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DESIGN AND IMPLEMENTATION OF EMBEDDED WEB SERVER FOR MONITORING AND CONTROLLING SOLAR POWER PLANT REMOTELY

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ABSTRACT:

In this paper, Embedded web server is designed for monitoring a Solar Power plant. Embedded web server is designed using raspberry pi based on ARM and Linux as real time operating system. Environmental parameters, status of battery and energy generated from solar are monitored through web browser as well as GSM. Similarly the relay is turned ON or OFF remotely using web browser though internet as well as GSM AT commands. The sensor node is placed at solar power plant that collects the information about parameters and display on LCD. Information collected by sensor node is sent to database at embedded board through ZigBee protocol. The board has Ethernet interface and runs the simple data web server. The system offers a complete, low cost, powerful and user friendly way of monitoring and controlling the solar power plant remotely.

KEYWORDS: Embedded web server, GSM, ZigBee, ARM.

I. INTRODUCTION:

This Solar energy drives the climate and weather and supports virtually all life on Earth. Solar energy is generated from the sun. Heat and light from sun, along with solar based resources such as wind and wave power and biomass, account for most the available flow of renewable energy. Solar power is becoming increasingly popular, as environment friendly renewable energy source that produces no pollution, requires minimal maintenance and energy from the sun is free. here many technologies for solar energy application through the residential, transportation sector, commercial, industrial and agricultural . The solar energy wide variety of technologies is flexibility. One types of Solar Energy system is Solar Photovoltaic Power. Photovoltaic system use cell to convert sunlight into electricity. When light falls on the cell it creates an electric field across the layers causing electricity flow. So, the greater intensity of the light, the greater electricity flows. PV cells are referred to in terms of the amount of energy they generate in sunlight is known as kilowatt peak. So the monitoring of status of the solar power plant is necessary also any one switching application can be turned ON or OFF using embedded web server as well as SMS services using GSM remotely. This embedded system can serve the web documents on request by a user , such type of web server is called embedded web server (EWS).It is designed based on ARM11 controller and Linux as real time operating system using raspberry pi that contains internet software which suite for monitoring, controlling and remotely access the system.

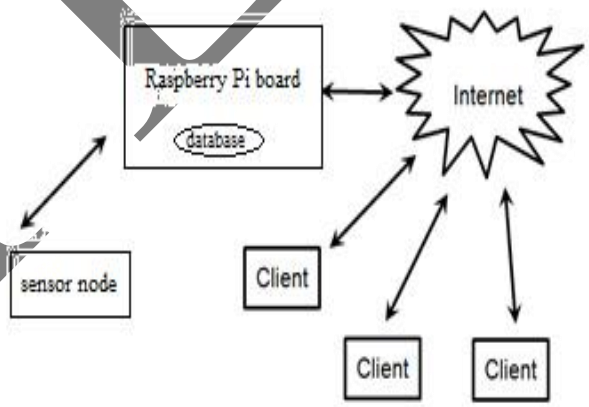

Fig. 1 Embedded web server

II. LITERAURE SURVEY:

Farihah Shariff and Nasrudin Abd Rahim designed the system in remote area, the need for monitoring PV system is crucial to ensure stable PV power delivery. They have described the hardware and software design for PV monitoring system in remote area. The monitoring system is equipped with voltage sensor, current sensor, temperature sensor and irradiation sensor and GSM modem for data transmission. The GSM implementing system has too large bandwidth for the data communication. Thus, there is wastage of the essential bandwidth, which goes without being used. So we have used low cost, efficient and reliable embedded web server and GSM modem for monitoring and controlling the information/ data from solar power plant.

