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Automatic Monitoring and Lifetime Detection of Solar Panels Using Internet of Things

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ABSTRACT : Examine and recognize faults on a set of Solar panels, using Internet Of Things (IOT). An effective implementation of an remote observing system for solar Photovoltaic cell (PV) and Power Conditioning Unit (PCU). Today, with the growth in sensor technology it is a very likely option to connect the solar energy systems to the cloud (internet) with the help of Internet of Things, the analysis of the performance, productivity and efficiency can be calculated very easily when system is connected to cloud. With the software-technology monitoring of vast solar panels are made easy and accurate. In existing system the data are monitored manually and noted down in notebooks and excel file. Our proposed system invokes automatic monitoring of output. The sensors like temperature sensors are fixed on the solar panels and the current voltage produced are been transmitted through wireless communication and monitored in base station (system).

I. INTRODUCTION

A. *OVERVIEW*:

The Internet of Things *(*IoT*)* is a kind of system which append and supervise devices, the ability to relocate data over a web without governing human-to-human or human-to-computer interaction. The concept of combining computers, sensors, and networks to observe and control devices has distributed for decades. The recent merging of several technology market trends, however, is bringing the Internet of Things closer to widespread reality. These include present Connectivity, Widespread Acceptance of IP-based Networking, Computing Economics, Miniaturization, Advances in Data Analytics, and the Rise of Cloud Computing.IoT implementations use different technical discipline models, each with its own characteristics. Four common discipline models described by the Internet planning Board include: Device-to-Device, Device-to-Cloud, Device-to-Gateway, and Back-End Data-Sharing. These models foreground theplasticity in the ways that IoT devices can connect and provide value to the user.

An Embedded system is a remarkable purpose computer contained electro-mechanical system in which the computer is completely combined by the device it controls. An embedded system has distinct requirements and implements pre-defined mission, unlike a general-purpose personal computer. An embedded system is a computer- hold system.The core of any embedded system is a microprocessor, programmed to perform a few duties (often just one task). This is to be analyse to other computer systems with general purpose hardware and externally laden software. Embedded systems are often designed for mass production.

B.WIRELESS SENSOR NETWORKS:

Wireless sensor networks (WSN), sometimes called wireless sensor and actuator networks (WSAN), are spatially scatter self determining sensors to observe physical or environmental conditions, such as temperature.solar panel will include this wireless sensor network(temperature sensor) for monitoring environmental condition of remote place.WSN also used used to control solar photovoltaic power conditioning unit from server.

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II.RELATED WORK

[1] Ali Al-Dahoud, Mohamed Fezari, FatmaZohra Belhouchet
Upgrading pre-installed monitoring system for a set of Photovoltaic (PV) panels, using wireless sensor network (WNS), to handle and recognize faults within solar panels that affect greatly the energy produced by the solar panels. The new solution is to combine the identification and sorting of faults within the sensors node. The WSN nodes are executed with suitable sensors for more often occurred faults on the solar power panels. A simulation has been done on nodes delivery and a study for the design of a node with appropriate sensors taking into account the priorities of the processing faults. The main conclusion of simulation are very stimulating in point of fast detection of faults with least computation and minimum data dispatch.

[2] Simon Siregar, Duddy Soegiarto
The use of of single power solar system in production of electricity for streetlights nowadays is broadly used. Generally, many of this kind of streetlight is using one solar panel system to strength its lamp. The difficulty that can be arise for this kind of streetlight is how to control and guarantee the optimal system.The use of ACS712 current sensor and voltage sensor using voltage divider circuit with GSM communication system allows to supervise both the battery and the solar panel. The statistics from the current sensor and voltage sensor then handled by a microcontroller. This microcontroller then send the data through a GSM transmission system to a server, via short message service (SMS). This server then manage the data by parsing the information from the SMS, and send the statistics to a web server database. This information then can be retrieved by internet. The anticipated outcome of this monitoring system is a system that can be used in supervising small solar power plants system as the street lights.

[3]C. Ranhotitogamage, S. C. Mukhopadhyay, S. N. Garratt.
This paper has investigated the design and development work of a wireless performance observing of dispenses solar panel along with automated data record. The developed system is transferable, simple and configured based on the accessible resources in the laboratory. The system can be continuing for wide range of solar cells for material research and development activities. The counterfeit system has been used for our research and very acceptable results are obtained.

III SYSTEM ANALYSIS

A.Problem Definition

A Remote supervising system for solar PV PCU face four main obstacles, mean time to repair is tedious, inflexibility, poor manageability, and difficulty to maintain and also datas are noted down manually or excel file.The main objectives of this research is to design and implement a Smart Remote monitoring system using IOT that is capableof monitoring the Solar PV PCU and stores data in the base station using putty software. The recommended system has a great adaptability. This will decrease the continuance cost and will increase the efficiency of the system.

