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Smart PV Panel Cleaning System and Dual Axis Tracking, Monitoring using IoT

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ABSTRACT

With the growing requirement of electricity and concern for the environmental impact of fossil fuels,implementation of eco-friendly energy sources like solar poweris rising. The solar PV modules are generally employed in dust environments which is the case in tropical countries like India. The dust gets accumulated on the front surface of the module and blocks incident light from the sun. The power output reduces as much as by 30% if the module is not cleaned for a month. Accumulation of dust on even one panel in an array reduces their efficiency in energy generation considerably and need to keep the panel surface as clean as possible. In this paper, we designed a system which not only tracks sun but also clean module automatically.This mechanism required an LDR for tracking the sun. While cleaning the solar panels, a mechanism consists of sliding brushes has been developed. In terms of daily energy generation, the present tracking -cum cleaning scheme provides about 30% more energy output as compared to the stationary PV module. This paper gives an idea about the combination of tracking and cleaning system.

KEYWORDS: Solar Panel, Cleaning System, Dual Axis Tracking and Monitoring, NODE MUC

INTRODUCTION

An unavoidable shortage of fossil fuel sources in the future, renewable types of energy have become a topic of interest for researchers, technicians, investors and decision makers all around the world. New types of energy that are getting attention include hydroelectricity, bioenergy, solar, wind and geothermal energy, tidal power and wave power. Because of their renewability, they are considered as favourable replacements for fossil fuel sources. Among those types of energy, solar photovoltaic (PV) energy is one of the most available resources. This technology has been adopted more widely for residential use nowadays, thanks to research and development activities to improve solar cells' performance and lower the cost.According to International Energy Agency (IEA), worldwide PV capacity has grown at 49% per year on average since early 2000s. Solar PV energy is highly expected to become a major source of power in the future.

In our proposed work tried to solve the problem of dirtiness of solar panels through sensing the air dust, humidity / fog and based on that the cleaning operation done automatically when needed. The aim of the work is to clean the solar panels automatically so that we do not need employees. It also maintains the life of the solar panels when it cleans constantly. So it gives us full energy. The aim of our work is to clean the solar panels automatically without the need for an employee to clean them. Reduce the cost of cleaning process. Expand the life time of the panel. Monitor the panel status. It is automatically cleaning so no need to higher employees for cleaning service. It will expand the life time of the panels. In addition, when the panel is dirty it will not give the expected power so it has to be clean.

PROPOSED SYSTEM

This project is proposed a solar panels are stationary and do not follow the movement of the sun. Because of climactic changes this disadvantage of solar panel.solar dual axis tracker system is used to tracks the movement of sun across the sky and tries to maintain the solar panel perpendicular to the sun's rays, ensuring that the maximum amount of sunlight is incident on the panel entire day.The wiper system is expensive and difficult to install over a large PV area

BLOCK DIAGRAM

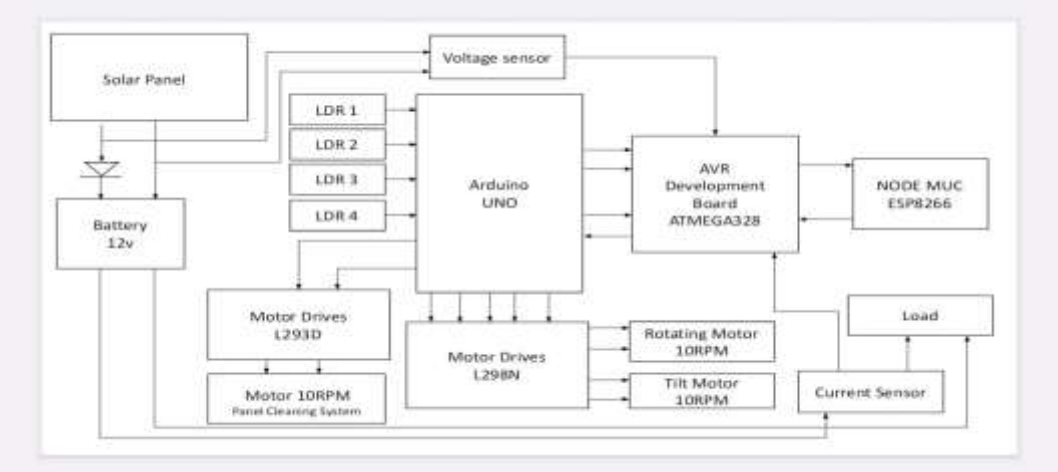

Fig1.1 Block Diagram

BLOCK DIAGRAM DESCRIPTION

In this project, we have to use solar energy source.it can be clearing dust partical and track solar energy by using dual axis tracking system.Current and Voltage can be sensed by current and voltage sensor and MCU is a open source IOT development board and it is used for update the data to internet .

COMPONENT USED

SOLAR PANEL:

This solar panel is made of single-crystal material that performs high solar energy transformation efficiency at 17%. These are waterproof, scratch resistant, and UV resistant. They use a high efficiency monocrystalline cell. They output12V at 300mA. The substrate is a plastic composite, specifically designed to be strong and lightweight. They can easily stand up to typical outdoor use including being dropped and leaned on. They're very high quality and suggested for projects that will be exposed to the outdoors.

