NEW AGE UPS WITH BATTERY MONITORING USING RASPBERRY PI

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ABSTRACT: At remote places where continuous power requirement is necessary battery banks and inverters are used to cater the power to different systems and instruments, in case of AC mains failures. In this paper a real time web based system is proposed to monitor and select one of the available power source automatically for providing uninterrupted power to the load through battery and provides information of health condition of battery at remote site. The whole system is built on Raspberry Pi using the Raspbian operating system and framework library for remote access. The programming of the system is done by using Python for GPIO programming of Raspberry Pi development board. The availability of three input sources are detected by ADC and information is forwarded to Raspberry Pi using SPI protocol. The information about available and connected and disconnected power sources are detected by using logger function which log the data in a file. Threading library used for continues sensing of the all sources. The port forwarding technique used to access the system remotely. This gives information about connected power source, health condition of battery is forwarded to remote PC using internet for a required action to be taken. This dissertation attempts to study the remote monitoring and control is one of the most important requirements for maximize the process plant availability.

KEYWORDS: Battery, Power source detection, Remote monitoring, Remote Controlling.

I. INTRODUCTION

The arrival of internet reduced the whole world communication boundary to that of a single village. After the "everybody in internet wave" now obliviously follows the "everything in the internet wave". When the embedded devices are provided with internet access, it is of no doubt that demand will rise due to the remote accessing capability of the devices. Remote monitoring and control is one of the most important requirements for maximizing process plant availability. With the development of modern industry, the requirement for industrial monitoring system is getting higher. At remote places where continuous power requirement is necessary battery banks and inverters are used to cater the power to different systems and instruments, in case of power supply failures. This means the life and proper functioning of batteries is very important aspect in such scenarios. The best way to ensure the integrity of backup power system is battery maintenance and a sound battery management program, which identifies and predicts battery failure. System monitors the remote signals and controls the remote devices through reliable protocols and communication network . The main objective of this project is to provide uninterrupted power supply to a load, by selecting the supply from any source out of 3 such as mains, secondary supply, and solar cell automatically in the absence of any of the source. The demand for electricity is increasing every day and frequent power cuts is causing many problems in various areas like industries, hospitals and houses. An alternative arrangement for power source is a must. This arrangement can be designed by using Raspberry Pi and relays. When a source, say mains fails the supply automatically shifts to next priority source and so on. The output could be a lamp can be used to show that which source is used to provide the supply. In some applications, human beings have been replaced by unmanned devices that will acquire data and relay the data back to the base. There are data-acquisition and control devices that will be a substitute for a supervisor in a multisite job operation [1].Different nontechnical and technical methods were proposed in the past to monitor and control power supply to avoid the breakdown.

An important requirement of electric power distribution systems is the need for automatic operation. In particular, the rapid and reliable transfer of the system from one power source to another during certain system events is important to achieving the reliability goals for such systems and the facility serves. However, the design of such an automatic transfer system is all–too-often considered "less important" then many other aspects of the overall power system design. This paper deals with the three switches to demonstrate the respective failure of that power supply. The switches used are of "normally open" type switch. When any of the switches is pressed it shows the absence of that particular source, switches are connected to Controller as input signals. A Controller is Raspberry Pi is used. The output of controller is given to the relay driver IC, which switches appropriate relay to maintain uninterrupted supply to the load. The output shall be observed using a load drawing power supply from solar cell to charge battery initially. On failure of the solar cell supply the load gets supply from the next available source to charge battery and to a load, say a primery supply (Mains 1). If the Primary supply(Mains1) also fails it switches over to the next available source and so on. Upto1A output load is used to demonstrate the source of the power supply.

Using uninterrupted power supply in an automated mode, we always have a substitute arrangement as backup the system is a manual mode to take place of main power supply in case of power-cut in an emergency case, where the power cut cannot be avoided. In many cases load can be changed as per the requirements, it could be a motor, lamp or anything else which is essentially required at the time.The demand for electricity is increasing every day and frequent power cuts is causing many problems in various areas like Railway short station, industries, hospitals, offices and houses which are necessary to be prevented. An alternative arrangement for power source must be used. The main objective of this project is to provide uninterrupted power supply to a load, by selecting the supply from different sources such as mains, generator/secondary supply and solar automatically in the absence of any of the source and monitoring and control remotely.The project of BMS (Battery Monitoring System) gives online information of auto mode and manual mode which gives status of available/connected power sources to charge the battery.The voltage status of the of the battery which are monitored remotely so that we can prevent the batteries prior to failure. However, Battery Monitoring System specifically measure, record and analyze the connected source to charge battery and battery parameters . Continuous monitoring and analysis of these parameters can be used to identify battery status or avoid unplanned power interruption.

