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Single Axis Solar Tracking System

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Abstract: *Solar energy is the largest global renewable energy source. It is a readily available alternative energy source that is also clean. It is quite advantageous for electricity generation. Solar panels are mostly used to capture solar energy. This paper shows how a solar panel works using an Arduino-based tracker. The major goal of this project is to provide a procedure for tracking. Here, LDRs are used to detect the intensity of sunlight, and the solar panel is subsequently changed to track the energy from the sun. The rotation of the solar panel is controlled by a gear motor in this project. The LDR signals are used to regulate the gear motor, which is controlled by a microcontroller. In comparison to finite solar trackers, this prototype model shows a single axis sun tracker that records more energy and provides higher efficiency.*

Keywords: *LDR (light dependent resistor), solar energy, Single axis, STS (Solar Tracking System).*

I. Introduction

As a result of the restricted availability of conventional energy resources, the globe is currently experiencing a serious energy crisis, with fossil fuels also being scarce. With the advancement inthe technology, the demand for electricity for resource production rises as well. There are numerous energy resources accessible, with electricity being one of the most cost-effective. Renewable energy is defined as energy that is derived from natural resources and is abundant. Solar energy is produced by the sun, and the working principle of our project is that sunlight is captured in the form of heat by a photovoltaic cell, which then emits an electron due to the photovoltaic effect, resulting in the generation of electricity. Solar Panels can be found herein this project, the solar panel is attached to a stepper motor, which functions when it gets an instruction from the Arduino UNO indicating which direction the panel should be rotated to capture the most amount of light. Arduino UNO makes a choice based on the two LDRs located on the top and bottom of the solar panel, and then sends an instruction to Arduino UNO after receiving the input. Single Axis Solar Tracking System will generate more power as compared to Fixed Mounted solar panel;it is observed that Our Project is 20-30% more efficient as compared to Fixed Solar Mounted Solar Panel.

Purpose of Solar Tracking System

1) To maximize the output of Solar panels throughout the day.
2) To Track the Sun and Adjust the Position of Panel Accordingly.
3) Better Efficiency as compared to Fixed Mounted Solar Panel.
4) Fully Automated Process and no Manal Work needed Once Installed.

II. Literature Survey

According to Robert H. Dold's US patent No. 0215199 A1, a Dual Axis STS is capable of withstanding adverse weather conditions, which appears to be a favorable insight for adopting STS over fixed mounted Panels. Solar PV Array, 2 LDRs, Gear Motor, Arduino UNO, L293D Motor Driver IC, and Voltage Regulator IC are all included in this single axis solar tracking system. Solar PV Panel is mounted in this frame in such a way that when the Gear Motor rotates, the Panel rotates as well; therefore it is attached to the lower end of the panel and then fixed to the base with the help of a stand. This paper gives a high-level description of our project's design and operation. An Arduino Uno is used as the project's heart, which works with the signal from the LDRs Sensor.
This project ensures that enough energy is available to meet current demand while lowering carbon emissions and damaging the environment. This project is based on new technology, thus it is required to program and design the logic, and the project will work based on that logic.

III. Material and Methods

a) **Light Dependent Resistors:**Light Dependent Resistors (LDR) is resistors that are affected by light. The LDR is made up of a plastic case that allows access to external light. Cadmium sulphide (CdS) is a component of LDR that is utilized as a photoconductor with relatively few electrons when not lit. When there is no light, it has a high resistance in the mega ohm region.

b) **Arduino:** The Arduino Uno is a microcontroller with 14 input/output pins. Fig 1 shows the different input and output pins. This board includes digital and analogue input/output (I/O) pins, as well as a Universal Serial Bus (USB) port for loading programmed from personal computers. This microcontroller is programmable in the C and C++ languages. The Arduino project provides an integrated development environment in addition to typical compiler tool chains.

