Wireless Transmission of DC meter reading from solar panel

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ABSTRACT

National Institute of Wind Energy (NIWE) has established Solar Radiation Resource Assessment (SRRA) stations all over India as a part of promoting and efficiently utilizing solar energy. The challenge faced by SRRA stations in remote areas is to continuously monitor the panel efficiency and solar intensity patterns at a particular location. Here, we aim to automate the process of solar power measurement at SRRA stations and update it to the central receiving station (CRS) at NIWE. The overall process comprises of recording the power every minute and updating it in a controller which is then cumulatively added at the end of the day and is transmitted to the CRS. This helps in gaining insight about the areas with higher solar intensity and establishing solar plants for effective harnessing of renewable resources.

Keyword: - *Solar Energy, DC Meter, Wireless Communication, NSM, SRRA, IoT, Renewable Energy*

1. INTRODUCTION

A Photovoltaic system is based on the ability of certain materials to convert the radiant energy of the sun into electrical energy. The total amount of solar energy that lights a given area is known as irradiance (G) and it is measured in watts per square meter (W/m2). The instantaneous values are normally averaged over a period of time, so it is common to talk about total irradiance per hour, day or month.

Enhancing the share of renewable in the overall energy basket of the country is a priority for the Government. With solar power at the center stage, this ambitious program has target to install 100 GW of solar energy by 2022. The Government of India has revised National Solar Mission(NSM) target of grid connected solar projects from 20 GW to 100 GW by 2022 of which 40 GW is proposed to be achieved by grid connected roof top solar-PV and the remaining of 60 GW by medium and large scale grid connected solar power. A number of instruments have been in use to promote development of solar power in the country. However, the effectiveness of these instruments depends on the way they are implemented.

It serves twin purposes such as Long Term Energy Security and Ecological Security. Objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. Ministry of New and Renewable Energy (MNRE) has allocated a project to National Institute of Wind Energy (NIWE), Chennai for building up the solar radiation resource assessment stations all over India. NIWE has now established 117 Solar Radiation Resource Assessment stations and 4 Advanced Measurement Stations. The SRRA station consists of two towers for measuring solar and meteorological parameters. All the SRRA stations are powered by renewable solar energy with the help of solar panels.

2. RELATED WORKS

[1]The current and voltage generated is measured by means of respective sensors. The solar power is calculated using the formula and cumulative values are taken and is sent to the database (web browser) created using LABVIEW for visual presentation. [2]Parallel communication is used throughout the system which is reliable and simpler one. By means of using Transceiver module X-bee, transmission is made easier. State of Art algorithm does not seem to be very effective and distance of the wireless transmission is confined to a smaller area. [3]Performance parameters are measured for each PV panel and are transmitted to a remote coordinator. [4]Provides the complete on site characterization of individual solar cells based on wireless sensor networks and the transfer of data to remote computers with web-based technology. The methodology proposed is suitable to solar topologies were each panel is optimized autonomously from the other panels. [5]The method uses Ethernet and GSM modem for data acquisition and reception. For Ethernet, category 5 cable should be connected to the system and transmission through it is efficient for about 100 meters, above which signal fading occurs. To overcome the above issue, repeaters need to be installed. As distance increases, number of repeaters and cost involved for designing the system rises. In GSM mode of data transfer, the delay in dispatch of SMS is a serious drawback in real time systems. There is a need to recharge the SIM periodically, both at transmitter and receiver sites, and the possibility to hack the GSM network requires the need for an alternative technology. [6]The measurement module includes Xbee to receive and store the amount of power generated by the solar plant and RS232 to transmit this information to the central database/receiving station. Xbee has a transmission range constraint of 800 meters, hence it appears to be ineffective in remote area monitoring. RS232 is a serial communication standard for transfer of information. Power reading measured by DC energy meter is in parallel form, RS485 thereby requiring an additional parallel to serial converter. The use of battery to supply power to the microcontroller unit reduces the life of the system as the system is on throughout the day. [7]The amount of solar energy produced is measured by the meter is transmitted by means of a GSM module at the site of the solar panel. The above said transmitted data is received by another GSM module located at the server end and is processed and stored as data in the Personal Computer. By the use of this technology, the cost of implementing the process seems to be high due to recursive recharging of the SIM cards for this purpose. [8]This is addressed to give the power generated to the Electricity Department. Electricity Board uses AC supply but Solar Panels produces DC, hence the power generated by the solar panels is inverted before is sent. Thus, some amount of energy is lost as a result of invertor and efficiency is getting reduced. The Power is measured by means of an AC meter after the inversion.