In this project , data is compiled in a central server and are then served to the clients via the Internet. The client framework is in a central server and has all the applications. A person that needs to access any data must first access the server. In this system, a reliable bidirectional Point-to-Point Protocol (PPP) link(Port Forwarding) for real-time control and surveillance via web. At remote PC the Internet allows interaction through commands sent through Transmission Control Protocol/IP (TCP/IP) and User Datagram Protocol [2]. The heart of communication is TCP/IP protocol. Network Communication is performed by the IEEE 802.3 Ethernet standard. It is the most modern technology of embedded systems. Since ARM embedded web server based on Raspberry Pi has fast execution capability and Ethernet standard can provide internet access with reasonable speed, this system is suitable for enhancing security in industrial conditions by remotely monitoring various industrial applications.

II. RELATED WORK

The embedded systems and Internet technology are combined in our proposed system to form a new technology the Embedded Internet Technology, which developed with the popularization of computer network technology in recent years. The heart of communication is TCP/IP protocol. Network Communication is performed by the IEEE 802.3 Ethernet standard. It is the most modern technology of embedded systems. Since ARM embedded web server based on Raspberry Pi has fast execution capability and Ethernet standard can provide internet access with reasonable speed, this system is suitable for enhancing security in industrial conditions by remotely monitoring various industrial applications. The major drawbacks of methods and system will overcome in our proposed project. As per railway communication system or any other communication field where uninterrupted power supply is required .Some site are unmanned or some are at remote location where man cannot reach immediately after failure of supply. To avoid this we implementing a remote monitoring auto power supply control system which reduces this downtime and significantly reduces downtime cost.

III.SOFTWARE/HARDWARE DESIGN DESCRIPTION

The main hardware structure of the remote monitoring and controlling system based on Raspberry Pi .The remote monitoring and controlling system based on R Pi platform has high universality. Sensors is used for current sensing from three different sources monitoring and for process control.
There are three input sources are chosen i.e.Solar,Mains1(Primary supply),Mains2(Secondary supply).There are two modes of operations
    1. Automatic Mode 2.Manual Mode
In auto mode source is selected depending upon priority based to charge the battery. In manual mode the source is selected depending upon user choice as which is convenient to them to charge the battery. The Only three power sources are considered for supplying power to charge the battery. Load up to 1 A will be considered for the system. The three input sources are selected depending on priority basis i.e. I/O channel of ADC can select a depending on mode of operation. The variety of electrical and non electrical signals like current, voltage, resistance etc are continuously monitored by current sensor. These all data is read by ADC and forwarded to Raspberry Pi by using SPI protocol.

IV. PORT FORWARDING

Port forwarding or port mapping is an application of network address translation (NAT) that redirects a communication request from one address and port number combination to another while the packets are traversing a network gateway, such as a router or firewall. This technique is most commonly used to make services on a host residing on a protected or masqueraded (internal) network available to hosts on the opposite side of the gateway (external network), by remapping the destination IP address and port number of the communication to an internal host.It allows remote computers (for example, computers on the Internet) to connect to a specific computer or service within a private local-area network (LAN).For typical residential network, nodes obtain Internet access through a DSL or cable modem connected to a router or network address translator (NAT/NAPT). Hosts on the private network are connected to an Ethernet switch or communicate via a wireless LAN. The NAT device's external interface is configured with a public IP address. The computers behind the router, on the other hand, are invisible to hosts on the Internet as they each communicate only with a private IP address. When configuring port forwarding, the network administrator sets aside one port number on the gateway for the exclusive use of communicating with a service in the private network, located on a specific host. External hosts must know this port number and the address of the gateway to communicate with the network-internal service. Often, the port numbers of well-known Internet services, such as port number 80 for web services (HTTP), are used in port forwarding, so that common Internet services may be implemented on hosts within private networks.

V. FLASK FRAME WORK

It is a micro web framework in Python. Version 0.11 June16.It is known as micro framework because it does not require particular tools / libraries, so that we use can built two pages in a single web page. Thus no database abstraction layer from validation or any component.

Features:-

a)Contain development server and debugger. b) Integrated support for unit test. c) Google app engine compatibility.

VI. RASPBERRY PI

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation. It has a Broadcom BCM2835 system on a chip (SoC),which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU. Its GPU provides Open GL ES 2.0, hardware-accelerated Open VG, and 1080p30 H.264 high profile decode which is capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering with 512 MB RAM. It does not

include a built-in hard disk or solid-state drive, but uses an SD card for booting and persistent storage. Ihas 10/100 Base T Ethernet socket.

Raspbian OS

Raspbian is an unofficial port of Debian Wheezy arm hf with compilation settings adjusted to produce code that uses "hardware floating point", the "hard float" ABI and will run on the Raspberry Pi. The port is necessary because the official Debian Wheezy arm hf release is compatible only with versions of the ARM architecture later than the one used on the Raspberry Pi (ARMv7-A CPUs and higher vs the Raspberry Pi's ARMv6 CPU).