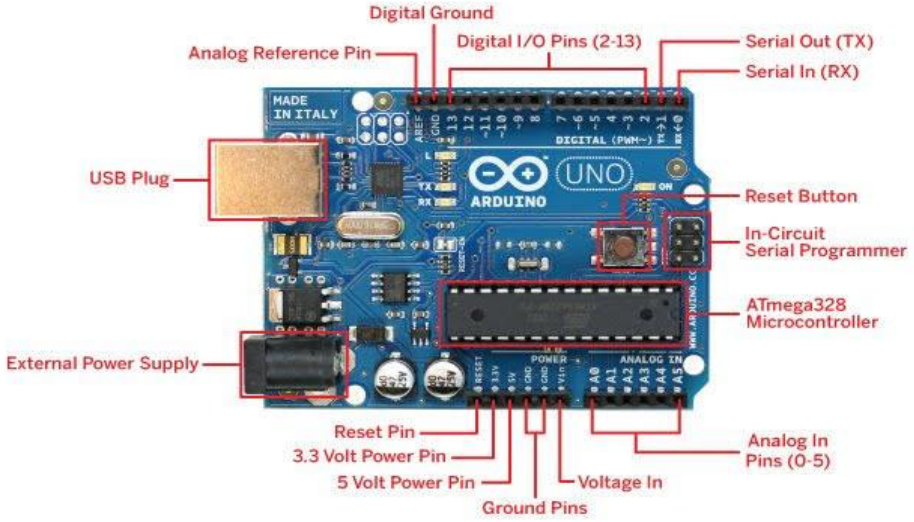

Figure no 1: Arduino UNO

c) **Solar Panel:** The solar panel is the surface on which the sun ray's fall. It's a photovoltaic module that consists of a 6x10 photovoltaic solar cell assembly. The photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications is made up of photovoltaic modules. The DC output power of each module is rated under conventional test conditions, and typically ranges from 100 to 365 Watts (W). Given the same rated output, the efficiency of a module dictates its size — an 8 percent efficient 230 W module will have twice the area of a 16 percent efficient 230 W module. There are a few commercially available solar modules that are more efficient than 22 percent, and some are said to be more efficient than 24 percent. A single solar module can only provide a certain quantity of energy; therefore, most setups use numerous modules. An array of photovoltaic modules, an inverter, a battery pack for storage, interconnecting wiring, and optionally a solar tracking

mechanism make up a photovoltaic system. The most common application of solar panels is solar water heating systems.

Figure no 2: Solar Panel

d) **Gear Motor:** A gear motor is a type of motor which produces high torque while maintaining low speed, motor output. Several Applications of Gear motors are, Can Opening, Operating Garage Door, Time Control Knobs of Washing Machine, and Electric Alarm clocks, Regardless of what type of gear motor you're working with, they all work in the same manner. A dc brushless electric motor is known as a gear motor or stepper motor. The display is known as an electronic display number of equal step when the input information is delivered as an electrical signal. The motor's position can therefore be signalled to move and hold at one of these phases without the use of a position sensor, as long as the motor is properly sized in terms of torque and speed for the application. Gear motors are commonly employed in commercial applications when a large amount of force is needed to move a heavy object using tiny machinery.

e) **L293D Motor driver:** Motor driver IC which is used to control motors with a microcontroller is an L293D motor driver. This motor consists of three IC's. Four motors are controlled with the shield using two L293D IC's. Servos, DC motors, and stepper motors may all be controlled with this shield. There is a custom library in shield for the module that writes the entire function of the module. To operate the motor, only few commands are required. The L293D Motor Driver IC allows a DC motor to rotate in only one direction. The L293D is a 16-pin IC that can drive two DC motors at the same time. This means that a single L293D IC may drive two DC motors at the same time. Check the Voltage Specification to see if the L293d can operate little and silent huge motors. A single L293D IC contains two H-Bridge circuits that may independently rotate two dc motors. On the l293d, there are two Enable pins. Pins 1 and 9 must both be high in order to drive the motor.You'll need to set pin 1 to high. For driving the motor's left H-bridge. You'll also need to raise pin 9 for the right H-Bridge. If either pin1 or pin9 becomes low, the motor in the associated segment will stop operating. It's as though a switch has been flipped.

IV. Block Diagram

The fig. 3 shows the block diagram of the work carried and prototype of model connections are shown in fig. 4. The details about each component are explained in section III.

