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Solar Panel Health Monitoring, Cleaning and Alerting System Using Iot and Sensors

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ABSTRACT—Energy is one of the major issues that the world is facing in India, the supply of energy has been one ofthe major problems for both urban and rural households. About 60% to 70% of the energy demand ofthe country is met by fuelwood and agriculture residues.
Solar energy is a renewable source of energy, which has a great potential and it is radiated by the sun.
Renewable energy is important to replace the using of electric energy generated by petroleum. Solarpower has become a source of renewable energy and solar energy application should be enhanced.
The solar PV modules are generally employed in dusty environments which are the case tropicalcountries like India. The dust gets accumulated on the front surface of the module and blocks theincident light from the sun.

I. INTRODUCTION

The sun emits energy at an extremely large rate hence there is abundant availability of solar energy in the nature. If all solar energy could be converted into usable forms, it would be more enough to supply the world's energy demand. However, this is not possible because of conditions in the atmosphere such as effect of clouds, dust and temperature. Solar energy can be converted to more usable energy forms through solar panel. There is unprecedented interest in renewable energy, particularly solar energy, which provides electricity without giving rise to any carbon dioxide emission. Of the many alternatives, photovoltaic method of extracting power from solar energy have been considered has promising toward meeting the continuously increasing demand for energy.

In solar power generation plants, lakhs of solar panels are arranged in form of multiple arrays. The solar panel farms are generally situated in dirt and dust areas which is mostly in case of tropical countries. The performance of solar panels depends on various factors, the power generated by farms can decrease if there is dust and dirt on panels and this is the main factor for reduction. Solar power plants Node Mcu is a microcontroller with wifi module in built in it . need to be monitored for optimum power output.

This helps help us to bringing back 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 present an automated IOT based solar power monitoring system that allows for automated solar power monitoring from anywhere across the globe over the internet. We use nodemcu controller-based system to monitor solar panel parameters. This solar power monitor system continous monitors the solar panel and transmits the power.

Challenges

• Traditionally cleaning system wasdone manually. The manual cleaning has disadvantages like risk of staff accidents and damage of the panels,

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movement difficulties, poor maintenance etc.
• The automatic dust cleaning system of solar panels has taken to overcome the difficulties arise in the traditional cleaning and also produces an effective, non- abrasive cleaning and avoids the irregularities in productivity due to the deposition of dust.
• The studies carried out to evaluate the efficiency of solar panel for dust collected on it for one day, one week and a month.
The efficiency of solar panel also calculated after cleaning the surface for one day, one week and one month.

Motivation
• Renewable energy is extracted from natural resources that regenerates in less than a human lifetime without minimizing the existing resources.
• These resources, for example sunshine, wind energy, rains, oceanic tides, all kinds of waves, biomass energies, and thermal energy stored in the earth's crust, have the advantage of being practically everywhere available in one form or another.
• They are practically eternal. What is more, they do not show much of an effect on the climatic conditions or the ecosystem.
• On the of the used in a variety of applications are only available in countable quantitiesdirect current (DC) generate.

Objectives
*To clean the solar panel effectively.
*To make the system automated using Arduino.
*To avoid the manual work
To avoid dust associated problems on solar panels.
*To check the Solar PV workingd by solar panels and piezoelectric devices into alternating current (AC) for use in the electrical grid.

II. HARDWARE COMPONENT DESCRIPTION

Hardware Requirements:
1. Arudino Uno
2. Solar panel
3. Battery
4. LCD Display
5. Temperature Sensor
6. RACK and PION
7. DC Motor
8. L293D

1. Arudino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). 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.The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 upto version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Revision 3 of the board has the following newfeatures:

1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.

Stronger RESET circuit.
Atmega 16U2 replace the 8U2.
Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for acomparison with previous versions, see the index of Arduino boards.

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2. Solar panel

Solar energy is green energy which is easily available in day time. We can generate electricityby using PV cell. It is huge source of never-ending energy. Solar panel contains photovoltaic material which generate electrical energy when sun light falls on it. Depending upon the light intensity and position of the sun radiation the output electrical energy will be generate. The output of solar panels is given to battery through PWM charge controller.

3. Battery

The online range of sealed lead acid batteries are maintenance free, valve regulated and leak proof ideally suited to all other application. There will be no loss in power output over the battery life.Low self-discharge of about 2-3% per month compared with 20-30% for more common battery systems.

Quality construction with no compromise on materials to ensure a long service life. Low internal resistance means a high discharge rate. Wide operating temperature range operating between -15° C to +50 ° C when fully charged.

