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Design and development of solar tracker energy system

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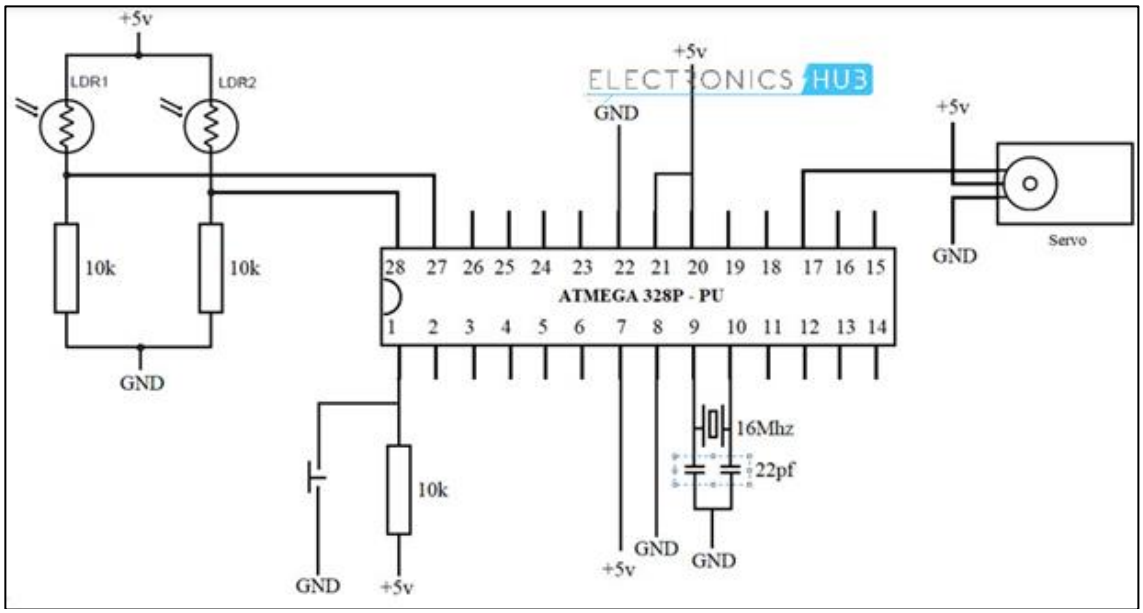
Abstract
Due to their various advantages, renewable energy sources are becoming a top priority in the modern world. Our ever-increasing energy needs are being met by a non-polluting, limitless source of power: solar power. To compensate for the diurnal and seasonal variations in sunshine, the solar panels, which are the main solar-energy conversion components, are set at a specific angle.
Sunlight exposure is limited, as is the efficiency level of a solar tracking system that uses panels. As par t of our efforts to improve the efficiency of the solar panels, we have built a solar tracking system utilisi ng a microcontroller, stepper motor, and light dependent resistors (LDRs).When sunlight is detected by LDRs and stepper motors are activated to move the solar panel so that it receives maximum sun, this tracker's micro-controller is at work. Due to the minimal number of solar panels and appropriate direction towards the sun, this system is able to provide optimum illumination and decrease the cost of power generation. This is a college project in which I developed an application.

Keywords: solar tracker, LDRs, stepper motor, solar panel, stepping sequence

1. Introduction
Electricity production from renewable sources is growing as non-renewable energy supplies are depleted. With each passing day, solar panels are growing increasingly popular among consumers and businesses alike. An article on how to install solar panels at home has previously been published on our site. Solar panels capture solar energy, convert it to electrical energy, and store it in a battery. Below are some examples of how batteries may be used to store energy. Due to Earth's rotation, the Sun's location in relation to the solar panel is not fixed. Solar panels should be able to absorb as much energy as possible in order to make the most of solar energy. But only if the solar panels are always pointed in the direction of the Sun. As a result, the solar panel should spin continually in the direction of the Sun's rays to maximize efficiency. This article discusses a solar panel rotation circuit.

2. Principle of Sun Tracking Solar Panel
It consists of two LDRs, a servo motor, a solar panel, and a microcontroller. The solar panel has two light-dependent resistors on the borders. When light shines on them, they generate little resistance. The panel is rotated in the direction of the sun by a servo motor attached to it. Light on two LDRs is compared, and the panel is turned towards the LDRs with the highest intensity, i.e. lowest resistance in comparison to the other LDR. This is done by using a servo motor to rotate the panel at a specific angle. When the intensity of the light falling on right LDR is more, panel slowly moves towards right and if intensity on the left LDR is more, panel slowly moves towards left. In the noon time, Sun is ahead and intensity of light on both the panels is same. In such cases, panel is constant and there is no rotation.

