IoT-Based Solar Panel Monitoring System

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Abstract- Renewable energy sources are a practical solution for addressing the ongoing supply gap in the power industry. Because of the availability of solar energy throughout the world, unlike other geographically restricted resources, solar energy is most beneficial of all renewable energy resources. Sophisticated frameworks for remote monitoring of the plant using web-based interface are required for this massive scale of solar system deployment. Since the greater part of them are set in areas that are inaccessible and therefore monitoring them is not possible from a specific location. Internet of Things (IoT) enables the objects to be detected and remotely controlled by an established infrastructure of a network, creating possibilities for the pure physical-environment integration into frameworks that are based on computers. Application of IoT is proving beneficial for monitoring renewable energy generation. This application of IoT uses system based on Arduino to monitor parameters of the solar panel. The solar panel is monitored by the system continuously and the power output is transmitted over the internet to the IoT Network. It now uses an effective Interface to display these solar panel parameters to the user and it also alerts user when the outcome falls underneath the cut-off points specified. This makes, distantly monitoring of solar power plants more convenient and the best output of power is guaranteed.

I. INTRODUCTION

Electricity is the most essential needs in the lives of everyone in this modern world. The energy consumption graph is rising from day to day, while energy resources are diminishing in parallel. For the generation of electricity, many number of sources are used to balance the lack of electricity. There are two prime sources to generate electricity: one is the conventional sources of energy and the another one is non-conventional sources of energy. Several carriers of the energy like nuclear fuels and fossil fuels too are utilized, yet they are not the renewable resources and these are said to be the non-conventional resources. In it's broadest sense, solar power source plays a vital role in achieving the sustainable power source. Sun's rays serves as a significant source for the electricity generation by converting it into electric power and this application is conventional, which is known as the Solar Thermal Energy.

II. LITERATURE SURVEY

Purusothaman, SRR Dhiwaakar, et al:Explain about the focus is on the DG agents, grid agent and Mu agents. DG agents like the distributed energy resources (DERs), load, storage and the grid agents. The Mu agent acts as the communication channel between the DG agents to the higher-level agents such as the control agent. The implementation of the system has been done using an Arduino microcontroller

Author Kabalci, Ersan, Alper Gorgun, and Yasin Kabalci:Introduces An instant monitoring infrastructure of a renewable energy generation system that is constituted with a wind turbine and solar panel arrays. The monitoring platform is based on current and voltage measurements of each renewable source.

Jiju, K., et al: Describes the development of an online monitoring and control system for distributed Renewable Energy Sources (RES) based on Android platform. This method utilizes the Bluetooth interface of Android Tablet or Mobile phone, as a communication link for data exchange with digital hardware of Power Conditioning Unit (PCU). Goto, Yoshihiro, et al [4] explained about an integrated system that manages and remotely monitors telecommunications power plants has been developed and has started operations. The system is used to operate and maintain more than 200,000 telecommunication power plants, which including devices such as rectifiers, inverters, and UPSs, and air-

conditioning plants installed in about 8,000 telecommunication buildings. Features of the system are the integrate the management and remote monitoring functions, into one system and improved user interfaces, which use information and communication technology such as web technology. e measured with the developed sensing circuits and processed by an 18F4450 microcontroller of Microchip.

III. METHODOLOGY

For the current status of the solar panel to be sensed, the sensors are used, that is the current is sensed, using the current sensor. The solar panel is rotated by the DC Motor, using the DC Servo Motor relying on the LDR, with the goal that the panel gets the maximum sunlight at every moment. To the motor, relay serves as the driver. To the sensor, LDR and the relay, the controller is wired. LDR and the analog signal from the sensor acts as controller's input and the relay is supplied with the output signal, on the basis of the input from LDR and parameters of the solar panel like power and voltage generated which are calculated from the sensor's current signal are displayed on the LCD. An interface is shared across the controller and the cloud server utilizing the Wi-Fi module, subsequently the panel parameters like voltage, current and power generated are transferred to the server. Along these lines, the ongoing status of the panel can be viewed remotely. It can be compared and analysed, as the parameters of the panel are stored in the server every hour and every day. Data from the different solar panels is integrated by Internet of Things platform and applies analytics to share the most significant data with applications made to address.

