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IOT BASED SOLAR POWER MONITORING SYSTEM

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Abstact: As the world now is turning towards renewable energy sources and countries like Iceland have obtained 100% renewable energy status and India has also started to lean towards renewable energy, moreover rooftop solar panels are becoming a trend nowadays but In order to know how efficiently the solar photovoltaic system is working and for performance evaluation there should be some monitoring system. Therefore here we propose a system using a microcontroller and internet of things technology using sensors to monitor the parameters of the solar photovoltaic system remotely from anywhere using smart phones and computers using web server. Some solar photovoltaic systems are located in inaccessible locations and it is difficult to monitor it and the solar panels are not utilized to its full efficiency all day ,in order to achieve the solar panel must absorb maximum sunlight every instant , in order to achieve it here we propose a sun tracking technology to control the solar panel and rotate it so it absorbs maximum sunlight every instant .The system is based on a new cost effective technology using a microcontroller and internet of things technology monitors and controls the solar photovoltaic system remotely from anywhere around the world.

Keywords: Arduino Uno, Wireless Sensors, IOT, Sun tracking system

1. Introduction

The internet of things is a futuristic technology by which an object could be sensed, monitored and controlled remotely using the cloud server network. By using this technology machines can communicate with themselves and be controlled without requiring humans.

In the past decade of years there is increase in demand for reliable and abundant electrical energy derived from renewable energy sources renewable energy plays important role in energy crisis of country. The government started to decrease the usage of conventional energy sources and encouraging people to use renewable energy sources like hydro and solar. One such example of renewable energy is solar power. Solar energy is a very large, inexhaustible source of energy.

Each hour the earth receives 430 quintillion joules of solar energy which is more than enough to power the whole world for an year. But the problem here is it is tough to utilize this much of energy efficiently. The solar panels nowadays are installed everywhere but they are not monitored so we donot know how much they generate and moreover the solar panels operates at its maximum efficiency for an hour or 2 hours but these can be overcomed by monitoring and controlling the solar panel using IoT.

An IOT Based Solar Power Monitoring system monitors the Solar panel parameters like voltage current and power generated over a Web server using internet and the solar panel detects sunlight using LDR so that it can get positioned where it receives maximum sunlight ,due to this solar panel can operate at its maximum efficiency all day.

The system will show the voltage, current and power generated by solar panel on the LCD and as well as on a webpage so that it can be monitored very easily. The solar panel current is sensed using a current sensor, then the power and voltage are calculated using the analog signal generated from the sensor. Using a dc motor and LDR the sunlight is tracked and atmega 328p (ardiuno) is used as the microcontroller. In this Iot project the solar panel can be monitored from anywhere using computer or smart phone

2. Existing System

The solar panels are monitored using a controller and current and voltage are sensed using current and potential transformers. The solar tracking is not implemented and controlling of solar panel is not done till now. Therefore the solar panel is not used to its maximum potential at each instant of time.

3. Proposed System

- This system monitors the solar panel parameters like voltage ,current and power generated
- This will update in the web server. So, we can monitor anywhere through internet.
- Web server keeps track of the daily power production of solar panel and stores it on a daily basis.
- The solar panel is rotated and aligned to a position where it receives maximum sunlight so that it can operate at its maximum efficiency.

3.1 Working

The sensors is used to sense the real time status of the solar panel, that is it senses the current using the current sensor. The dc motor rotates the solar panel using the dc servo motor depending upon the LDR, so that solar panel receives

maximum sunlight at each instant. The relay acts as the driver for the motor. The controller is connected to the sensor , LDR and the relay .The analog signal from the sensor and the LDR act as input to the controller and the output signal is given to the relay based on LDR's input and the solar panel parameters like voltage and power generated which are calculated from current signal from the sensor are displayed on the LCD.

The controller is interfaced with the cloud server using the wifi module, therefore the solar panel parameters like voltage, current and power generated are uploaded to the server. So the solar panel's real time status can be viewed remotely. Moreover the parameters of the panel are stored in the server each hour and each day so that it can be compared and analysed.

3.2 Hardware Required

1)Ardiuno Uno

2)ESP8266 Wifi Modem

3)Voltage divider circuit

4)Rectifier and filter unit

5)16x2 LCD

6)DC Motor

7)Relay

8)Step down transformer(230/15v)

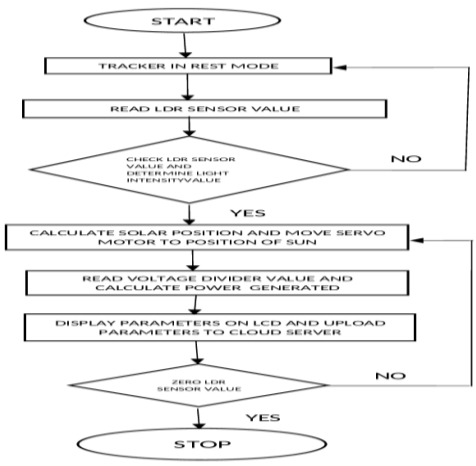
9)Solar panel(10 W)

3.3 Software Required

1)Thinkspeak iot platform

2)Ardiuno IDE

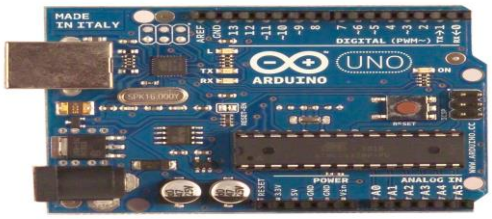
4. Flowchart



5. Hardware Components

5.1 Ardiuno 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 crystal oscillator, 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 Atmega8U2 programmed as a USB-to-serial converter.