3. Sun Tracking Solar Panel Circuit Diagram



4. Literature Review

A microcontroller-based solar tracking system has been successfully demonstrated by various organisations so far. Autotracking a sun tracker based on an 8051 microcontroller with LDRs, optocouplers, stepper motor relays, analogue to digital converters, etc. and manual tracking using "Sun Tracking Software" is described in. According to Anuraj *et al*., using ATMEGA 16 to build a solar tracking system increased electricity efficiency by 20%. Tudorache *et al*. explained the design and execution of solar tracker system for Photovoltaic (PV) power plants. The operation of the tracker is based on a DC motor controlled by an intelligent driver circuit which moves a mini PV panel sensing the difference signal from two efficient light sensors.

Using a PIC 16F84A microcontroller, the tracking implementation of a solar tracker prototype with two degrees of freedom-azimuth and vertical-is described. With the use of an LDR sensor in each quadrant and basic electrical circuitry, Wang *et al*. developed a dual-axis solar tracking PV system. Assisting in tracking is an AC motor with two axes, and a stand-alone photovoltaic power inverter.

5. Automated Sun Tracking Solar Panel Circuit Design

(a) Microcontroller

This is a microcontroller that is part of the AVR family. It's based on RISC architecture, which is very sophisticated. A 8-bit controller, as the name suggests. 32 kilobytes of programmable flash memory, 1 kilobytes of EEPROM, and 2 kilobytes of SRAM are available. A total of 23 programmable I/O pins are available on the board. In addition, it has peripheral features like two 8-bit timers and one 16-bit timer, a 6-channel ADC with 10-bit resolution, and a programmable USART.

(b) Solar Panel

For demonstration purposes, the solar panel is put on a piece of cardboard, which is connected to a servo motor at the bottom. An array of photovoltaic cells is used to create solar panels. Basically, a photovoltaic cell is just a solar cell with a different name. Silicium, a semiconductor substance, is used in solar cells.

When a light beam from the Sun strikes the solar cell, it absorbs some energy. For the electrons to leap from one orbit in the atom's nucleus to another, they must absorb enough energy. Electric fields in cells direct electrons, resulting in current. These cells can produce energy by inserting metal contacts.

(c) LDR

Resistance levels of Light Dependent Resistors (LDRs) vary on the intensity of the light. The LDR resistance value decreases as light intensity rises. In the dark, LDR's resistance will be at its highest. Analog values from LDR should be transformed into digital values using a converter. Digital-to-analog converters are a good way to do this task.

An analog-to-digital converter is included inside the microcontroller. ADC0 to ADC5 (Pins 23 to 28) are the six ADC channels on the board. Individual 10K resistors are used to link the two LDRs to the ADC pins 27 and 28 in a voltage divider method. The successive approximation approach is used for ADC conversion.

(d) Servo Motor

To rotate the panel, a servo motor is employed. It's required that Pin 17 (which includes an embedded pulse width modulation signal) be linked to the servo motor's control pin in order to operate it. Connecting the solar panel and battery allows you to store the energy created by your solar cells and utilize it when you need it later on. To properly regulate the charge collected from solar panels and charge batteries, there are different charge controller circuits.

6. How Does a Solar Panel Work

- Circuit must be configured Assemble the circuit according to the instructions and upload the code to the Microcontroller device.
- Put the circuit on and position it straight under the sun (on the rooftop).
- Because of the two LDR sensors, a microcontroller may adjust servo motor positioning, which in turn moves th e panel when the light falls on the LDR sensors.

7. Solar Panels That Track The Sun Have Several Advantages.

- Solar energy may be used despite the fact that it is a non-renewable resource.
- That saves money as well by eliminating the need to pa y for the use of energy (excluding the initial setup cost).
- As a result of watching the sun continually, it maximizes solar energy capture.

8. Sun Tracking Solar Panel Applications

- There are several uses for this type of panel, such as lig hting up traffic signals and streetlights.
- As a homeowner, you have the option of installing solar panels in order to power your appliances with solar electricity.
- Because it rotates, this sort of panel may be used in industries to save energy and money.

9. Limitations of Sun Tracking Solar Panel Circuit

1. Despite the fact that solar energy may be used to the ful lest degree, the wet season might cause issues.
2. Solar energy can be stored in batteries, but they are bulky, take up a lot of room, and need to be replaced on a regular basis.
3. There is a cost associated with them.

10. Conclusion

Through the use of a microcontroller and a stepper motor, this solar tracker system could track the sun's movement in space. No matter the weather or location, this system will work. The threshold voltage of the tracker may be changed according to our needs. Once the sun has set, it can also reset the starting position. For added protection from dust particles and longer life expectancy during nighttime use of the solar panel, the panel faces the ground. Due to this, the solar tracker prototype is a small device with a number of restrictions. Increasing the number of LDRs might be beneficial in the real world. Aside from that, we've taken into account the tracker's rotation in a single dimension. This tracker will thus have more degrees of freedom in the future.

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