3. PROPOSED ALGORITHM

A. Design Considerations:

- The DC Meter measures voltage and current produced by the panel
- The observed current reading is six times the actual current by default
- Power is calculated from measured voltage and current
- Minimum current of 1.2A/5V is required for the functioning of the circuit
- Power of 20W is required for the circuit designed
- The output from the meter is parallel data with the RS485
- A Convertor is used to convert the data to serial format of RS232/ USB
- Conversion is mandatory as the processor accepts only data in RS232/ USB format
- Ethernet port in the processor provides Internet facility for wireless transmission of measured data
- The data transmitted is stored in the server for future use

B. Description of the Proposed Algorithm:

Problem Statement:

The SRRA stations are located at remote places and are difficult to measure the solar power generated by the panels. The Power generated is very much necessary in order to implement the Jawaharlal Nehru National Mission, which can be implemented in the areas where the intensity is high for high efficiency.

Aim:

The aim of the proposed algorithm is to measure the power generated by the solar panel every second, sample the data every minute and averages it over a day and transmits it wirelessly to the Central Receiving Station (CRS) located at the NIWE by means of IoT.

Step 1 Harvesting Power from solar panel:

The power generated by the panel can be calculated from the current (I) and voltage (V) measured by the meter which incorporates sensors. This is implied by the following equation:

$$P_{received} = V * I$$

The current value displayed in the meter is six times the actual current because of the sensitivity issues in the meter. The current produced by the solar panel is in the range of the milli-amperes. Hence in order to display in the LCD of the DC meter, the concept of multiplication factor is being introduced.

$$P_{actual} = (V * I) / 6$$

P_{actual} is the actual power excluding the multiplication factor

Step 2 Data Acquisition and Transmission:

The Panel installed at the location produces a peak voltage of 100 watts. The power depends on the geographical location of the panel and varies instantaneously. Here, we use a DC meter which measures the voltage and current from time to time. These data are useful in computing the power generated at that particular time and at that particular location. The Power measured is updated every now and then in the memory attached to the processor. The processor used here is Raspberry Pi which works at 1.2GHz, and has 64 bit ARM Cortex A53 processor in it. This Raspberry Pi has an on chip RJ45 port. This port can be connected to Internet by Wi-Fi or by means of the Ethernet cable from the router. The Raspberry Pi has the System on Chip BCM2835. The data extracted from the meter is of the format RS485. On the other hand Raspberry Pi accepts data only in RS232 format. So, for the inter conversion from one standard to the other, we use RS485 to RS232 convertor which will make the data available in the acceptable format for Raspberry Pi. The data is given as input to the GPIO pins of the Raspberry Pi and the value of power generated is stored. The power value gets updated and at a specific period of time in a day, the readings are transferred to the web server by means of the Internet connectivity provided.

Step 3 Outcomes:

Thus it will be easy for the large investors to identify the areas with high solar intensity, which will help them to implement even more thereby promoting Renewable form of energy and saving the non-renewable energy for the future generations to come.

4. PSUEDO CODE

Step 1: Align the solar panel and DC meter in the direction to get supply of at least 2A.
Step 2: Obtain the values of current (I), voltage (V) and power (P) from the DC Meter.
Step 3: Calculate the actual power from the received power using condition
Actual power = Received power/multiplication factor
Step 4: Store the actual power in the memory at an interval of one minute.
Step 5: Update the power stored in the memory to the server once in every 24 hours by taking cumulative power generated and send it to the email id provided.
Step 6: Refresh the memory to the next day and create a new column.
Step 7: Go to step 2.
Step 8: End.

5. RESULT

http:// 192.168.20.175/DC.html

POWER MEASUREMENT SERVER at CRS Station

Date	Power Generated (watts)
22.02.2017	72
23.02.2017	64
24.02.2017	81

Screenshot of Web Server

The screenshot and graph conveys the cumulative solar power generated by the panel on each day. This statistical report can be mailed whenever required for recording purposes. From this, proper areas to get maximum efficiency can be identified at ease.

6. FUTURE WORK

The output results show that the methodology used here performs better, faster and much economical in the measurement of the DC reading which needs to be sampled every second as it changes constantly with the intensity of the solar radiation. As a future advancement, facility of getting the details stored in the server can be made available as Short Message Service to the user. To add more detail and to bring insight knowledge of the Renewable energy, a mobile application can be developed to get the updated reading every now and then and also to educate people on the effects on using Non-Renewable resources and its impact on human life.

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