SINGLE AXIS SOLAR PANEL PROTECTION SYSTEM

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ABSTRACT

This paper describes the design and implementation of a single axis sun tracking and protection system. This utilizes LDR's and air-flow sensors to make PV cell facing in the direction of maximum irradiation to promote system efficiency and also aligning them parallel to the direction of harsh winds for panel protection. Meanwhile, the algorithm is implemented such that during normal weather, solar tracking occurs and when comes the harsh winds solar tracking is temporarily be replaced by solar protection system. This paper will first highlight and elaborate the concept.

KEYWORDS: Light Dependent Resistors, Airflow sensors, Ultrasonic sensors, Motor driver IC module, DC motor, Arduino UNO.

INTRODUCTION

The solar energy is a clean, abundant renewable energy resource available all over the world. Nowadays there is a scarcity in electricity generation, due to the lack of resources such as coal, petrol, diesel etc. Hence, tapping solar power from solar panels effectively came into use.

Photovoltaic panels are of active solar power types that are widely used in our day-to-day world. The PV panel's cost and efficiency varies with the quality of material used. The material used such as mono crystalline accounts to high cost and efficiency which are mostly used in solar thermal power plant whereas the materials like poly silicon and thin film silicon accounts to medium cost and efficiency are mostly used in residential areas. The type of glass used on solar panel really does matter. The types include tempered and flat glass. The tempered glass is relatively costlier and more safer than flat glass type model.

In order to support the electricity demand in rural as well as urban areas, the government has insisted for the usage of the solar power panel to be mounted on house or apartment terrace. Most people prefer for the medium quality panels based on their financial status. These panels are made to withstand the winds only below 80mph. Hence for the winds above 80mph the panels needs to be protected from the air impact.

This protection can be done by aligning the panel in parallel to the direction of the wind. This reduces the impact of wind on panels which in turn reduces the chance of damage occurrence. Air flow sensor are exclusively used which senses the wind direction and sends appropriate signal to the Arduino which is programmed to rotate the panel accordingly. This system works only when winds blow over 80mph, which temporarily stops the usual tracking mechanism because the protection is on top priority than solar tracking system.

LITERATURE SURVEY

The Literature paper [1], "Performance Comparison of Mirror Reflected Solar Panel with Tracking and Cooling" deals with the performance of a mirror reflected solar panel with automatic cooling and tracking. This protects the panel and also improves the performance by reducing the panel temperature.

The Literature paper [2], "A Photovoltaic Generation Heating System Based On Double Parabolic Reflector Focusing and Hybrid Tracking Technology", deals with the automatic tracking technology combining calendar method with hill climbing method that can speed up the tracking and enhances the performance and helps in prolonged service life of panel.

The Literature paper [3], "Dual Axis Sun Tracking System with PV Cell as the Sensor, Utilizing Hybrid Electrical Characteristics of the Cell to Determine Insolation", deals with the tracking system that doesn't make use of external light sensors. Instead it makes the practical utilization of solar panels as sensors by determining the insolation.

The Literature paper [4], "Practical Issues and Characterization of a Photovoltaic/Thermal Linear Focus 20× Solar Concentrator", helps in the panel integration on building roofs that makes use of four small sized linear focus semi parabolic mirrors mechanically linked and driven by a stepper motor and tracking the sun along a single axis.

EXISTING SYSTEM

The Sun tracking solar panel consists of two LDRs, solar panel, DC motor and ATMEGA8 Micro controller (Arduino UNO). Two light dependent resistors are arranged on the edges of the solar panel. Light dependent resistors produce low resistance when light falls on them. The DC motor connected to the panel rotates the panel in the direction of Sun. Panel is arranged in such a way that light on two LDRs is compared and panel is rotated towards LDR which have high intensity i.e. low resistance compared to other. DC motor rotates the panel accordingly. 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.

PROPOSED SYSTEM

BLOCK DIAGRAM

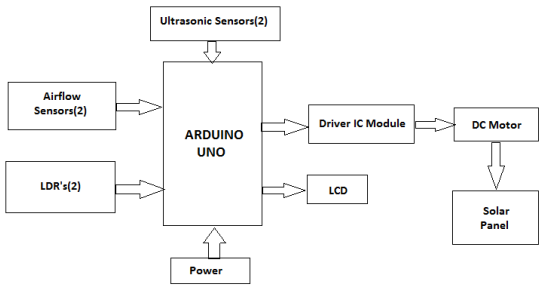


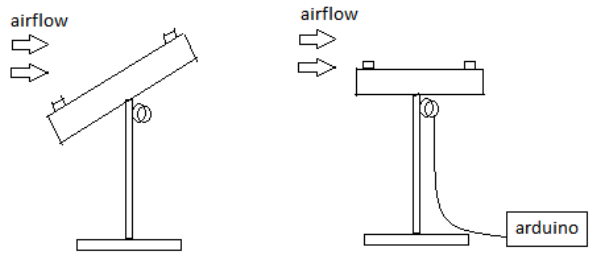
FIGURE 1: SINGLE AXIS SOLAR PANEL TRACKING AND PROTECTION SYSTEM

The System describes about the effective usage of solar panel equipments by improving its life durability and efficiency. The Arduino is

programmed to sense the air speed through air flow sensor. When air speed is below 80mph, it is considered to be of normal weather and if not is considered to be bad weather.

