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Solar Power Monitoring and Tracking System

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ABSTARCT

Using the Advance Technology for supervising solar power generation can greatly enhance the performance, Tracking, monitoring and maintenance of the Solar plant. With advancement of technologies the cost of renewable energy equipment is going down globally encouraging large scale solar plant installations. This massive scale of solar system deployment requires sophisticated systems for automation of the plant monitoring remotely using web interfaces as majority of them are installed in inaccessible locations and thus unable to be monitored from a dedicated location. We tend to use solar panel, LDR, humidity, voltage, and temperature sensors and servo motors.

Always the output power of the solar panel depends on the radiation reached to the solar cell. The system also displays the malfunctioned Solar panel, Humidity, Voltage and Temperature. This system collects free energy from the sun and stores it in the battery and then converts this energy to the respective alternating current. Its makes the energy usable in normal homes as an independent power source. This system is designed to react to its environment in the shortest amount of time. All the panels are connected, and sensors are directly connected to the central controller which monitor panels and tracks panels and loads. This will facilitate preventive maintenance, fault detection of the plant in addition to real time monitoring.

Key Words: Arduino Uno, Voltage Sensor, LDR's, Temperature Sensor.

INTRODUCTION

Solar energy is an unlimited source of energy which if harnessed properly will get the mankind devoid of using the conventional sources of energy he has been long using. This project has been designed keeping this in view to make the harnessing of solar energy more efficient. Solar energy also has the potential to be the major energy supply in the future. Solar tracker is an automated solar panel that actually follow the Sun to increase the power. The difficulty was in finding the best light detecting circuit part. An important criterion for this would be being able to adjust voltage levels based on the smallest amount of rotation of the components while mounted to the solar panel. The sun position in the sky varies both with equipment over any fixed position. Many of the solar panels had been positioned on a fixed surface such as a roof. As sun is a moving object, this approach is not the best method. One of the solutions is to actively track the sun using a sun tracking device to move the solar panel to follow the Sun. With the Sun always facing the panel, the maximum energy can be absorbed, as the panel is operating at their greatest efficiency. The main reason for this project is to get the maximum efficiency for the solar cells.

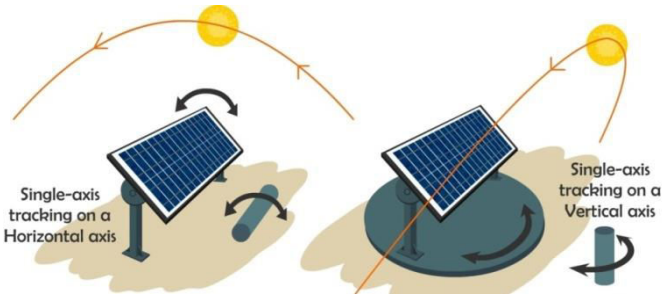


Fig 1 Solar Tracking

Solar power plants need to be monitored for optimum power output. This helps retrieve efficient power output from power plants while monitoring for faulty solar panels, connections, and dust accumulated on panels lowering output and other such issues affecting solar performance. So here we propose an automated LCD based solar power monitoring system that allows for automated solar power monitoring from anywhere over the internet. Our system constantly monitors the solar panel and transmits the power output to LCD system over the USB. It now displays these parameters to the user using an effective sensors and also alerts user when the output falls below specific limits. This makes remotely monitoring of solar plants very easy and ensures best power output.

LITERATURE SURVEY

Many researchers had made many studies in this major problem and proved that 50% of the PV solar panels performance reduces by the dust accumulation on the cleaned panels. The studies made on the effects that causes to the solar panel due dirt the by well-known organization in the world Google of 1.6 MW solar plant in there California headquarters. 4.7% average loss is recorded in the pioneer's investigations by impact of dust in the solar systems that is made by the authors Hottel e.l. The authors Salim et al made an investigation on dust accumulation and stated that there is a 32% reduction of solar power in a span of eight months in a solar village near Riyadh. An experiment is conducted by the authors Dirk Goosen et. Al in on the deposition of the dust particles which had affected the performance of the PV cells and investigated the airborne. concentration and wind velocity effect caused by accumulation of dust. Author Garg of Roorkee made an experiment and discovered that panel would reduce 8% average transmittance by the accumulation of dirt on 45-degree tilted glass plate after a 10-day period. Due to accumulation of dust on the panels it is observed that useful energy is reduced by 30%. The common methods used to clean the dust is by spraying water on the panels with cleaning agent. Vibrating the panels with motors as the cell phone vibrates so that the dust goes off from the panels. The dust jumps off from the panels by creating a positive charge.

