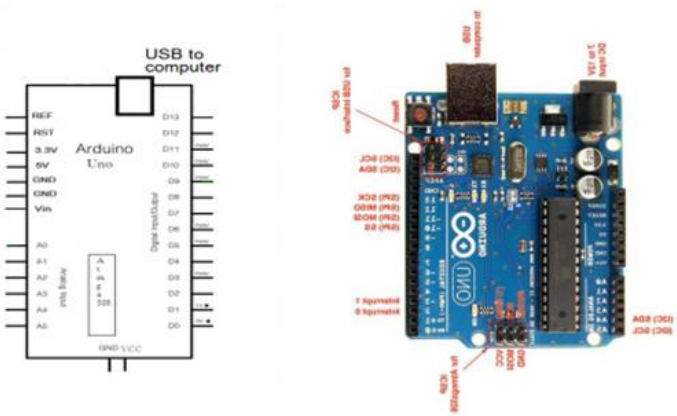

Fig.2 Arduino Uno and its pin configuration.

If light intensity rises then voltage across LDR will decrease and voltage across R1 will rise. Also if light intensity decreases then voltage across R1 will decrease. For different output voltage the MCU will switch on and switch off the switches of light to control the light intensity in a specific area.

In lighting control system we have two different conditions for light intensity per square meter which are given below:

- If Light intensity>1000 then it will be consider as high light intensity.
- If Light intensity<1000 then it will be consider as low light intensity.

B. Microcontroller

The Arduino Uno is a microcontroller board which is based on the ATmega328. It contains everything which is needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Arduino Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

- Features of Microcontroller ATmega328
- Operating Voltage 5V
- 14 digital input/output pins
- 6 analog inputs
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6 DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA

C. Light Dependent Resistor (Ldr)

The LDR, which is also called as "Photoresistor" or "photo conductor" is an electronic component whose resistance decreases with increase in light intensity. Fig.3 shows Light Dependent Resistor (LDR). The light dependant resistor uses high resistance semiconductor material. When the light falls on the LDR the bound electrons [ie., Valence electrons] get the light energy from the incident photons. Because of this additional energy, these electrons become free and jump in to the conduction band, generating electron –hole pairs. Fig.4 shows Generation Of Charge Carriers Due To Light. Due to these charge carriers, the conductivity of the device increases, decreasing its resistivity.

Fig.3 Light Dependent Resistor (LDR)

As light falls on the LDR, the light photons are absorbed by the semiconductor lattice and their energy is transferred to the electrons. This process gives some of them sufficient energy to break free from the crystal lattice so that they can conduct.

This results in a lowering of the resistance of the semiconductor and hence the overall LDR resistance decreases. This process is progressive, and as more light shines on the LDR semiconductor, so more no. of electrons are released to conduct electrical energy and the resistance falls further. Fig.5 shows Resistance V/S Light Intensity.

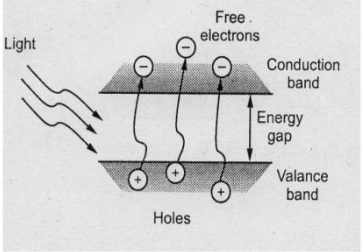

Fig.4 Generation Of Charge Carriers Due To Light

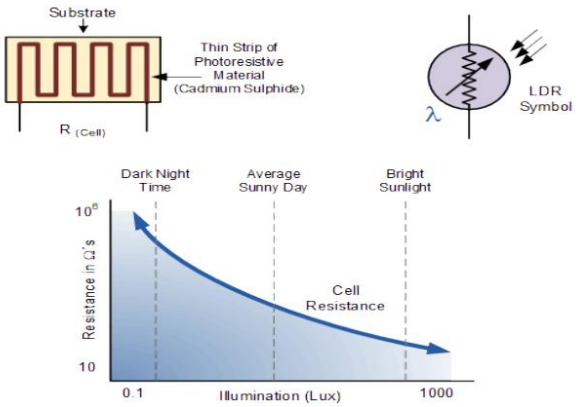

Fig.5 Resistance V/S Light Intensity

D. Servo Motor

Servos are basically Dc motors with position feedback. It means you can tell the micro-controller through your code to move the servo to the desired position. In Arduino Uno, a standard servo can be moved from 0 to 180 degree and 90 is the servo centre. Fig.6 shows tower pro SG90 micro servo motor used in this system.

Fig.6 Tower Pro SG90 Micro Servo

Features:

- Compliant with most standard receiver connector: Futaba, Hitec, Sanwa, GWS etc
- Great for truck, boat, racing car and airplane
- 18 Power Supply: Through External Adapter
- Stable & Shock Proof Servo Arms and Screws Include
- Specifications Size: 23 X 12.2mm X 29mm
- Weight: 9g
- Operating Speed: 0.3sec/60degree (4.8V)
- Temperature Rang: 10us
- Operating Voltage: 4.2V~6.0V
- Package Contents Towerpro SG90 9g Micro Servo

Brown or black wire will be connected to ground of the micro-controller. Red wire will be connected to Vcc(4.8V to 6V). Yellow or white wire will be connected to the output of the micro-controller and is called signal wire.

III. RESULT

Fig.7 shows the readings on the LDR. From the serial monitor we can able to observe LOW Lightning for the value below the threshold and HIGH Lightning for the value above the threshold.

The servo motor rotates for the value below the threshold and servo motor stops for the value above the threshold. This threshold value is based upon the maximum and minimum temperature of a particular place

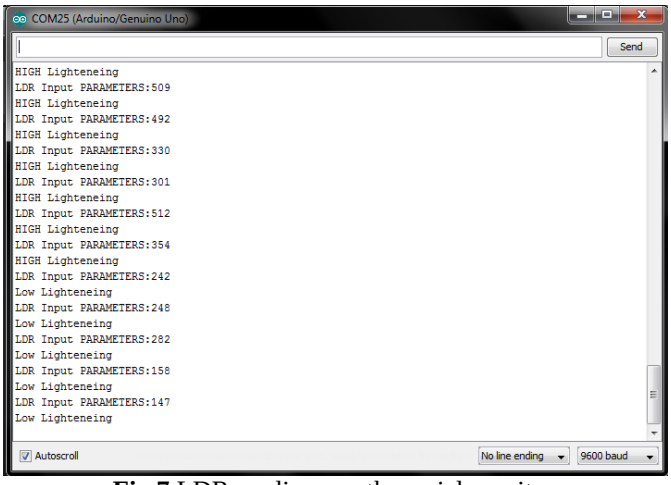

Fig.7 LDR readings on the serial monitor

IV. CONCLUSION

Dual axis solar tracking is successfully implemented. LDRs are arranged accordingly so that it can able to sense the maximum intensity of the solar light and make the solar panel to stop in the position perpendicular to the sunlight, through the servo motor. Thus the overall system efficiency can be increased.

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