When normal weather prevails, the system is designed to track the sun for improving its efficiency. LDR's sense the light intensity and sends the appropriate signals to the Arduino UNO. The Arduino checks for the maximum values of the two LDR's, compares and sends the signal to the DC motor to rotate the panel to the direction at which maximum intensity occurs.

When bad weather prevails, the sun tracking mechanism is stopped temporarily. The protection mechanism comes to effect. Again the Arduino checks for the airflow direction by acquiring the values of its Airflow sensors. One of the two airflow sensors fitted at the extreme ends of the solar panel is detected by Arduino and it commands the DC motor to rotate in the direction where the air flow above 80mph is detected.



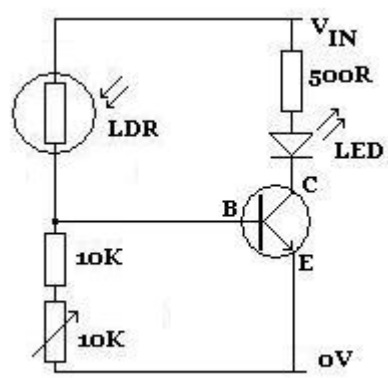
Solar panel without and with protection

The DC motor connected to the solar panel makes it to align parallel to the direction of wind flow, reducing the impact of wind-on-panel and hence the chance of damage occurrence is mitigated. The protection scheme is stopped only when the airflow speed is below 80mph and then the sun tracking occurs. The position of the panel is determined by Ultrasonic sensor. This sensor sends and receives the signals from a particular fixed position to the base of solar panel. The distance in values is calculated and the microcontroller interprets the values and helps to detect and ensure the position of panel during the mechanism changes. The output of Arduino isn't sufficient for the motor to run and hence we used Driver IC module which is connected in between the DC motor and Arduino board. The LCD is connected just for the readability of the instances occurring during the whole process.

ARDUINO UNO

Arduino/Genuino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The Arduino is connected with LDR's, Airflow sensors, Ultrasonic sensors and DC motor. The Arduino is programmed with the software called Arduino IDE which uses the C language.

LIGHT DEPENDENT RESISTOR



A Light Dependent Resistor is a device which has a resistance which varies according to the

amount of light falling on its surface. The 10K variable resistor is used to fine-tune the level of brightness required before the LED lights up. The 10K standard resistor can be changed as required to achieve the desired effect, although any replacement must be at least 1K to protect the transistor from being damaged by excessive current.

AIRFLOW SENSOR

Anemometer/Airflow sensor is a low cost Arduino friendly sensor. This sensor has hardware compensation for ambient temperature and stand for positive temperature co-efficient thermistors. It can sense from 0 to 150mph winds and gives output sense voltage up to 3.3V. Hence it is most suitable for all range of microcontrollers and Arduino development boards.

MOTOR DRIVER IC MODULE

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It is based on the H bridge concept. The motor here is rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.

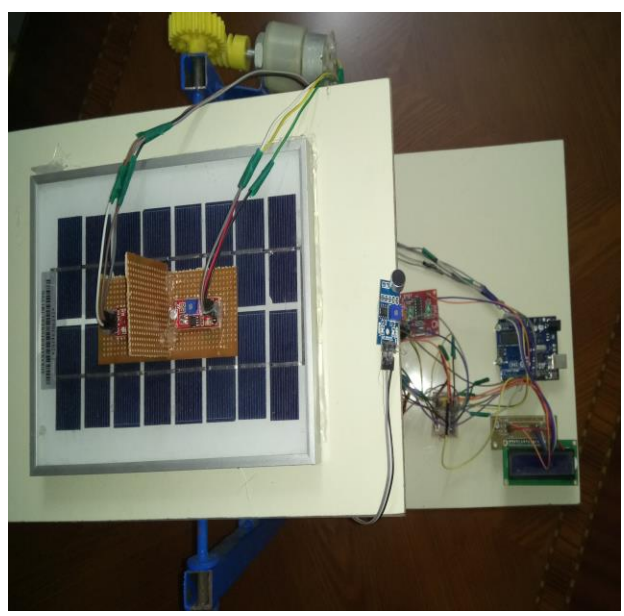
ULTRASONIC SENSOR

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object. By this way, the panel position is determined and sends the data to Arduino.

$$distance = \frac{speed\ of\ sound\ \times time\ taken}{2}$$

PROTOTYPE

The Solar panel setup is safely mounted on a plate. The LDR's are connected on top at the center of the panel and the Airflow sensors to the extreme ends of the panel. The Ultrasonic sensors are placed at a particular distance below the solar panel. A DC motor is connected with solar panel and gets its input from Arduino UNO through Driver IC module. The Arduino is interfaced with LCD, LDR's, airflow and ultrasonic sensors. The Arduino is programmed internally with the help of Arduino IDE for the proper alignment of solar panel connected with motor.



CONCLUSION

By our solution, we can reduce the damage caused on medium quality solar panels which are mostly used by middle class peoples. The protection scheme only uses airflow sensor in addition with tracking system**.** This encourages the people to install solar power panels on their building roofs to support the electricity demand raising nowadays.

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