B.Proposed System Feature

Implementation of an intelligent remote monitoring system for solar Photovoltaic (PV) Power Conditioning Unit (PCU) which is used in a greenhouse environment. Advancements in sensor technology it is a very viable option to connect the solar energy systems to the cloud (internet) with the help of Internet of Things.Once these systems are connected to the cloud, the analysis of the performance, productivity and efficiency can be calculated very easily. With the software-technology monitoring of vast solar panels are made easy and accurate. The sensors like thermocouple, voltage and current sensors are fixed on the solar panels and the current / voltage produced are been transmitted through wireless communication and monitored in base station (system) using visual basic. From the base station the data are updated in the live server using Internet of Things.The result of our demonstration shows that the system can monitor, store and manipulate data from solar PV PCU.The remote monitoring functions are realized in real-time.

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IV. SYSTEM DESIGN

A.Proposed Remote Monitoring System For Solar PV System

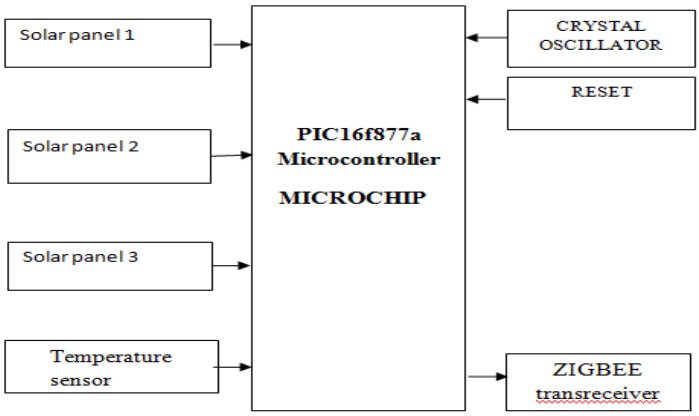

Figure 1 solar lite

The architecture of a proposed monitoring system of solar PV PCU is as shown in the figure.1. The Proposed system consists of embedded system and host network, in which embedded system consists of 3 solar panels,temperature sensor, crystal oscillator, reset, zigbee transreceiver. solar panels are used to store electricity which comes from sun. Temperature sensor is used to address the current temperature of environment. Crystal Oscillator is an electronic circuit which uses mechanical resonance of vibrating crystal of piezo electric material to create electrical signal.PIC microcontroller is used which generates electrical signal which ranges from 0-5 volts.ZigbeeTransceiver is used which going to transmit voltage generated from solar panel to base station and ZigbeeReceiver receive the voltage and sent through wireless communication, which can be updated in live server.

B.Software Design

On the web page HTML (Hyper Text Mark-up Language) was used for front end design.HTML is a format that says a computer how to display a web page.The documents themselves are plain text files withspecial "tags" or codes that a web browser uses tointerpret and display information on your computer. It isa text file containing small mark-up tags. The markup tags tell the Web browser procedure,to display the page. Then we used CSS for defining the font family, fontboldness, font size and the style of the text on the webpage. We implemented a bootstrap responsive design for changing the layout, size and pixels of the webpage according to the user end device like mobile, tablet and laptop. We utilized jQuery for a plugin like meter and date picker in webpage. In webpage, we used Ajax for updating a webpage without reloading the page. The webpage is designed as dynamic and interactive webpage with the help of PHP (Hypertext preprocessing) server side scripting language. Cloud computing is the core of Internet of thing. In proposed design we implemented the cloud computing concept by using PHP, MySQL andJavaScript for getting data, storing in data base and manipulating stored data. Here we are storing the data in a MySQL database which runs under Apache server.The data stored in database can be manipulated using JavaScript.

C. Implementation Set Up

Oncesolar panel is connected, it is integrated with temperature sensor. When we switch on the kit, currect or voltage is produced from solar panel according to room temperature. Capacitor is used to store electric charge. Diode was used, which allows flow of current in one direction.Max232 was which convert signals from TLA232 serial port to signals. Current or voltage produced is displayed on LCD(Liquid Crystal Display).Then by using Zigbee Transmitter and receiver current produced are wirelessly transmitted through base station. Finally from base station, it is updated in live server with help of IoT.Thus remote monitoring functions are realized in real time.

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V. IMPLEMENTATION

Solar Panel

Solar panel electricity systems, also known as solar photovoltaic (PV), capture the sun's energy using photovoltaic cells. Solar panels are generally manufactured with help of silicon chips known as photovoltaic cells, or PV cells. A photovoltaic system (informally, PV system) is an arrangement of components designed to supply usable electric power for a variety of purposes, using the Sun (or, less commonly, other light sources) as the power source. The cells transfer the sunlight into electricity, which helps to run electricity.