By using a brush manual, we must clean the PV panels. Solar panel monitoring is important. It is vital that solar panels are monitored regularly in one way or another. You need to make sure they are operating correctly, and the system is generating as much as predicted. If you have solar panels installed, you should at the very least check the generation meter once a week and take a note of the reading. And should go to the place of the panels arranged and note the readings every time. It is a manual checking procedure, always should go to the place of solar panel system arrangement to note down the readings. So, it is not possible to take readings all the time, whenever required should go to the place of system arrangement. And optimum power cannot be obtained due to no proper alignment of solar power. Among the sustainable power sources is electrical sun oriented vitality from the Sun can besaddled utilizing sunlight based boards or sun based cells to change over sun based light into electrical flow. Most photovoltaic cells utilize photoelectric impact. This is a procedureby which electrons are discharged from certain materials, for example, a metal, because of being struck by photons. A few substances, for example, selenium, are especially vulnerable with this impact and whenever utilized in sun oriented cells, they can create some electric potential through photoemission. Sun rays come in type of UV-light, a type of electromagnetic radiation and once they fall of sun oriented board surface made of materials, for example, silicon, the illumination is retained and changed over into electrical vitality through photograph discharge. Most extreme assimilation happens when the sunlight based boards and sun oriented cells legitimately face the Sun, with the goal that thesun's beams fall oppositely on the ingestion surface. This assimilation and transformation may not be ideal given that the sun oriented boards and sun powered cells are mounted in fixed positions for the most part on housetops with inclinations. For suitable sun based vitality age utilizing single establishment, its proficiency must be improved and thusly different sunlight based following strategies are conceived to intently follow sun development amid the day.

BLOCK DIAGRAM

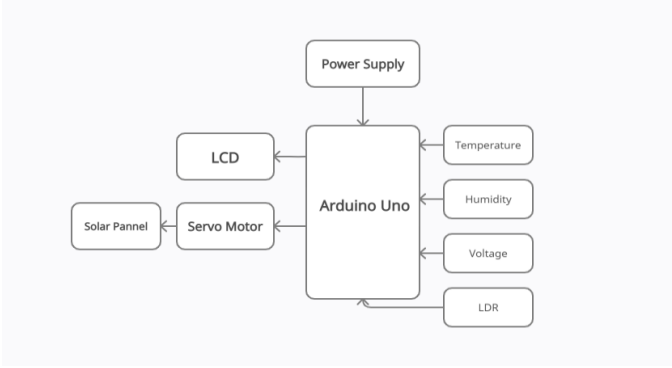


Fig 2 Block Diagram

HARDWARE REQUIREMENT

ARDUINO UNO

Arduino 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 ceramic resonator , a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started

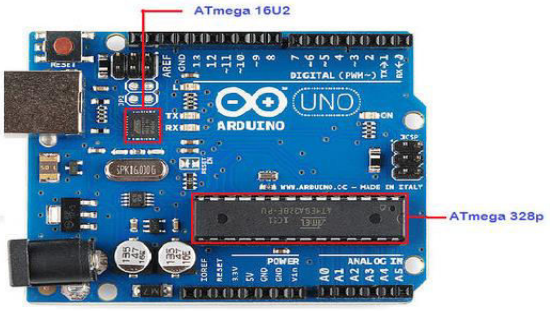


Fig 3 Arduino Uno

VOLTAGE SENSOR

A voltage sensor is a sensor used to calculate and monitor the amount of voltage in an object. A voltage sensor can determine, monitor, and measure the supply of voltage. It can measure the AC level and/or DC voltage level. The input to the voltage sensor is the voltage itself, and the output can be analog voltage signals, switches, audible signals, analog current levels, frequency, or even frequency-modulated outputs.

Fig 4 Voltage Sensor

DHT11 SENSOR

DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability.

It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and outputs a digital signal on the data pin (no analog input pins needed). Its very simple to use, and libraries and sample codes are available for Arduino and Raspberry Pi.

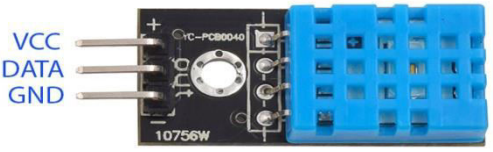


Fig 5 DHT11 Sensor

LDR SENSOR

Photo conductivity is the main working principle of a LDR or light dependent resistor. All the electrons in the semiconductor of the valance band excites when the light or photos fall on the resistor. When the light falls on the LDR resistance gets decreased and increase in the dark or called as dark resistance. Basing on the materials the LDR‟s are classified in to two types Intrinsic Photo Resistor and Extrinsic photo resistor.

