Solar Power Remote Monitoring And Controlling Using Iot And Server

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Abstract- *The microcontroller located at the centre of the block diagram forms the control unit of each node. Embedded within the microcontroller is a program that helps the microcontroller to take action based on the inputs provided by the output of the voltage circuit.*

The used solar panel is of 12V and 10W capacity. The power from the solar power is connected to the Buck Booster Circuit which is used to recharge the battery. We can measure the output power of Solar Panel and battery. The two Voltage circuits are used for dividing the voltage levels and the output of the voltage circuit which is in analog form is converted to digital form by ADC, and can be displayed on ALCD. The Measured Parameter can be uploaded to Amazon Cloud Server (Amazon Elastic Cloud Computing) through GSM/GPRS. The CPU fan can be controlled through relay for dust cleaning of the solar panels.

Keywords- Microcontroller, ALCD, Buck Booster Circuit.

I. INTRODUCTION

Solar power is emerging as the number one competitive renewable energy resource, so to improve the utilization of solar energy resources, solar power monitoring systems is more important. Photovoltaic solar panels are increasing in popularity and users need accurate information of their solar energy installation.

Currently, most residential solar panel systems only provide energy information on a monthly basis and do not allow individual panel monitoring. PV solar panel has at least 25 years warranty, whereas inverters only come with an 8-10 years warranty. That means that sometime in the 8-10 years range the inverter will die and the system will stop producing energy.

With a monitoring system in place, the installer or home owner will know immediately that the system has been compromised. Otherwise it could be weeks or months before the home owner looks at their energy usage statement from their utility company and realizes that their solar electricity system is no longer producing energy.

Other problems arrive when solar power monitoring system is not in use and that problems are related to the battery charging and discharging states. Overcharging of battery will produces Gasification and that reduces the effective capacity of battery, whereas over discharging produces Hard Sulfation. As result of sulfation it generates big crystals on battery plate which do not take part in any chemical reaction and can make battery unusable. So, it is very important to get more information about solar panel performance, tracking and maintenance.

The hardware is developed with Solar Panel, Renesas controller, and voltage divider circuit, relay and buck booster circuit and GSM. It is also possible to record and reach database file to analyse history of renewable energy source system. This will also help to increase performance of the existing solar system also other alternative resources of energy. In this system monitoring interface contains power production and consumption. Controlling feature includes automatic dusting of solar panels using fan, thereby increasing the efficiency of solar power generation.

II.BLOCK DIAGRAM

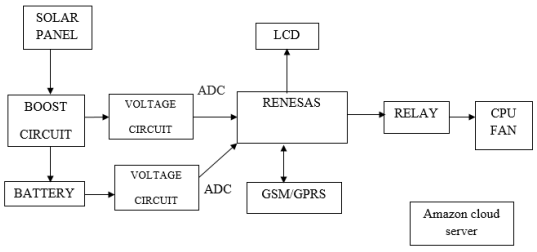

Fig 1: Block diagram

Many embedded systems have substantially different designs according to their functions and utilities. In this project design, structured modular design concept is adopted and the system is mainly composed of a single

microcontroller, Solar Panel, CPU Fan, Relay, Voltage Circuit, GSM/GPRS, Amazon cloud server (Control node) and database(Management node). Apart from the database, the entire unit is placed near Solar Panel.

The microcontroller located at the centre of the block diagram forms the control unit of each node. Embedded within the microcontroller is a program that helps the microcontroller to take action based on the inputs provided by the output of the voltage circuit.

The used solar panel is of 12V and 10W capacity. The power from the solar power is connected to the Buck Booster Circuit which is used to recharge the battery. We can measure the output power of Solar Panel and battery. The two Voltage circuits are used for dividing the voltage levels and the output of the voltage circuit which is in analog form is converted to digital form by ADC, and can be displayed on ALCD. The Measured Parameter can be uploaded to Amazon Cloud Server (Amazon Elastic Cloud Computing) through GSM/GPRS. The CPU fan can be controlled through relay for dust cleaning of the solar panels.

III. HARDWARE DETAILS

A. Renesas Controller

Renesas microcontroller surpasses its predecessor i.e. 8051 family of microcontrollers, with various in-built features. A few of the many features are mentioned below.

