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AUTOMATIC SUN TRACKING SOLAR PANEL

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***Abstract*:**

Energy crisis is the most important issue in today's world. Conventional energy resources are not only limited but also the prime culprit for environmental pollution. Renewable energy resources are getting priorities in the whole world to lessen the dependency on conventional resources.

Solar energy is rapidly gaining the focus as in important means of expanding renewable energy uses. The energy extracted from solar photovoltaic (PV) or solar thermal depends on solar insulation. A microcontroller is based designed based design technology of an automatic solar tracker is presented in this work. Sun trackers move the solar collector to follow the sun trajectories and keep the orientation of the solar collector at an optimal tilt angle.

This method is increasing power collection efficiency by developing a device that tracks the sun to keep the panel at a right angle to its rays.

Keywords: **Solar Panel, Stepper Motor ,Actuator , LDR (Light Dependent Resistor), Microcontroller , Display Unit (Optional), Battery.**

Introduction:

Nowadays, climate change on globe is at a critical level. Global warming or climate changes can be seen through some of them natural phenomenon like the Renewable-energy is an energy which comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished). Solar energy is rapidly advancing as an important means of renewable energy resource in many applications like thermal energy storage systems and electric power generation systems from the sun through the form of solar radiation. The sun is the most

There is no price and also no air pollution created by solar energy, environmentally friendly and the solar energies are interminable supplies.

By using solar arrays, a series of solar cells electrically connected, a DC voltage is generated which can be physically used on a load. Solar arrays or panels are being used increasingly as efficiencies reach higher levels, and are especially popular in remote areas where placement of electricity lines is not economically viable Usually, the single-axis tracker follows the sun's east-west movement while two-axis tracker also follows the sun's altitude angle.,

As the day progresses to midday, the angle of incidence approaches 0°, causing a steady increase in power until at the point where the light incident on the panel is completely perpendicular, and maximum power is achieved.

From this background, we see the need to maintain the maximum power output from the panel by maintaining an angle of incidence as close to 0° as possible. By tilting the solar panel to continuously face the sun, this can be achieved. It was resolved that real-time tracking would be necessary to follow the sun effectively, so that no external data would be required in operation.

2.1 Photovoltaic cell:

The principle of operation of a PV cell

The most abundant and convenient source of renewable energy is solar energy, which can be harnessed by photovoltaic cells. Photovoltaic cells are the basic of the solar system. The word photovoltaic comes from "Photo" means light and "voltaic" means producing electricity. Therefore, the photovoltaic process is "producing electricity directly from sunlight". The output power of a photovoltaic cell depends on the amount of light projected on the cell. Time of the day, season, panel position and orientation are also the factors behind the output power. The current-voltage and power-voltage characteristics of a photovoltaic cell are shown in Fig. Photovoltaic cells are the smallest part of a solar panel. Solar panel gives maximum power output at the time when sun is directly aligned with the panel.

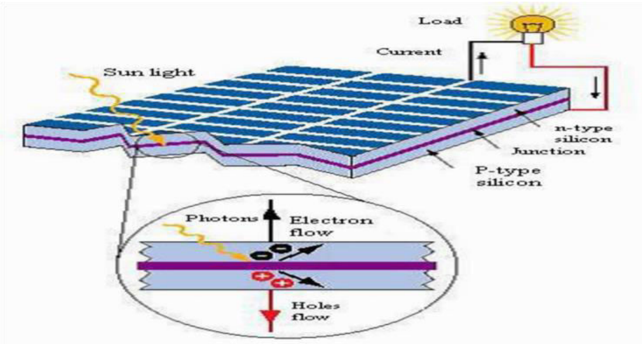

Fig: Photovoltaic cell

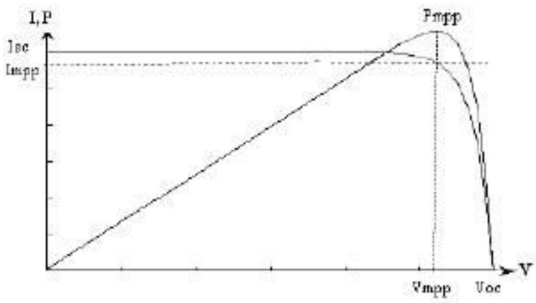

Fig: Curve of solar panel.

