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Research Paper on

Arduino UNO Solar Tracker Dual Axis

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ABSTRACT

Green and hygienic energy be contingent meanly on the Solar energy, especially in municipal area. This paper presents the Arduino-based novel design of dual-axis solar tracking system with high-efficiency using through the use of four-point sunlight sensors. The key objective of this research is to change the maximum sunlight to electrical power by auto movement of the solar panel. This paper presents the dual-axis solar tracking system using Arduino UNO where the servomotors reorient the panel to get optimum power and the LDR circuit detects the position of sun. The effective use of solar trackers can increase electricity production by around a third, and some claim by as much as 40% in some regions, compared with modules at a fixed angle. As a outcome of which, we get more efficient system which is compact, low cost as well as easy to use.

Keywords: Arduino, efficiency, solar panel, solar tracking, LDR, servomotors.

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I. INTRODUCTION

Sun is an rich source of energy and this solar energy can be harnesses successfully using solar photovoltaic cells and photovoltaic effect to convert energy into electrical energy. But the conversion efficiency of a normal PV cell is low. One of the main reason for this is that the output of PV cell is dependent directly on the light intensity and with the position of sun in the sky. Due to fast development of technology, most of the people around the world need to use energy to complete their daily work. Many natural energy sources are increasingly being used in the society. One of them is solar energy that uses the solar panel and solar tracker. The Solar panel is designed to use the light energy if the sun and make it as a source for generating electricity. The dual-axis solar tracker could produce 40% more power compared to the single-axis solar tracker. The dual-axis solar tracker give maximum energy from solar panel because of their ability to change the position and follow the Sun light vertically and horizontally according to the Sun's position in the sky, the dual-axis solar tracker are able to angle themselves to be in line with the Sun light compared to the single axis solar tracker. The previous researches using the single-axis solar tracker shows that the solar energy established is wasted and it does not track the sunlight accurately to give maximum production of electricity. It is proven that dual-axis solar tracker had an yearly energy gain of 36.504% compared to single-axis solar tracker.

Solar tracking system

A. The solar tracking system with single-axis principle depends on rotating the panel around a tilted shaft under the action of controlling, Servomotors according to the sun light track estimated by means of two light intensity sensors. The light sensors include four LDRs. Depending on the intensity of the sunrays one of the LDRs will has a shadow and the other will be illuminated.

B. The tracking system with dual-axis principle rest on on rotating the panel toward the position of the sunlight using two servomotors, so that the solar panel will always face perpendicularly the sun light, the 4 (LDRs) as a sensor to deliver feedback by sense the higher intensity area of sunlight to the Arduino UNO microcontroller. It can move in every direction towards the higher intensity of the light.

II. METHODOLOGY

Basically, the tracking system of any solar panel is operating according to the direction of the sunlight. The tracking system depends mainly on an auto-tracking technique instead of adaptive technique or pre-defined movement. The system will routinely move the solar panel

until it is faced perpendicularly towards the sunlight. The sensors provide the feedback signals to the controller to control the system. The main part of the planned methodology is Arduino uno microcontroller circuit, solar panel and servomotor and the Arduino Uno Board uses ATmega328 microcontroller which collect the sensors signals and decide which motor should move to which direction for regulating the system in such a way that the sun light falls directly on the panel. The 4-point sensor (Fig. 1) will detect the direction of light depending on the light intensity detected by each sensor and send the data to microcontroller. The microcontroller will compare the intensity of light based on the data collected from the sensor and accordingly controlled the actuator.

Fig. 1: Configuration of 4 LDR's

A. PROBLEM STATEMENT

A sunlight-based tracker is utilized as a part of different frameworks for the change of loading of sun powered radiation. The issue that is postured is the usage of a framework which is fit for improving creation of energy by 30-40%. The control circuit is objectified by the microcontroller. The control circuit at that point positions the engine that is utilized to situate the sun-oriented board ideally.

B. OBJECTIVES

The venture was completed to fulfil two important destinations:

- Design a framework that trails the sunlight-based UV light for sun-oriented boards in double pivot.
- Prove that the resulting reality expands the proficiency impressively. The scope of increment in proficiency is relied upon to be in the vicinity of 30 and 40 percent.

C. BLOCK DIAGRAM

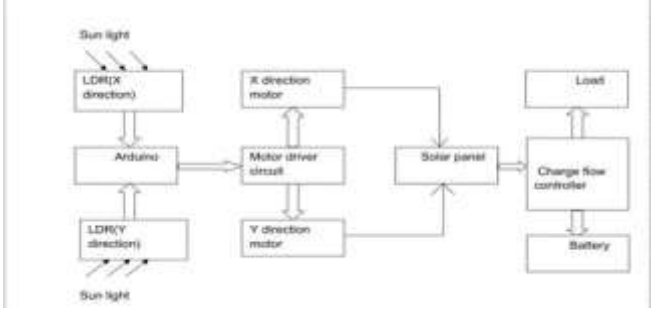

Fig. 2: Block Diagram of dual-axis solar tracker

- (Fig. 2) Ddepicts the flow chart for the proposed system for the software part. Initial position of the sun should be set. LDR is used to detect the light. We need only the sun light, so we have to set the threshold level.
- If the light intensity is larger than the threshold value then only the proceedings will occur. After that, the sun's position is compared with the centre to the right, left, up and down position. The servomotor rotates the panel to the required position, so that maximum intensity of the light can be captured by the panel.