- Renesas is a 16 bit microcontroller
- Minimum instruction time can be changed from ultra-low speed (30.5us) to high speed (0.03125us).
- 16 to 512KB of ROM and 2 to 32KB of RAM are available depending upon the series and number of pins.
- On-chip high-speed (32 MHz to 1 MHz) as well a low-speed (15 KHz) oscillator is present.
- 10 bit resolution A/D converter (6 to 26 channels depending upon the series)
- Totally 3 UART for Serial Interface
- Totally 0-7 channels for timer with built in PWM features.
- Most of the pins of Renesas have multi-task features.
- Cost of Renesas microcontroller is comparatively less.
- Rigid body of microcontroller hence less prone to damages due to electrostatic charge.
- Operates with 5v power supply.

B. Alpha-numeric Liquid Crystal Display (ALCD)

A liquid crystal display (LCD) is a flat panel display, electronic visual display, based on Liquid Crystal Technology.A liquid crystal display consists of an array of tiny segments (called pixels) that can be manipulated to present an information. Liquid crystals do not emit light directly instead they use light modulating techniques.

LCDs are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones.

LCDs are preferred to cathode ray tube (CRT) displays in most applications because

- The size of LCDs come in wider varieties.
- They do not use Phosphor, hence images are not burnt-in.
- Safer disposal
- Energy Efficient
- Low Power Consumption
- It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome.

C. GSM

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer.

GSM/GPRS Quad band TTL UART modem(SIM800C) from rhydoLABZ, is built with Quad Band GSM/GPRS engine- SIM800, works on frequencies 850/ 900/

1800/ 1900 MHz. The Modem comes with selectable interfacing voltage, which allows you to connect 5V & 3V3 microcontroller directly without any level conversion chips. The baud rate is configurable from 9600-115200 through AT command. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface.

D. Solar Panel

A solar panel (also solar module, photovoltaic module or photovoltaic panel) is a packaged, connected assembly of photovoltaic cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications.

Because a single solar panel can produce only a limited amount of power, many installations contain several panels. A photovoltaic system typically includes an array of solar panels, an inverter, and sometimes a battery and interconnection wiring.

A solar cell (also called photovoltaic cell or photoelectric cell) is a solid state electrical device that converts the energy of light directly into electricity by the photovoltaic effect. Assemblies of solar cells are used to make solar modules which are used to capture energy from sunlight. When multiple modules are assembled together (such as prior to installation on a pole-mounted tracker system), the resulting integrated group of modules all oriented in one plane is referred to in the solar industry as a solar panel. The electrical energy generated from solar modules, referred to as solar power, is an example of solar energy.

E. Relay

Relays are electromechanical devices that use an electromagnet to operate a pair of movable contacts from an open position to a closed position. It is basically used to control the load.

The advantage of relays is that it takes a relatively small amount of power to operate the relay coil, but the relay itself can be used to control motors, heaters, lamps or AC circuits which themselves can draw a lot more electrical power.

The electro-mechanical relay is an output device (actuator) which come in a whole host of shapes, sizes and designs, and have many uses and applications in electronic circuits. But while electrical relays can be used to allow low power electronic or computer type circuits to switch relatively high currents or voltages either “ON” or “OFF”, some form of relay switch circuit is required to control it.

F. Voltage circuit

Voltage Divider, in fact is a fundamental circuit in the field of electronics which can produce a portion of its input voltage as output. It is formed using two resistors or any passive components and a voltage source. The resistors are connected in series here and the voltage is given across these two resistors. This circuit is also termed as potential divider. The input voltage is distributed among the resistors (components) of the voltage divider circuit. As a result, voltage division takes place.

G. Boost circuit

The buck–boost converter is a type of DC-to-DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude.

Two different topologies are called buck–boost converter. Both of them can produce a range of output voltages, from an output voltage much larger (in absolute magnitude) than the input voltage, down to almost zero.

H. CPU fan

A computer fan is any fan inside, or attached to, a computer case used for active cooling, and may refer to fans that draw cooler air into the case from the outside, expel warm air from inside, or move air across a heat sink to cool a particular component. Generally these are found in axial and sometimes centrifugal forms.

In solar power monitoring and controlling system using IOT and server fan is used as output to blow the dust which accumulates on the solar panel at a certain period.