FIGURE 2

Solar cells are the basic components of photovoltaic panels. Solar cells generally took advantage of the photoelectric effect,which has ability of some semiconductors to transform electromagnetic radiation into electrical current. A solar cell is generally a p-n junction which is made from two irrelevant layers of silicon doped with a small quantity of impurity atoms: in the case of the n-layer, atoms with one more valence electron, called donors, and in the case of the p-layer, with one less valence electron, known as acceptors. When the two layers are combined together, near the intermix the free electrons of the n-layer are diffused in the p-side, leaving behind an area positively charged by the donors. Similarly, the free holes in the p-layer are diffused in the n-side, leaving behind a region negatively charged by the acceptors. This creates an electrical current between the two sides that is a potential barrier to further flow of electricity.

Integrating Sensors

A sensor is a device that detects and responds to some type of input from the physical environment. Thin, flexible, and lightweight cells can be integrated into sensors.Any light technology allows our solar cell to harvest a significant amount of energy from both indoor and outdoor light to ensure devices run longer under any lighting condition. The LM35 sensors are used here, where series are correctness joined -circuit temperature devices with an output voltage nearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical.

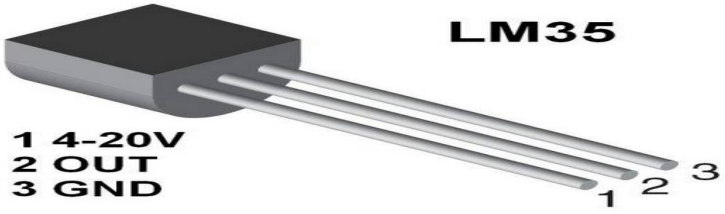

FIGURE-3

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Programming Microcontroller

Microcontroller is used to check variation of voltage from solar panel.The microcontroller used here is PIC microcontroller..PIC stands for "peripheral interface controller, a typical microcontroller includes a processor, memory, and peripherals.*PIC microcontrollers* (Programmable Interface Controllers), are electronic circuits *means* that a program can be written quite quickly, with fewer mistakes. The range of voltage microcontroller holds is 0-5v.Minimum voltage it accompany is 0v.Maximum voltage it accompany is 5v.PIC 16F877 is one of the most advanced microcontroller and a family of Harvard architecture microcontrollers from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is absolute for applications such as machine control applications, measurement devices, study purpose, and so on. The fig 5. PIC 16F877 features all the components which modern microcontrollers normally have.Microcontroller is a single chip microcomputer made through VLSI fabrication

FIGURE 4

Wireless Sensor Communication

Once fault occur in a solar panel then from microcontroller Voltage received from solar panel is passed to zigbee transmitter.zigbee is used to create networks that require a low data transfer rate, energy efficiency and secure networking.From zigbee transmitter value is passed to receiver From receiver it is passed to base station.ZigBee transceiver is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios and also devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones.

Solar Panel Monitoring

Once fault occur in a solar panel then from microcontroller Voltage received from solar panel is passed to zigbee transmitter.zigbee is used to create networks that require a low data transfer rate, energy efficiency and secure networking. From zigbee transmitter value is passed to zigbee receiver. From receiver it is passed to base station using UART port Visual Basic based software package, that design a standalone photovoltaic system,they developed software offers a friendly Graphic User Interface tool to size components according to load requirements and size specification. Visual Basic tool is used to transmit voltage generated from solar panel toserver. Using this voltage, solar panel can be monitored with range of 500 meters.IoT is used to monitor the solar system worldwide which cannot be achieved using server. To monitor solar system web page is created using PHP,where we can able to monitor the system worldwide. Remote monitoring functions are achieved in Real time. Thus damaged solar panel can be identified easily.

VI. RESULTS

Once connection to server was succesful, the data from solar panel are sent to web server for monitoring parameters of Power Conditioning Unit (PCU). By entering theassigned IP address in the web browser, this web server page will appear. The web server displays all the parameter of the solar PV PCU. It also gives the instant status of the PCU. Then