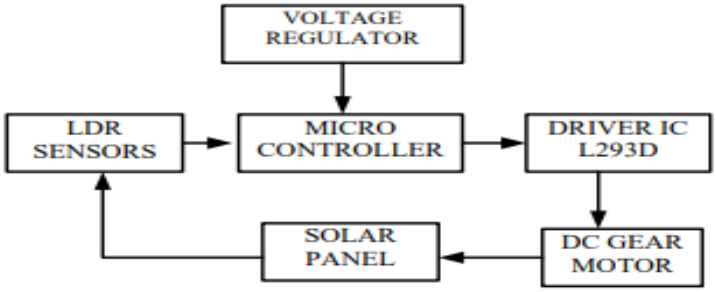

Fig 3: Block diagram of Single axis solar tracker

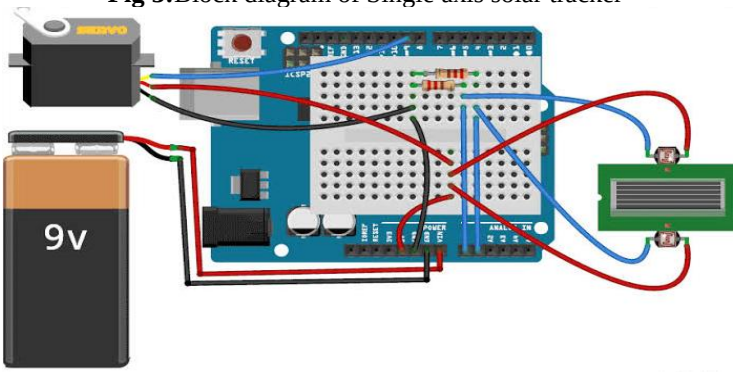

Figure no 4: Prototype model connection

V. Working Model

Fig. 5 shows the implemented model of the work. The procedural steps carried are as follows:

1) In this project, two LDRs are used one on each side of the solar panel.
2) The Arduino is coded in Embedded C and runs on a 9-volt DC supply.
3) When LDR1 receives more light than LDR2, the IR sensor sends an instruction to Arduino UNO, and Arduino UNO instructs the Gear Motor to move in an anti-clockwise direction via the Motor Driver IC.
4) Similarly, if LDR2 receives more light than LDR1, it will send an instruction to the Arduino UNO via the IR sensor, and the Arduino UNO will instruct the Gear Motor to rotate clockwise via the Motor Driver IC.
5) If Else Ladder Statements are used to create programming logic.

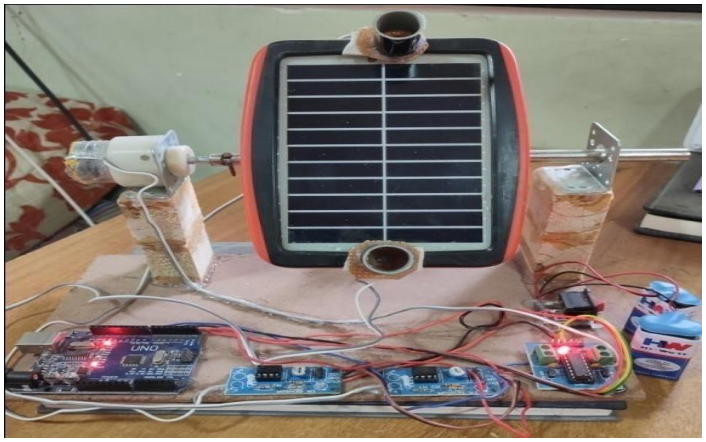

Figure no 5: Project Model

The cost details for 1 kW tracking system are included in Table 1. The total cost is around ₹54000 for 1 kW tracking system including solar panel and other accessories.

Table no. 1 - Cost Sheet for 1 KW Tracking System

Sr. No.	Specifications	Rate	Weight	No.	Cost
1	PV panel 250W	12500	19.5kg	4	50000
2	Gear motor	600	-	1	600
3	Center rod 13 feet	750	9 kg	1	750
4	Frame structure + other cost	2600	8 kg	1	2600
	Total cost	-	-	-	53950

VI. Advantages and Applications

Single-axis trackers have single degree of flexibility, which serves as a rotation axis. This is usually aligned in a north-south direction, but any cardinal direction can be used. One-axis trackers have the following advantages:

1) As compared to a stable or stationary solar system, a single axis solar tracker generates an additional 25-30% of electric energy.
2) Long-term maintenance for any electronic parts has become less common as a result of the technological era.
3) Under the One Sun One Grid initiative, electrical energy can be generated and distributed over the world 24 hours a day, seven days a week.
4) It is environmentally beneficial when compared to other forms of energy.
5) Photovoltaic panels, reflectors, lenses, and other optical devices are oriented toward the sun using solar trackers. Trackers are used to align the collection system to maximize energy production because the sun's position in the sky changes with the seasons and time of day.

The following are some of the most common solar energy applications:

1) Solar energy is used to heat water.
2) Continued concentrated application, such as in hospital operations where many electronic components demand electricity.
3) Cookers powered by the sun.
4) Delegate solar power to the Andaman and Nicobar Islands.

VII. Conclusion

The country that excels in solar will also excel in the rest of the globe. India, as a tropical country, must use solar energy to cut carbon emissions. When compared to a stationary or steady solar system, a single-axis solar tracker provides more energy. PV cells are also improving as a result of the tracker's long-term advancements. The usage of a big amount of conventional energy is reduced as a result of solar energy production, and therefore the large pollution rate is reduced.

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