IV. SOFTWARE DETAILS

A. Internet of Things (IOT)

The internet of things (IOT) is the network of physical devices, vehicles, buildings and other items-embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. IOT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. The interconnection of

these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities.

B. Cube suite+

Integrated development environment Cube Suite (Cube suite) offers the ultimate in simplicity, usability, and security for the repetitive editing, building and debugging that typifies software development. Easy to install and operate, CubeSuite offers a highly user-friendly development environment featuring significantly shorter build times and graphical debug functions. The robust line up of expanded functions and user support functions ensures a dependable environment for all users.

C. Renesas Flash Program

Renesas Flash Programmer (RFP) is software that erases, writes, and verifies programs on the target system on which a Renesas Electronics single-chip microcontroller with on-chip flash memory is mounted by using an E1 emulator (hereafter referred to as E1), E20 emulator (hereafter referred to as E20), or the on-chip debug emulator with programming function, QB-MINI2 (hereafter referred to as MINICUBE2), or a serial interface.

D. Amazon Elastic Cloud Computing (Amazon EC2)

Amazon Elastic Compute Cloud (Amazon EC2) provides scalable computing capacity in the Amazon Web Services (AWS) cloud. Using Amazon EC2 eliminates the need to invest in hardware up front, so that development and deployment of applications can be done faster. Amazon EC2 can be use to launch as many or as few virtual servers as needed, configure security and networking, and manage storage. Amazon EC2 enables to scale up or down to handle changes in requirements or spikes in popularity, reducing the need to forecast traffic.

V. RESULTS AND DISCUSSION

The Proposed system mainly consists of two blocks embedded system gateway and host network. In proposed system, Host network and embedded system gateway forms a core of IOT system. In host network, a GPRS modem is used to connect Solar PV panel to the Internet. In embedded system gateway, Renesas Microcontroller module is used which in turn is used to interconnect the solar PV to the GPRS modem. Initially the Embedded system gateway initiates the connection of GPRS modem.

When the connection is established embedded system gateway will start receiving the parameters from solar PV using serial communication UART port. The data from the solar PV is collected in the embedded system gateway and transferred to GPRS modem using serial UART port. The GPRS modem will host the received data in authorized IP address of website via internet. The solar PV data are sent to the web server and stored in the amazon cloud. The data can be analyzed anywhere any time. The authorized person can monitor all the parameters through the internet via web server. And also Controlling feature includes automatic periodic blowing of dust which accumulates on the solar panels. The prototype of Solar Power Monitoring and Controlling using IOT and server is as shown in Fig 2

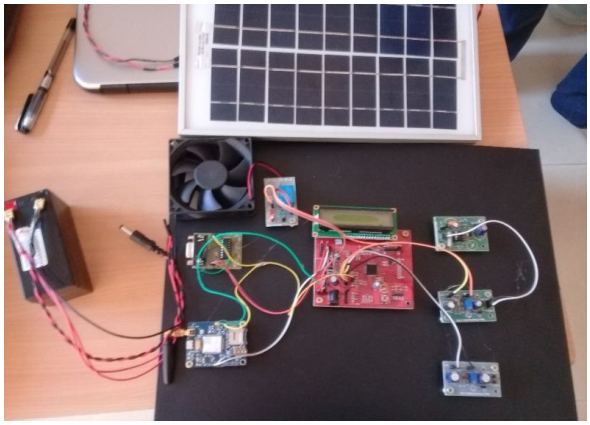

Fig.2: Prototype of Solar Power Monitoring and Controlling using IOT and server.

VI. CONCLUSION

The Solar Power Monitoring and Controlling using Internet of Things has been experimentally proven to work satisfactorily by monitoring the parameters successfully through the internet. The designed system not only monitors the parameter of solar panel, but it also automatically blows away the dust accumulated on the solar panels and hence increase the efficiency of solar power generation. It also stores all the parameters in the cloud in a timely manner. This will help the user to analyze the condition of various parameters in the system.

VII. FUTURE SCOPE

The future work for Solar Power Remote Monitoring and Controlling using IOT and server can be carried out by automatic controlling the load for example switching ON/OFF of the load. The advance provision of remotely managing the Solar Power Generation plants of various operations like remote shutdown, remote management is to be incorporate with this system later.

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