Fig 6 LDR

SOLAR PANEL

A solar panel, or photo-voltaic (PV) module, is an assembly of photo-voltaic cells mounted in a framework for installation. Solar panels use sunlight as a source of energy and generate direct current electricity. A collection of PV modules is called a PV Panel, and a system of Panels is an Array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.
The electricity generated by capturing the sun light is called as solar energy which is used for business and home purpose. The natural nuclear reactor is sun which releases the energy with tiny packets called photons. The atoms lose the electrons when the photons hit the solar cells. A solar panel is made of multiple panels that wired together, more electricity is generated by the more panels we deploy. Silicon like semiconductors are used to make the PV photovoltaic solar panels as shown in figure.

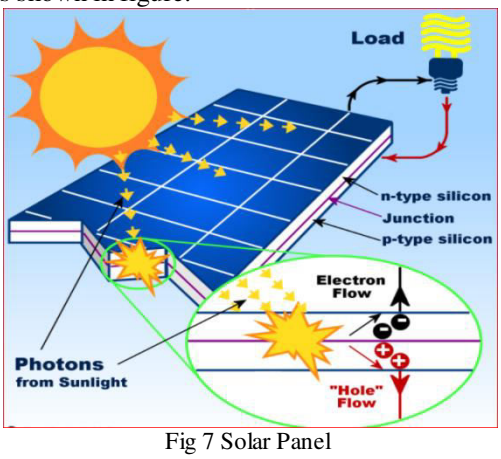


Fig 7 Solar Panel

SERVO MOTOR

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position 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

Fig 8 Servo Motor

ADVANTAGES AND DISADVANTAGES

- Because of the tracking the efficiency of output power increases greatly.
- The use of solar trackers is increasingly common in photovoltaic plants, since the solar industry has proven the great benefits they have. The trackers allow a significant increase in energy production and therefore improve project profitability.
- Dual-axis, besides moving along the azimuth, they also follow the elevation angle of the sun, thus achieving a full tracking.
- Solar trackers generate more electricity roughly in the same amount of space needed for fixed tilt systems, making them ideal optimizing land usage.
- With solar tracking you can extend the time of available maximum power and thus produce with greater capacity more hours a day.
- Tracking systems are going to be more expensive than the opposing fixed mounted variety. This is largely due to having motorized and moving parts. Which leads way to another disadvantage.
- Maintenance: Having all these moving, mechanical parts means that there will be some amount of regular inspection, adjustments or even replacements required.

EXPERIMENTAL RESULTS

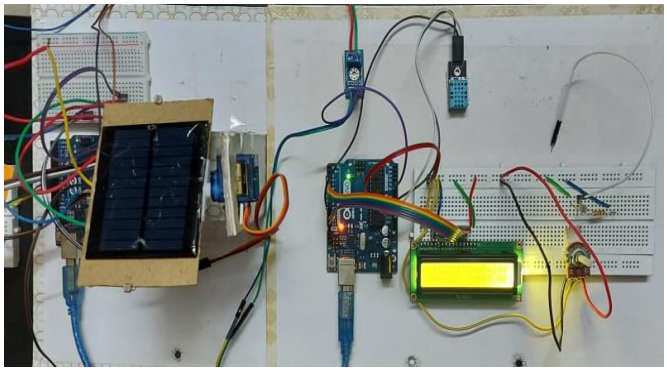
These are obtained from tracking the sun with respect to that obtained without tracking. It is seen that at a point the power output of both the solar panel with and without tracking are the same. This is as a result of both panels facing the sun at the same time.

	Voltage
Fixed Solar Panel	3.28V
Tracking Solar Panel	5.49V

Table 1 Resut

It has been established that solar tracking system is an efficient and feasible means of obtaining optimal solar energy from the sun. By constantly aligning the Solar panel with the sun, it directly receives sunlight falling on its surface thereby generating more electricity. Different techniques have been adopted in the design of this system but 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 can be used outside the mechanical

part, thus it is flexible for future modification. The solar module with tracking system as demonstrated in the analysis achieves about 24% efficiency improvement over the static solar module.
Hence implementation of this technique in building solar systems will greatly improve utility satisfaction.



CONCLUSION

An Arduino solar tracker was designed and constructed in the current work. LDR light sensors were used to sense the intensity of the solar light occurrence on the photo-voltaic cells panel.The existing tracking system successfully sketched the light source even it is a small torch light, in a dark room, or it is the sun light rays. The Arduino solar tracker with servo motor is employed by means of Arduino ATmega328p microcontroller. The essential software is developed via Arduino Uno. The cost and reliability of this solar tracker creates it suitable for the rural usage. The purpose of renewable energy from this paper offered new and advanced idea to help the people. As dual-axis tracking generates 40% more power from each panel, you can achieve the same power output with fewer panels, frames and so on, which reduces a project's upfront costs and offsets to a great extent the additional cost for tracking hardware.

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