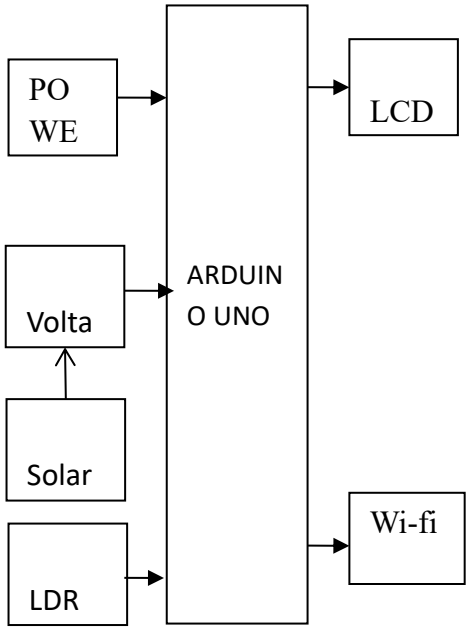

Fig 1: Block Diagram

IV. HARDWARE DECRIPTION

A. Arduino Uno

The Arduino Uno is an open-source microcontroller board, which is based on the ATmega328 (datasheet). Arduino Uno has 16MHz crystal oscillator, 6 analog inputs, a USB connection, an ICSP header, a power jack, 14 digital input or output pins and a reset button. It comprises of all which is needed to aid the microcontroller; power it with a battery or AC-to-DC adapter or just associate it to a PC with a USB link to get started. It is powered for its operations by a 5-volt dc supply. High functionality with familiarity and simplicity is the purpose of the Arduino UNO. It serves as a link between the solar panel and the Internet of Things (IoT).

B. Wi-Fi Module ESP8266

The ESP8266 is a Wi-Fi microchip, built by Espressif systems with a complete TCP/IP protocol stack and MCU (Micro Controller Unit) capability. It is inexpensive. This is mainly used for the IOT embedded applications development. ESP8266 is used to interface the cloud server with the microcontroller.

Arduino's measured data is processed by the ESP8266 module for data storage in the IOT or Cloud

C. Liquid Crystal Display (LCD)

Liquid Crystal Display (LCD) The LCD screen is a flat panel electronic display technology, commonly used in various devices and circuits. LCD is a basic (16x2) display, that is, it can display 16 characters per line and there are 2 such lines. 16x2 LCD display will have a black text on Green background. The LCD is used to view the different parameter values sensed by the sensors, such as the voltage, current and power of the solar grid. Over any other multi segment LEDs, these modules are mostly preferred because, LCDs are costeffective; can be programmed easily; there is no constraint on displaying custom characters (unlike in seven segments) and special characters, etc.

D. LCD MODULE

To display interactive messages we are using LCD Module. We examine an intelligent LCD display of two lines, 16 characters per line that is interfaced to the controllers. The protocol (handshaking) for the display is as shown. Whereas D0 to D7th bit is the Data lines, RS, RW and EN pins are the control pins and remaining pins are +5V, -5V and GND to provide supply. Where RS is the Register Select, RW is the Read Write and EN is the Enable pin.

- Power Supply Unit A step-down transformer (230/15V), a filter, a rectifier and a voltage regulator are part of the unit. The transformer remains associated with the AC supply and it steps down the voltage from 230V to 15V, at that point the rectifier changes over the AC into DC, the filter circuit consists of a bypass capacitor which eliminates the ripples that are not required in the DC voltage. Now, voltage regulator is used to maintain the voltage given to the Arduinobetween +12 to-12.

- Light Dependent Resistor (LDR) A light-dependent resistor (LDR), also called as photoresistor is a variable resistor which will be controlled by light. The fundamental working principle of an LDR is photo conductivity. The photo-resistor functions as a variable resistor, and the resistance value of the LDR varies depending on the intensity of light. So, we are connecting this LDR by providing constant voltage through Arduino pins to understand the level of light intensity at the solar power plant

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- Solar Panel The solar panel, otherwise called as photovoltaic module is a device which is utilized to transfer the solar energy into electrical energy by absorbing the sunlight. A solar panel is made of multiple cells, and multiple panels that are wired together forms a solar array; the greater number of panels we can deploy, the more will be the power generated. Silicon like semiconductor material is used to make the PV photovoltaic solar panels. Solar panels generate Direct Current.

V. RESULT

The following are the results after interfacing the solar panel with the mobile phone.The parameters that are found are voltage induced,current and the temeprature of the solar panel.

VI. CONCLUSION AND FUTURE SCOPE

Internet of Things (IoT) driven framework is aimed at getting an ideal power output from the solar panels, in this project. The different solar panel parameters like voltage, current and temperature are displayed on the LCD by using this IOT technology. The daily, weekly and monthly analysis becomes simple and efficient, as this system keeps continues track of the solar power plant. With the help of this analysis, it is possible to identify any issue occurred within power plant as there would be discrepancy in the information produced by the framework. Solar panel is worked at its maximum efficiency the entire day, by the solar tracking.

FUTURE SCOPE

The controller needs an external source to work, however, by means of the power generated by the solar module itself, the controller’s input supply of the power can be met. Dual axis solar panel tracking can be done, for very large solar panel. It is possible to foresee the future predictions of parameters, by analysing the information. Using various machine learning algorithms, Artificial intelligence this can be implemented, so that the system can turn out to be

smart enough to take decisions about information and performance.

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