Solar Tracking system:

Solar tracking is a widely-applied proven technology that increases energy production by directing or concentrated the photovoltaic to track the sun on its path from dawn until dusk. Instantaneous solar radiation collected by the photovoltaic modules, assembled in a tracking system, is higher than the critical irradiance level for a longer number of hours than in fixed systems.

There are numerous

approximate trajectory relative to the Sun's position. It has been estimated that the yield from solar panels can be increased by 30 - 60 % by utilizing a tracking system instead of a stationary array. Up to 40% extra power can be produced per annum using a variable elevation solar tracker.

From the overall system, the main controller received an analogue input from the Light Dependent Resistor (LDR) and converts it into digital signal by Analogue-to Digital converter. The output given to the servo motor will determine the movement of the solar panel.

Fig 2.3: various types of solar tracker

Two axis solar tracking:

On a long-term basis, the most solar energy can be obtained from a given area of solar modules by having the modules mounted in a 2axis tracking system. In such a tracking system, the modules are positioned such that the angle of incidence of incoming beam radiation with the solar module is 900 . Some systems use active tracking methods, in which the motors and/or hydraulic devices are used to position the modules, while others use passive methods, in which normally unused energy, such as heating of a fluid, is used to provide module alignment with the sun Combinations of the various sub-systems are utilized in some tracking systems. Because up to 90% of the solar radiation is beam radiation sunny day, 2-axis tracking can provide a substantial gain in the solar energy harvested.

Schematic arrangement:

Two-axis tracking system accommodates both degrees of freedom: azimuth and altitude. Schematic block diagram of the proposed automatic solar tracker is shown in the Fig: 2.4. Four LDRs sensors module are used and circuits are implemented in both degrees of freedom.

If one of the LDR gets more light intensity than other, the microcontroller will receive a signal. And the microcontroller analyses this data and generates a signal to actuate the motor, to move the sensor module to a position where equal light is being illuminated on pair of LDRs.

The signal generated by the microcontroller causes to energize the driving circuit, for the movement of server motor.

Fig: Schematic block diagram

Sensing elements and signal processing:

Ten LDRs have been used for tracking the azimuth and altitude angle. If light falling on the device is of high frequency, photons absorbed by the semiconductor gives enough energy to bound electrons to jump into the conduction band. The resulting free electron conducts electricity, thereby lowering the resistance.

In this work Ten LDRs are enough for providing the complete view of the sky and two-axis tracking. Each

LDR is placed in series with a resistor of 100kΩ and Wheatstone bridge circuit is formed using all ten LDRs and ten resistors. A voltage divider circuit is formed at the respective node between LDR and a series resistor of 100kΩ.

The LDR that detect the high intensity of light will send a signal to the microcontroller and the microcontroller will generate a signal that will cause the motor to rotate depending on the shadow of the LDR.

Functionality and mechanism of the system:

The LDR sensor is a variable resistor that changes the resistance according to the intensity of incident ray illuminated onto it. As the intensity of sunlight changes, the resistance and the voltage of LDR Sensors change. The output voltage across the resistor is converted into digital signal at the input of the microcontroller. The smart tracker panel in our project was installed with four LDRs sensors.

When the sunlight falls onto the PV panel, the LDR sensors generate different voltages to move the PV panel. Sun position sensors and butted of race end status.

Hardware and software Method:

The main intention of this project is to design a high quality solar tracker. The project is divided into two parts: hardware and software.

Hardware:

The main components of hardware in this project are solar panel, Light Dependent Resistor (LDR), Servo Motor.

Light dependent resistor (LDR)

Photo resistor or light dependent resistor (LDR) showing in Fig 3.1 is a resistor in which the resistance decreases with increasing incident light intensity or exhibit photoconductivity. LDR output voltages for light intensity are shown in Table 3.1. The resistance of an LDR is extremely high, sometimes as high as 1 Ohms. The light resistances will drop dramatically when illuminated.