III. PROPOSED STSTEM:

The monitoring and controlling solar power plant hereby presented. It consist of three parts such as Embedded web server, sensor units and client. Server and sensor unit communicates of transfers the data using ZigBee technology wirelessly . ARM11 architecture and Linux operating system based raspberry pi board used as embedded Linux board. It is having the processing unit, which is a single board computer developed by raspberry foundation. Arduino based AVR board is used at sensor unit and embedded C coded Algorithm has been fed into it. Python language is used for server designing and is connected to the internet so that client can communicate with server. Embedded web server refers to import Web Server at the scene the monitor and control equipment through internet, TCP/IP protocol used as the underlying communication protocol and Web server technology as its core. The embedded system can be utilized to serve the embedded web documents, including dynamic information about embedded systems to Web browsers. This type of web server is called an Embedded Web Server (EWS). There are three sensors at sensor unit which present at solar power plant shown in figure 2. At solar power plant, all hardware set up is installed. There are various sensors like temperature, humidity and light intensity sensor which senses the environment and send signal to raspberry pi. Raspberry pi has inbuilt ARM processor which process the data and stored data into database send to web browser through internet. On web browser, user can login to account and can check all the parameters within single window by GUI and database system. User or client can turn ON/OFF device remotely using web browser as well as GSM AT command.

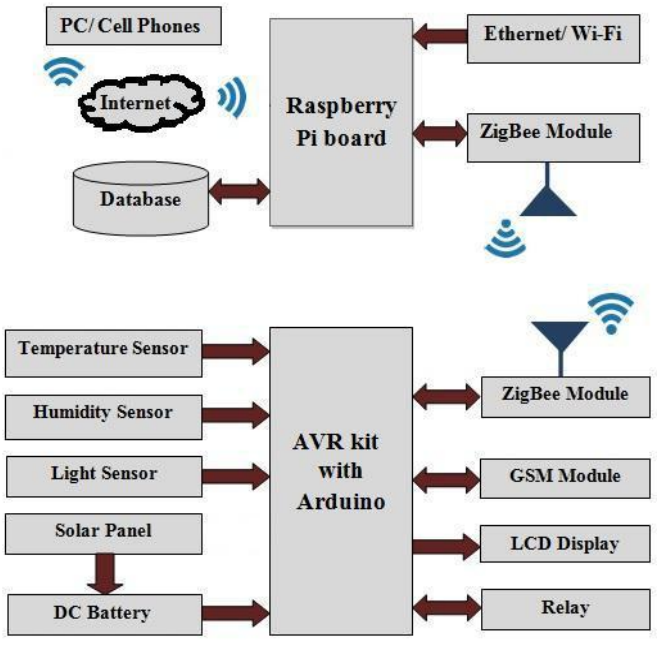

Fig. 2 System block diagram

IV. SYSTEM ARCHITECTURE:

The projects architecture consists of three parts sensor unit, raspberry pi board and client or user. The system design divided into two parts:

A .Hardware Design

B. Software Design

A. HARDWARE DESIGN:

a. RASPBERRY PI :

The Raspberry Pi is low cost ARM based palm-size computer. The Raspberry Pi has microprocessor ARM1176JZF-S which is a member of ARM11 family and has ARMv6 architecture. It is build around a BCM2835 Broadcom processor. ARM processor operates at 700 MHz & it has 512 MB RAM. It consumes 5V electricity at 1A current due to which power consumption of raspberry pi is less. It has many peripherals such as USB port, 10/100 Ethernet, GPIO, HDMI support & composite video outputs and SD card slot for booting.

Figure3. Raspberry Pi

b. SENSOR UNIT:

-bit

It is designed using high performance, low power, 8-bit Atmel AVR Microcontroller. Sensor unit consist of the ZigBee protocol based radio transceiver, power supply unit, humidity sensor, light intensity sensor, temperature Sensor, battery ,solar panel and gsm900 module . It will sense the parameters data and send to the raspberry pi board via the ZigBee wireless communication protocol.

c. SIM900 GPRS WIRELESS COMMUNICATION:

SIM900 is quad band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 1800 MHz and PCS 1900MHz. It has 68 SMT pads and provides all hardware interfaces between the module and customer's boards. Serial port and Debug port can help user to develop user's applications. It has programmable general purpose input and output. SIM900 designed with power saving technique so that the current consumption is as low as 0.1mA in sleep mode. It integrates TCP/IP protocols and extended TCP/IP AT commands which are very useful for data transfer

applications. The module takes the AT command from remote terminal or mobile devices and sends them to switching ON/OFF relay.

d. ZEGBEE MODULE :

The CC2500 is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400- 2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 500 kBaud. CC2500 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio. The main operating parameters and the 64-byte transmit/receive FIFOs of CC2500 can be controlled via an SPI interface. In a typical system, the CC2500 will be used together with a microcontroller and a few additional passive components.