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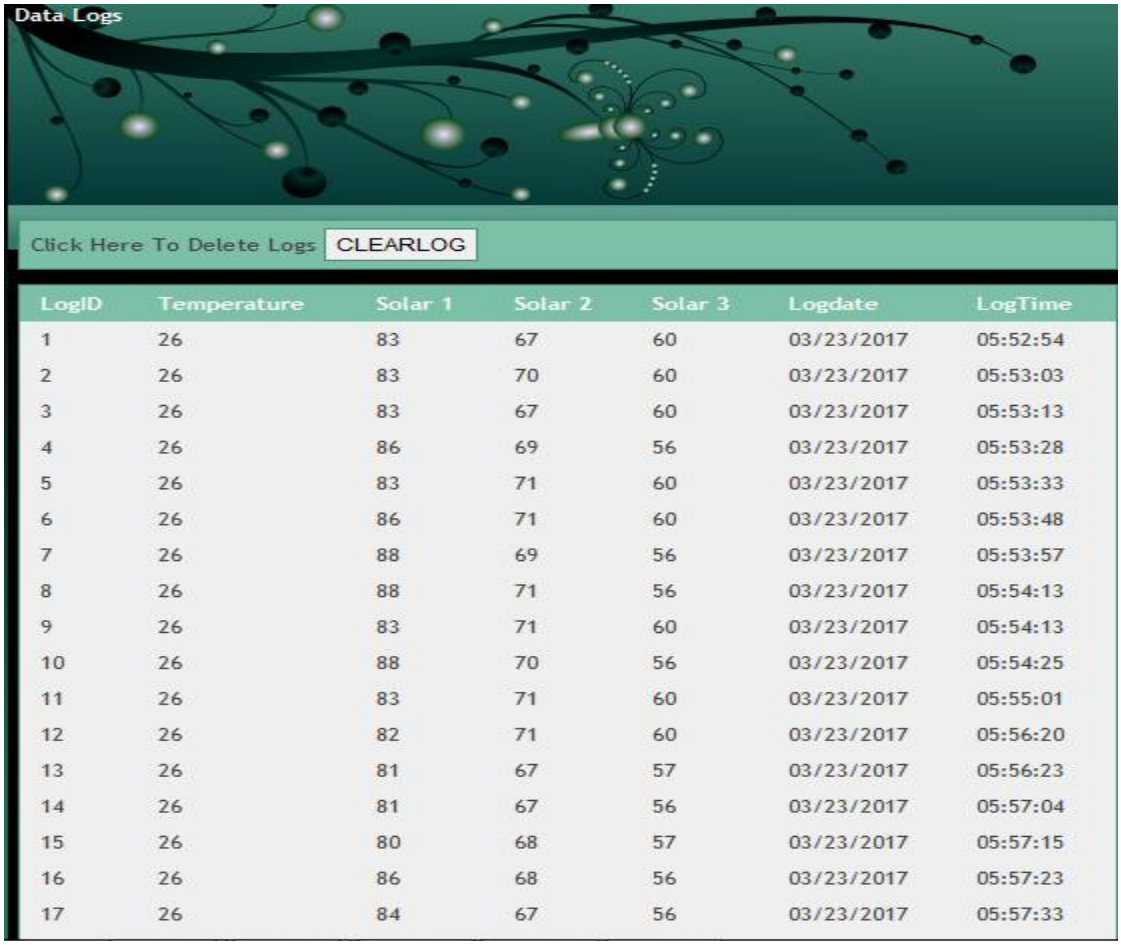
parameter received in the webpage is stored in the cloud. The stored data can be analyzed at anytime and anywhere. The plot shown in the figure.6 gives the analysis ofthe solar unit generated using the stored parameters in thecloud database. By seeing the plot we can come to know themaximum unit generated by solar PV PCU. We can alsoknow that was the temperature was above the thresholdlevel or not, if was above then at what time.



LogID	Temperature	Solar 1	Solar 2	Solar 3	Logdate	LogTime
1	26	83	67	60	03/23/2017	05:52:54
2	26	83	70	60	03/23/2017	05:53:03
3	26	83	67	60	03/23/2017	05:53:13
4	26	86	69	56	03/23/2017	05:53:28
5	26	83	71	60	03/23/2017	05:53:33
6	26	86	71	60	03/23/2017	05:53:48
7	26	88	69	56	03/23/2017	05:53:57
8	26	88	71	56	03/23/2017	05:54:13
9	26	83	71	60	03/23/2017	05:54:13
10	26	88	70	56	03/23/2017	05:54:25
11	26	83	71	60	03/23/2017	05:55:01
12	26	82	71	60	03/23/2017	05:56:20
13	26	81	67	57	03/23/2017	05:56:23
14	26	81	67	56	03/23/2017	05:57:04
15	26	80	68	57	03/23/2017	05:57:15
16	26	86	68	56	03/23/2017	05:57:23
17	26	84	67	56	03/23/2017	05:57:33

VII CONCLUSION AND FUTURE WORK

A. Conclusion

The solar PV PCU monitoring 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 PV PCU , but it also manipulate the data and produce the report according to the requirement,
for example calculate unit plot and generate total units generated per month. It also stores all the parameters in the cloud in a timely manner. This will help the user to analyse the condition of various parameters in the solar PV PCU.

B. Future work

Using this system as framework, the system can be expanded to include various other options ,which could be able to find faulty solar panels or cells .Thus cost will be reduced if we find faults soon .

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