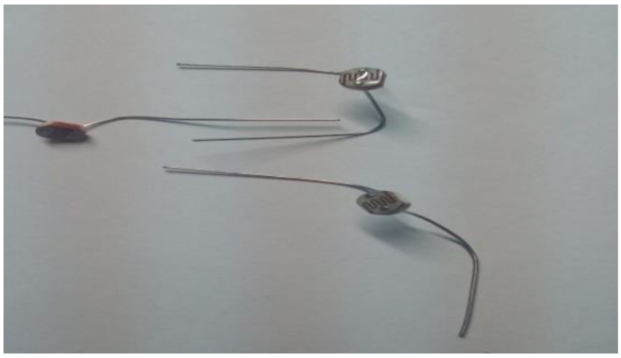

Fig. Light Dependent Resistor.

Light intensity	LDR output (v)
Dark	0.6
Average	4.0
Bright	4.6

Table 3.1: Light intensity measurement.

Solar panel:

Solar panels are devices that convert light into electricity. They are called "solar" panels because the

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most powerful source of light available is the sun.
solar panel packaged, connected assembly of photovoltaic cells.
The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications.

Fig: Solar Panel

Servo motor:
A servo motor is an electrical device which can push or rotate an object with great precision. It rotates an object at some specific angles or distance.
A servo motor just made up of simple motor which run through servo mechanism. It can reach a very high torque in a small and light weight packages. Due to these features they are being used in many applications like Robotics, machines, cars etc. A servo motor can usually only turn 900 in either direction in for a total of 1800 movement. Servo motors are rated in Kg/cm (kilogram per centimetre)

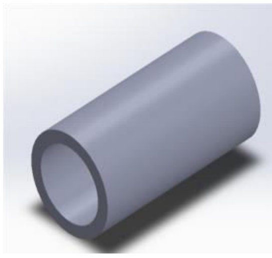
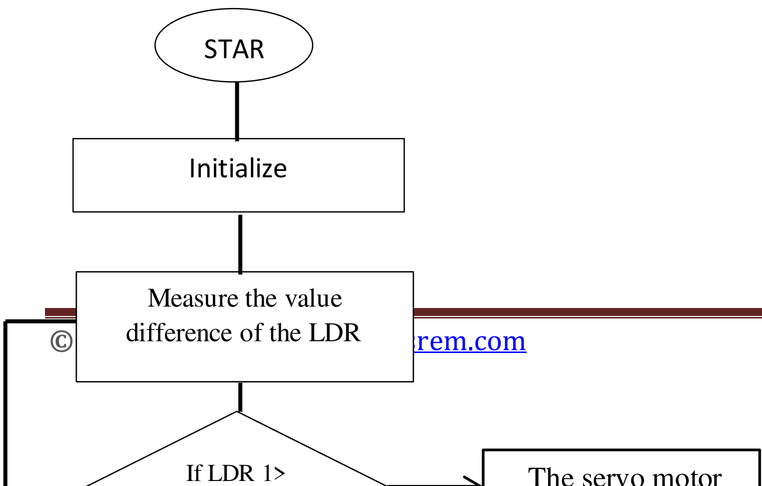


Fig: Servo Motor.

Software:
The software part consists of a programming language that is constructed using C programming.
Software procedure is shown in Fig.

Flowchart for the overall process:



Circuit Diagram:
The circuit design of solar tracker is simple but setting up the system must be done carefully. Four LDRs and four 100KΩ resistors are connected in a voltage divider fashion and the output is giving to 4 Analogue input pins. The PWM inputs of the two servo motors are given from digital pins 9 and 10. The circuit diagram of this project is shown in Fig.