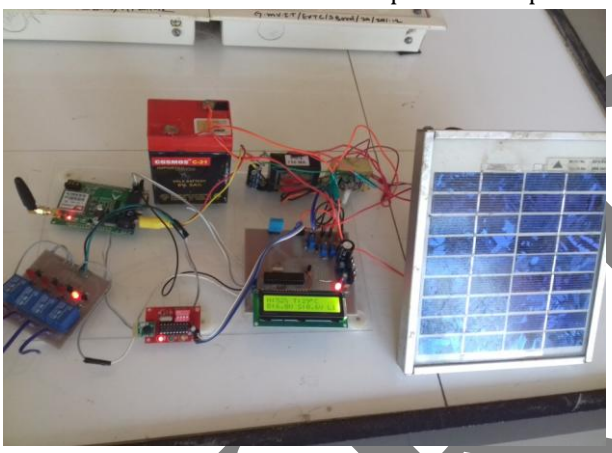

Figure4. ZigBee, GSM900 mudule and AVR board.

e. ETHERNET

Ethernet is the computer networking technology which allows computers to communicate and share resources over the internet. Ethernet was standardized as IEEE 802.3. It is one of the most widely implemented LAN standard originally developed by Xerox. Different Ethernet networks also connect to a router that provides access to the internet.

f. SENSORS:

Humidity and temperature module/sensor DHT22 and Light intensity sensor used for collecting environment data at solar power plant.

B. SOFTWARE DESIGN:

The software implementation of this system can be divided in to two main parts. At embedded server side the Linux based raspbein operating system, apache web server and php installed at raspberry pi board.

g. OPERATING SYSTEM:

Raspbian is an open source operating system. It is Linux kernel based operating system which uses on the light weight ARMv6 instruction set that a typical Broadcom processor understands.

h. APACHE WEB SERVER:

The Apache HTTP Server which allows the online distribution of website service using Hyper Text Transfer Protocol (HTTP). It is widely popular web server for *different* operating systems such as Linux, Unix, Windows, Mac OS X, OS/2 etc. Apache2 version is used in his project for creating web server.

i. PHP

The PHP hypertext preprocessor (PHP) is a server-side scripting language designed for web development. PHP code is integrated by a web server with a PHP processor module which generates the resulting web page. PHP is basically used for developing web based software applications and also to manage database, dynamic content. Embedded Server Pages with sensors are created using the following technique JavaScript and PHP.

V. EXPERIMENTAL RESULT :

Using hosted IP address which obtained after bridged between LAN/WiFi and Ethernet from raspberry pi can be accessed by client. The client has to type the IP address of website in address bar of any web browser. Client should see the webpage as displayed in the following figures Login page and Web page.