4. LCD Display

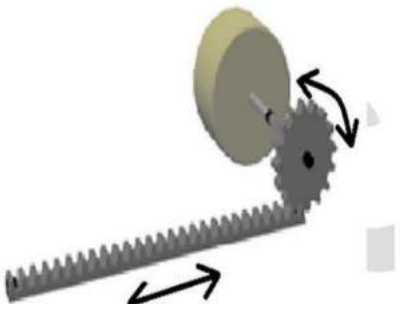
An LCD (Liquid Crystal Display) screen is an electronic display module and has a wide range of applications. A 16x2 LCD display i An LCD (Liquid Crystal Display) screen is an electronic display module and has a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various

• LCD display module with Yellow Backlight
• Size: 20x4 (2 Rows and 16 Characters Per Row)
• Built-in industry standard HD44780 equivalent LCD controller
• Commonly Used in laser printers, industrial test equipment, networking equipment such as routers and storage devices
• Operate with 5V DC LCD

5. Temperature Sensor

• DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output.
• By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability.
• This sensor includes a resistive-type humidity measurementcomponent and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference

6. RACK and PION



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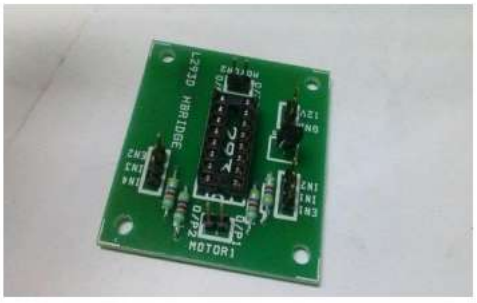
A rack and pinion is a type of linear actuator that comprises a pair of gears which convert linear motion into rotational motion. A circular gear called " the pinion " engages teeth on a linear " gear " bar called "the rack"; linear motion applied to the rack causes the opinion to move relative to the gear, thereby translating the linear motion of the rack into rotational motion.

7. DC Motor

The DC Motor used here is a gear DC Motor. A gear DC Motor is a combination of a motor and gearbox. The addition of this gear tends the motor to increase the rotational output and to reduce the speed. The important parameter of the gear DC Motor are speed in rpm, in this model the DC motor has 30 rpm speed, torque and efficiency.

1. Operating Voltage: 4.5V to 9V
2. Recommended/Rated Voltage: 6V
3. Current at No load: 70mA (max)
4. No-load Speed: 9000 rpm
5. Loaded current: 250mA (approx.)
6. Rated Load: 10g*cm
7. Motor Size: 27.5mm x 20mm x 15mm
8. Weight: 17 gm

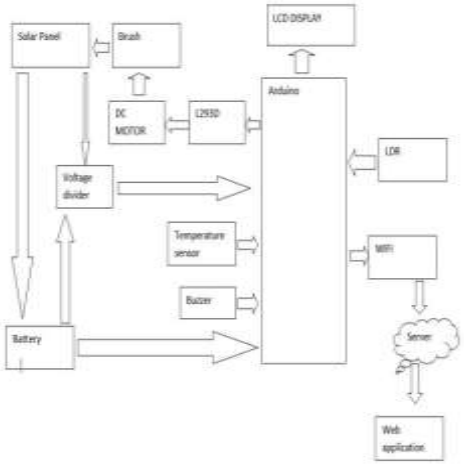
8. L293D



The L293D is a popular motor driver IC that is usable from 6 to12V, at up to 1A total output current.

By itself, the IC is somewhat difficult to wire and use, but the Compact L293D Motor Driver makes it much more convenient to use.

III. METHODOLGY



Working principle:

The solar panel voltage is readed through by divider circuit output,if voltage is less then 12v thecontroller starts moving the rack with help of DC motor,and the clean is over the voltage is highthen controller stops the dc motor,the temperature sensor is used to monitor the temperature at thesolar area, which data is sended to zigbee to control room to indicate the temperature is more orless.

1. As a result the rack attached to platform4. Battery
2. 2 also moves in the forward direction. Once the pinion reaches to the end of the first rackthe motor stops and 2 actuates making it stationary.Brush The brush is responsible for scrubbing and dusting away of the dust accumulated on thesurface of the solar panel. It is attached to the v-slot gantry plate platform which movesin thelinear. The brush is mounted on radial bearing which is rotated with the help of a 12 volt DCmotor.

i. The first frame is fixed. It is made of mild steel.
ii. The frame is brush moving in vertical direction. Main components are used in this machine for automatic panel cleaner includes following components.

1. DC motor
2. Roller brush
3. Water sprayer

iii. The above frames are controlled by Arduino programming.
iv. Arduino is micro-controller device in which the program is been dumped into it, andthrough the help of this micro-controller the frame moves.

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IV. CONCLUSION

- Existing automated cleaners mainly focus on large arrays and in general are unsuitable for installing on smaller arraysnamely residential roofs.
- Our system can be installed for roof top solar panels
- The solar panel cleaning system was first designed taking into consideration the design parameters.
- Our model was tested and the following observations were made.
- The rack and pinion mechanism work as it was designed to do.
- The linear actuator system worked very nicely and was able to achieve the required design parameter.
- The cleaning action of the brush was good but it failed to scrub the dust which was sticky in nature.
- The sticky dust needs to be remove using hard brush or through mopping action