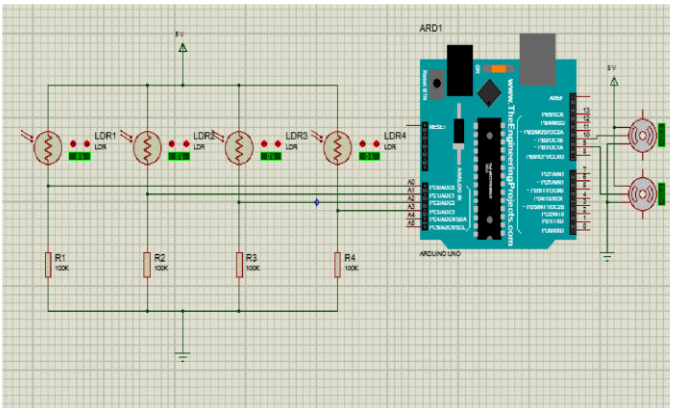


Fig: Circuit Diagram

Setup:

Step 1

- Take the placard and measure according to the design
- Cut the different part of the measured placard
- Cut four tubes which support the top and bottom plaque
- Sticks the different parts accordingly

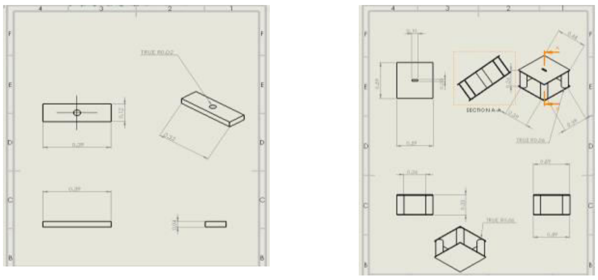


Fig: Tubes with top and bottom plaque base setup

Step 2

- Hole the plaque to fix the servo motors
- Now connect the servo motors to the perforated holes

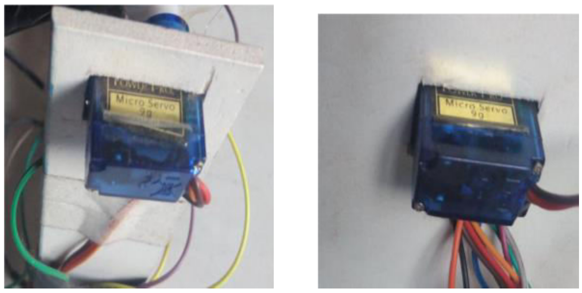


fig: Plaque hole and servo motors fixation

Step 3

• Stick the solar panel to the plaque

• Stick the four LDRs to the plaque Fixe the plaque to the motor

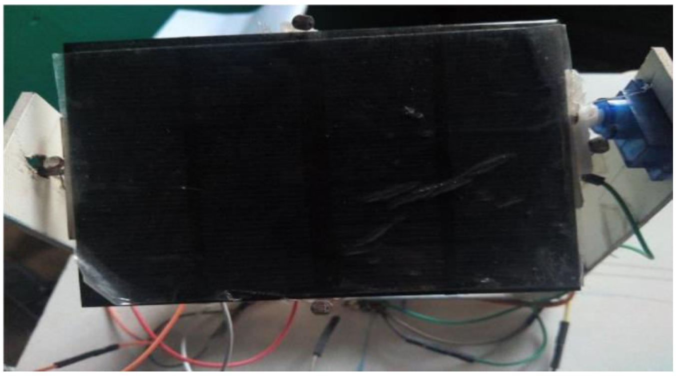


fig: LDRs and solar panel fixation

Step 4

- Connect the LDRs with the wires
- Connect the servo motors and the LDRs to the breadboard

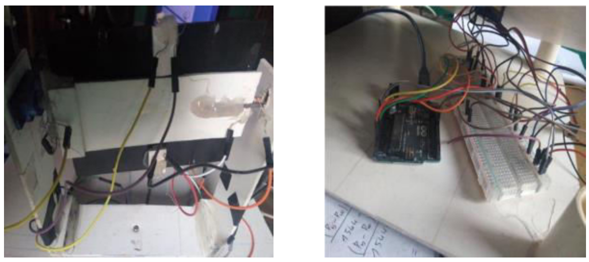


Fig: LDR and Servo Motor Connection

Solar tracker system descriptions:

1 Mechanical structures:
After the solar panels and other components were selected, the overall structural design of the solar tracker as seen in Fig 3.7. The compactness of the proposed solar tracker enables it to be mounted almost everywhere. It consists of the PV panel, the servo motors and and the vertical pillars with base plates support. The pillars holding panel are aligned to the sides of the panel for better flexibility during the panel rotation and the servo motors are mounted in such way the tracker system can rotates on a dual-axis freedom of rotation. The sensors are fixed at the sides of the panel to obtain the sun irradiance.