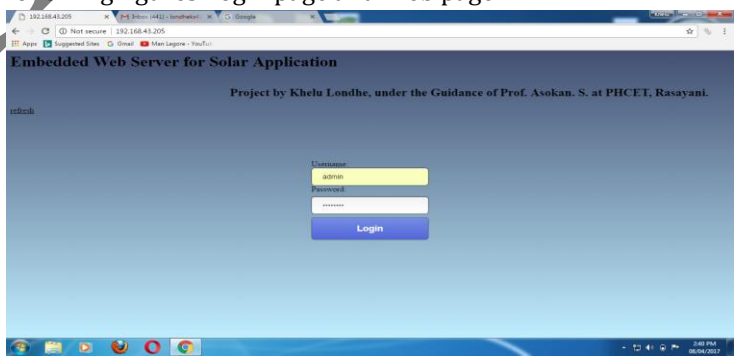

Figure5. Login Page

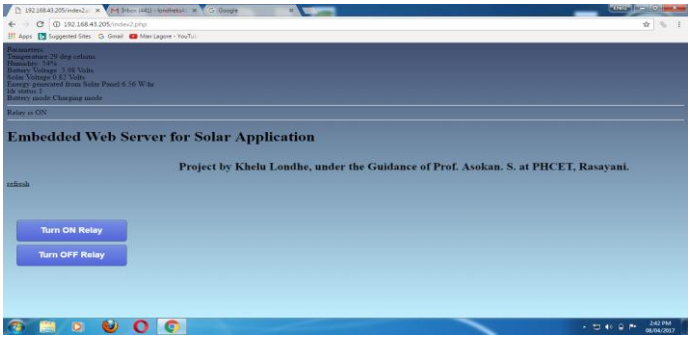

Figure6. Results on Web Page

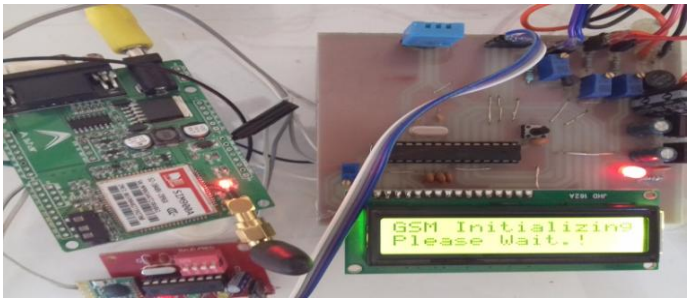

Figure7. GSM

VI. CONCLUSION

The raspberry pi has been extremely popular among the industry as well as in academics due to its low cost, small size and low power consumption. Embedded Web Server is designed and implemented using Raspberry Pi .Complete an intelligent system is developed for monitoring data from the solar power plant. A proper database is maintained for data obtained from the sensor unit and sent to server. This data can be accessed by any authorized user from remotely through web browser as well as GSM. The obtained data can be stored in database at web server and can be represented in graphical format to increase the readability of data**.** This paper shows salient features of proposed design and also analyzes the performance of developed system. User will build the solar application ON or OFF remotely through web browser as well as SMS using gsm AT command.

REFERENCES

1) Alexander P and N. Radhakrishnan, *Remote Lab Implementation on an Embedded Web Server*", IEEE 2015 International Conference on Circuit, Power and Computing Technologies [ICCPCT].
2) Al-Mamun, K. Sundaraj and N. Ahmed ,*Design and Development of a Low Cost Solar Energy System for the Rural Area"*, 2013 IEEE Conference on Systems, Process and Control (ICSPC2013), 13 to15 December 2013, Kuala Lumpur, Malaysia.
3) Lenord Melvix J.S.M, Sundararamabala subramanian K. and Ganes Madhan M, *Development of Intelligent Battery Monitoring System for Solar powered Lighting Applications* ,"2014 IEEE International Conference on Computational Intelligence and Computing Research.
4) Shri krushna Khedkar and Dr. G. M. Malwatkar, *Using Raspberry Pi and GSM Survey on Home Automation",* IEEE ICEEOT ,International Conference on Electrical, Electronics, and Optimization Techniques, 2016.
5) Jie Xiao and FenShi Zeng, *Design and Implementation of Embedded Web Server",* IEEE International Conference on Computer Science and Education, ICCSE 2012.
6) Pandurang H. Tarange, Rajan G. Mevekari, Prashant A. Shinde, *Web based Automatic Irrigation System using wireless sensor network and Embedded Linux board* 2015 International Conference on Circuit, Power and Computing Technologies [ICCPCT]- 978-1-4799-7075-9/15/2015 IEEE.
7) Simon Siregar and Duddy Soegiarto ,\ *Solar Panel and Battery Street Light Monitoring System Using GSM Wireless Communication System "*, IEEE 2014 2nd International Conference on Information and Communication Technology (ICoICT).
8) *Data Acquisition System For Performance Monitoring Of Solar Photovoltaic* (Pv) Power Generation vol. 1 issue 7, september – 2012
9) Shalini.N and Siva Sakthi. S ,*An Embedded Web server based Remote Motor Control system using Virtual Panel*", IEEE 2014 International Conference on Circuit, Power and Computing Technologies [ICCPCT]