5.2 Wifi Module ESP8266

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system. It is mostly used for development of IoT embedded applications. It is used for interfacing the microcontroller to the cloud server

5.3 LCD

This is a basic (16x2) 16 character by 2 line display. Black text on Green background.

5.4 DC Motor

DC motors are configured in many types and sizes, including brushless, servo, and gearmotor types. A motor consists of a rotor and a permanent magnetic field stator. The magnetic

field is maintained using either permanent magnets or electromagnetic windings. DC motors are most commonly used in variable speed and torque applications.

Here a dc servomotor (10 rpm)is used. They are also called as control motors. It works based on PWM (Pulse width modulation) principle, means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. The required gears are connected to the motor through the help of a resistor for rotation of solar panel.

5.6 Power Supply Unit

The unit consists of a step down transformer(230/15V),a rectifier ,filter and voltage regulator .The transformer is connected to the ac supply and it steps down the voltage from 230V to 15V ,then the rectifier converts the AC into DC ,the filter circuit consisting of a bypass capacitor removes the unwanted ripples in the DC voltage. Finally voltage regulator is used to maintain the voltage given to the ardiuno between +12 to -12.

5.7 Relay

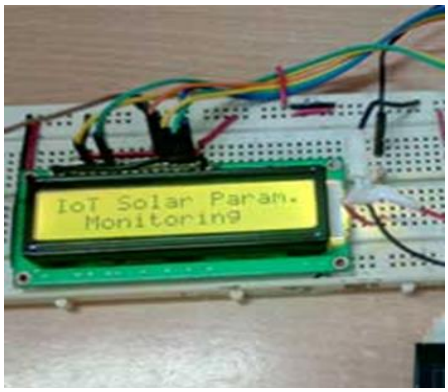
Relays are electromagnetic switches, which provides contact between two mechanical elements. A 5V Single Throw (SPST) relay, is used in this system, it consists of 5 Terminals: 5V, GND, Normally Open (NO), Normally Close (NC) and Common (COMM).Based on the signals given by the 3 LDRs to the ardiuno, the controller generated 3 digital signals and sends only the largest digital signal to the relay, now the relay drives the dc motor to the position where light intensity is highest. Relay acts as a driver circuit to the dc motor.

5.8 LDR

An LDR acts as a variable resistor, depending on the intensity of light the resistance value of LDR changes. When the light intensity is great the resistance value is low and vice versa.

6. Result and Discussion

1) By using the LCD the solar panel parameters ,the voltage current and the power is displayed in real time.

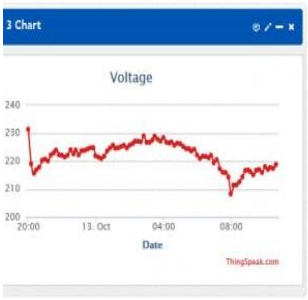


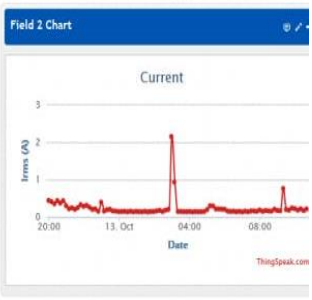
2) The solar panel parameters are also displayed and stored in an application or web page using the think speak IoT platform. So that the solar panel can be monitored remotely.

The result in the webpage is displayed in the form of a table containing the parameters with their unit with date and time.

S,NO	DATA	UNIT
1	VOLTAGE	Volts
2	CURRENT	Amperes
3	POWER	Watts

3) Each parameter is displayed in a graph with reference to time and date in the web server to analyse the data.





7. Conclusion

The proposed system stores the data from the solar photovoltaic system continuously, so it keeps track of the solar photovoltaic system and daily or monthly analysis becomes easy and efficient. Using the analysis it is possible to detect any fault occurring in the system as there would be inconsistency in the data generated by the system. By solar tracking the solar panel is operated at its maximum efficiency all day.

8. Future Scope

The controller requires an external supply to work but using the power generated from solar panel itself the controller's input power supply can be met. For very large solar panel dual axis solar panel tracking can be done. By analysing the data it is possible to predict the future values of parameters. Artificial intelligence can be implemented using various machine learning algorithms so that the system can become smart enough to take decisions about data and performance.

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