Electrical system:
The overall mechanical and electrical subsystems were integrated into the solar tracker system as shown in Fig 3.7. The block diagram of the solar tracker system consists of mostly electrical components. The solar tracker consists of the PV cells, and other subsystems such as the LDR sensors, servo motors and the microcontroller.
The LDR sensors sense the sunlight intensity and send the signal to the microcontroller to rotate the PV panel via the servo motor. The servo motor was controlled using the microcontroller.

The PWM wave is a continuous square wave signal that changes between 0 V and 6 V. The duration or width of the pulse determines the angle of the shaft's rotation. The microcontroller target board was used to control the servo motor. It receives the signals from the LDR sensors. The analogue voltage is converted into digital signal for processing.

Complete proposed automatic solar tracker:

Fig: complete propose d automatic solar tracker

Result and Discussion:
A solar tracker was proposed, designed and constructed. The final design was successful, in that it achieved an overall power collection efficiency increased to a fixed panel for the same panel on the tracking device. the solar energy capture is maximized by a 2-axis tracking system because the solar energy is greatest on cloud-free days when there is ample direct sunshine, and response of a solar module to a ray of light is proportional to the cosine of the angle between a line perpendicular to the module surface and a direct solar ray impinging on the surface. By extracting more power from the same solar panel, the cost per watt is decreased, thereby rendering solar power much more cost-effective than previously achieved using fixed solar panels. A single axis tracker offers a great power increase over a fixed solar panel, but a two-axis tracker would provide more power still. This could be a subject for further development. Solar tracking is by far the easiest method to increase overall efficiency of a solar power system for use by domestic or commercial users.

Conclusion:
In this project, the sun tracking system is developed based on microcontroller. It has been observed that the sun tracking systems can collect maximum energy than a fixed panel system and high efficiency is achieved through this tracker, it can be said that the proposed sun tracking system is a feasible method of maximizing the light energy received from sun.

This is an efficient tracking system for solar energy collection. The method implemented in this project is simple, easy to maintain and requires no technical attention for its operation.
The software developed for this work is easy to manipulate. The solar module with tracking system can collect maximum energy over a static module. Hence implementation of this technique in building solar systems will greatly improve utility satisfaction.

References:

1. Vinodkumar P. More and Vikas V. Kulkarni , ' Design and Implementation of Microcontroller Based Automatic Solar Radiation Tracker' , International Journal of Current Engineering and Technology ISSN 2277 – 4106 , (April 2014).

2. .Dipti Bawa, C.Y. Patil, "Fuzzy control based solar tracker using Arduino Uno", International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 12, (June 2013)

3. Zolkapli, M. 1; AI-Junid S. A. M.; Othman Z.; Manut, A.; Mohd Zulkifli M. A." High-Efficiency Dual-Axis Solar Tracking Developement using Arduino", International Conference on Technology, Informatics, Management, Engineering & Environment (TIME-E 2013) Bandung, Indonesia, (June 23-26, 2013).

4. Nelson A. Kelly , Thomas L. Gibson, "Improved photovoltaic energy output for cloudy conditions with a solar tracking system", General Motors R&D Center, 480106-269,

5. Chemical & Environmental Sciences Laboratory, 30500 Mound Road, Warren, MI 48090-9055, USA, (23 September 2009)

6. C.S. Chin, A. Babu , W. McBride, "Design, modeling and testing of a standalone single axis active solar tracker using MATLAB/Simulink", Renewable Energy,(2011)

7. Bajpai, Prabodh Kumar, Subhash , "Design, development and performance test of an automatic two-axis solar tracker system", Proceedings - 2011 Annual IEEE India Conference: Engineering Sustainable Solutions, INDICON-2011, (2011)