D. BRIEF ABOUT EACH COMPONENTS

- Solar Cell
- Arduino UNO
- LDR
- Servo Motor

- **Solar cell**

A photovoltaic cell, regularly known as a sun-based cell, is the innovation utilized for transformation of sun oriented specifically into electrical power. The photovoltaic cell is a non-mechanical gadget made of silicon amalgam. One cell can however carry just 1 or 2 watts that isn't sufficient for generally machines. Execution of a photovoltaic cluster relies upon daylight. Climatic conditions like mists and mist essentially influence the measure of sun-oriented vitality that is gotten by the exhibit and in this manner its execution. The vast majority of the PV modules are in the vicinity of 10 and 20 percent effective.

- **Arduino UNO**

The Arduino Uno (Fig. 3) is a microcontroller board in light of the ATmega328(datasheet). (Table. 1) Shows the detailed specifications of the same, It has 14 computerized input/yield pins, (of which 6 can be utilized as PWM yields), 6 simple information sources, a 16 MHz artistic resonator, a USB association, a power jack, an ICSP header, and a reset catch.

Table.1: Arduino Uno specifications

Microcontroller	ATmega328
Operating Voltage	5V
Supply Voltage (recommended)	7-12V
Maximum supply Voltage (not recommended)	20V
Digital I/O Pins	14(of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40mA
DC Current for 3.3V Pin	50mA
Flash Memory	32KB of which 0.5KB used by boot loader

SRAM	2KB
EEPROM	1KB
Clock Speed	16MHz

It contains everything projected to help the microcontroller; basically, interface it to a PC with a USB link or power it with an AC-to-DC connector or battery to begin. The Uno contrasts from every previous board in that it doesn't utilize the FTDI USB-to-serial driver chip. Rather, it includes the Atmega16U2 (Atmega8U2 up to variant R2) customized as a USB-to- serial converter.

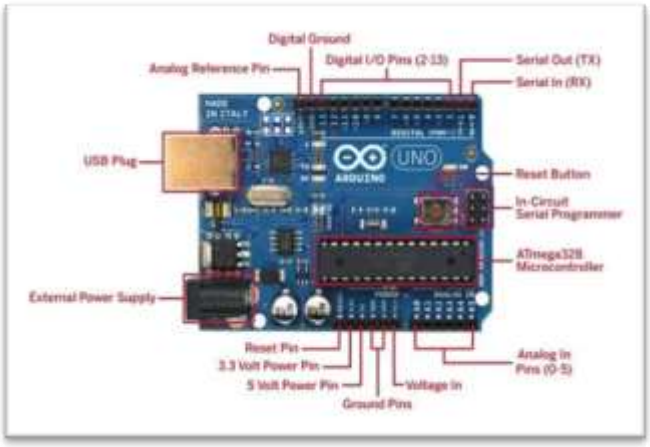

Fig. 3: Arduino UNO

- **LDR (Light Dependant Resistor)**

The least difficult optical sensor is a photon resistor or photocell which is a light touchy resistor these are made of two kinds, cadmium sulphide (CdS) and gallium arsenide (GaAs). The sun tracker framework charted here utilizations of two cadmium sulphide (CdS) photocells for detecting the light. The photocell is a dormant part whose protection is contrarily relative to the measure of light power coordinated towards it. It is associated in arrangement with capacitor. The photocell to be utilized for the tracker depends on its dim protection and light immersion protection. The term light immersion implies that further expanding the light power to the CdS cells won't diminish its protection any further. Light power is estimated in Lux, the brightening of daylight is roughly 30,000 lux.

- **Servo Motor**

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor comprises of a control circuit that provides feedback on the current spot of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply, then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only about the DC servo motor working. Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight parcels. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics.

III. FLOWCHART OF PROCESS

The given flow chart (Fig.4) shows the order of steps taken in the process for scheming and working of solar tracking system. The system is designed in order to respond to the sunlight incident on the solar panel, according to which the movement of solar panel is done. Working of system is controlled by Arduino microcontroller

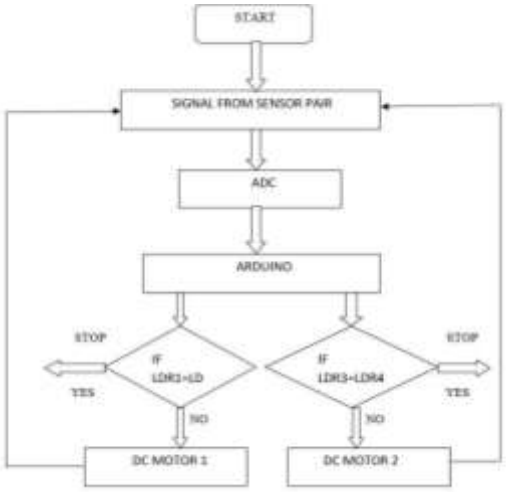

Fig. 4: Flow Diagram of the process

IV. RESULTS AND DISCUSSIONS

After designing, developing and applying the smart solar tracker system for voltage measurement, enhancement of solar panel efficiency, compact and low power system is successfully done. System is tested at different times of a day in company of varying orientation of sun so that it is able to detect the incident light in different conditions. The output is taken with the assistance of panel movement according to maximum efficiency. The size of operation of this type of solar tracker can vary with the application and place of usage, but it is more efficient than conventional solar panels by a margin of 40%(approx.) and it utilizes minimum space, less maintenance and cheap instalment.

V. CONCLUSION

The aim of this project was to propose a dual-axis tracking system which can sense the incident solar light on the panel and move it in the direction of maximum solar light incident. Further the advantages and disadvantages were also studied. The disadvantages were the challenges that had to be overcome. From this study the main conclusions are:

i. Proposed system is low cost and compact as compared to the other tracking systems in use for same application.
ii. It is very easy to program and modify because it is Arduino based and no external programmer is required.
iii. The designed system is easy to use and provides better efficiency of the panel.
iv. The system is easy to install and have minimum maintenance.

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