BATTERY MODULE:

This battery module is made up of ICR 18650 1500mAh Lithium-Ion Batteries of the highest quality with a BMS circuit. In comparison to Ni-Cd, Ni-MH, and lead-acid batteries, it is compact and light. The battery pack may be directly charged with the DC power adapter thanks to the inbuilt charge protection circuit, eliminating the need for specialized battery chargers and the risk of overcharging. This battery pack is incredibly simple to recharge and integrate into your project**.**

VOLTAGE SENSOR:

ZMPT101B a voltage transform ideal to measure the AC voltage. It has high accuracy, good consistency for voltage and power measurement up to 250V AC. Easy to use and comes with a multi turn trim potentiometer for adjusting the AC and DC output , output Signal: Analog ,0-5V.

CURRENT SENSOR:

Sensing and controlling current flow is a fundamental requirement in a wide variety of applications including, over-current protection circuits, battery chargers, switching mode power supplies, digital watt meters, programmable current sources, etc. This ACS721 current module is based on ACS712 sensor, which can accurately detect AC or DC current. The maximum AC or DC that can be detected can reach 5A, and the present current signal can be read via analog I / O port of Arduino.

NODE MCU:

Node MCU is an open source firmware for which open source prototyping board designs are available. The name "Node MCU" combines "node" and "MCU" (micro-controller unit). Strictly speaking, the term "Node MCU" refers to the firmware rather than the associated development kits.

ARDUINO UNO ATMEGE328p:

A microcontroller board called the Arduino Uno is based on the ATmega328 from Atmel. It contains 6 analogue inputs, 14 digital input output pins, 6 of which can be utilised as PWM outputs. Both an external power supply and a USB connection are options for powering the Arduino Uno. With a 3.3-5V operating voltage, it has 32KB of programmable FLASH memory, 1KB of EEPROM, and 2KB of SRAM. Six analogue input pins are present on the PCB of the Arduino atmega-328 microcontroller. The names of these analogue inputs range from A0 to A5. We may do the process utilising these 6

analogue input pins. Inputs with an analogue signal can be used in the 0 to 5V working range. The 12 digital input pins of the Arduino Atmega328 microcontroller are also included. You can write it out as D0 to D11. Applications requiring digital input/output can use over 12 inputs. The discrete input pulses can be triggered and provided to the digital input ports during the course of their operation. This microcontroller is used in this instance to create pulses with pulse width modulation.

LDR:

This light sensor module or light dependent resistor module (LDR Module) usesthe GL5528 photo-resistor to detect the light intensity of the environment.The LM393 op-amp is configured as a "voltage follower" to increase the accuracy of this device

DC GEAR MOTOR:

They have a gear ratio operate up to 12 volts and deliver a stall torque of 12kgcm. And a max speed of 10 RPM and feature full metal gears to help you drive wheels, gears.(Motor types: Permanent-magnet, Brush type: Precious metal, Drive Type: Homopolar motors

MOTOR CONTROL MODULE:

This L298N Based Motor Driver Module is a high power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular L298 motor driver ICand has the onboard 5V regulator which it can supply to an external circuit. It can control up to 4 DC motors, or 2 DC motors with directional and speed control.and perfect for controlling motors from microcontrollers, switches, relays

OBSERVATION AND RESULT

The integration of IoT technology into solar panel cleaning and dual-axis tracking systems can greatly enhance their efficiency and effectiveness. IoT sensors can be used to monitor the performance of the solar panels and track their position, making it easier to identify and address any issues that may arise. In addition, IoT-enabled cleaning systems can be programmed to clean the solar panels automatically, reducing the need for manual labor and ensuring that the panels are always operating at maximum efficiency. Overall, the use of IoT technology in solar panel systems can lead to significant improvements in energy efficiency and cost savings over time. Figure 1.2 IOT Output shows the output of IOT Output

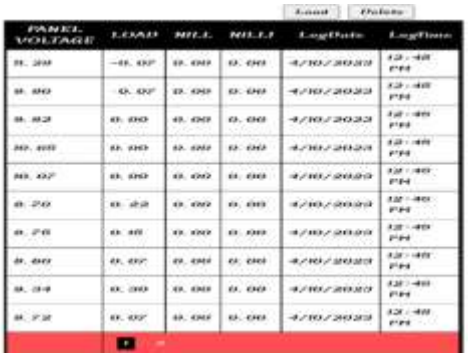

Figure 1.2 IOT Output

HARDWARE PICTURE FOR PROPOSED SYSTEM

Figure 1.3 Hardware picture for proposed system

CONCLUSION

In conclusion, the combination of a smart PV panel cleaning system and dual-axis tracking, monitoring using IoT technology can significantly improve the efficiency and output of solar energy systems. By incorporating sensors and automated cleaning technology, the system can constantly monitor the condition of the panels and clean them as needed, ensuring optimal performance. Dual-axis tracking enables the panels to follow the sun's movement throughout the day, maximizing the amount of sunlight captured. The IoT technology allows for remote monitoring and control, providing real-time data on the system's performance, and enabling proactive maintenance and troubleshooting. Overall, this integrated system can enhance the performance and longevity of solar energy systems. Figure 1.2 IOT Output shows the output of IOT Output.

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