VII. TCP/IP PROTOCOL

The software running on the embedded web server follows the same layered structure as used in the TCP/IP protocol suite. The TCP/IP protocol suite allows computers of all sizes, running different operating systems, to communicate with each other. The TCP/IP protocol suite is a combination of different protocols at various layers.Every layer acts independently from each other. The Link Layer normally includes the device driver in the operating system and the corresponding network interface (card) in the computer. An Ethernet controller driver controls the Ethernet interface. The network layer controls the communication between hosts on the Ethernet. The Address Resolution Protocol (ARP) at network layer translates IP addresses to Ethernet MAC addresses. Internet Protocol (IP) delivers packets to Transmission Control Protocol (TCP), UDP, and Internet Control Message Protocol (ICMP), the ICMP answers to PING requests. TCP/UDP delivers data to the applications. HTTP runs on the top of TCP/IP protocol. It is set of the rules for transferring files like text, image, sound and other multimedia file on the World Wide Web.When Web. The applications can communicate with the transport layer through buffers with data and variables with control information. As soon as a Web user opens their Web browser, the user is indirectly making use of HTTP. When you are set up with direct access to the Internet, your computer is provided with a copy of the TCP/IP program.

VIII. PROPOSED System

In our system we are designed two modes of operation, one is auto mode aned other is manual mode.Depending upon priority basis the availability of solar cell input voltage is checked and if it is available then that is be given to charge the battery and then to the load. On the failure of solar cell supply the battery will get supply from the next available source i.e. Primary supply(Mains1). If the primary supply also fails, it will switch over to the next available source automatically by the controller action, and so on. If all supply sources fail, the load gets supply from the battery. The information of selected power source and the present condition of battery parameters is forwarded to remote pc using internet.In a manual mode provision of selection of input power source other than prescribed priority list is made available on remote pc.This is helpful during some unwanted situation.The system will continuously monitor battery parameters like battery voltage, status of battery(charging/not charging) and selected power source to charge the battery.
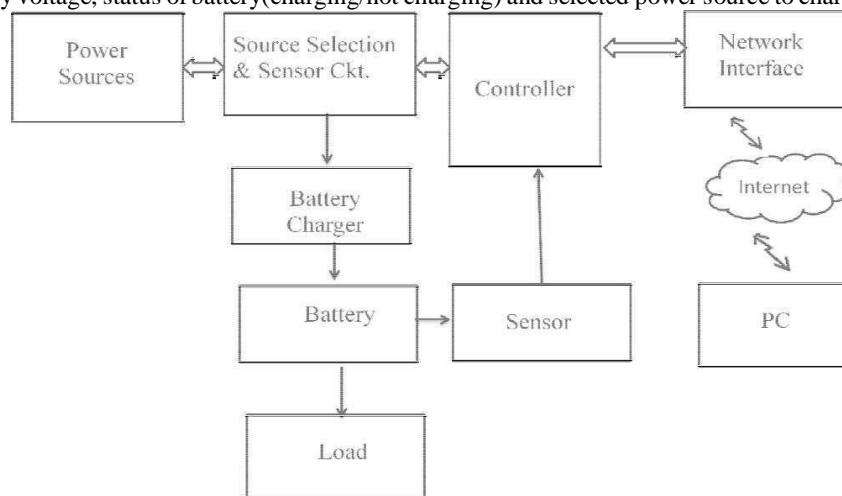

Fig. 1. Block diagram of proposed system

The individual testing of different modules are developed and the final setup was made arranging all devices in proper manner. After this final arrangement the whole system was tested. The available all three power sources are made step

down by using voltage divider circuitery.Output of divider circuit is read by specified ADC channel and then the analog value is converted into digital by means of analog to digital converter in order to read controller by using SPI protocol..R Pi is programmed to read this digital value corresponding to source selected it is stored in the controller. The ADC is continuously sense sources .This data is logged in a file it contains all information about available, connected power source and battery voltage .The final arrangement was made and the system was run, the data from proposed system received by RPi which is acting as server. Now when a remote computer requests for this data to the server it serves the data through a webpage as displayed in fig.The protocol used for the communication between webserver and web browser is Hyper Text Transfer Protocol or HTTP protocol. This protocol defines all the basic frame work of web communications by handling requests and also by providing control information to be transferred between browser and server. To obtain a web document, the browser and server should establish a connection at Port 80. The HTML web page displayed when the configured IP address entered on the web browser is shown. Here the first data gives information about the automatic mode of operation, connected/available power source, health condition of battery,charging status of battery and load ON/OFF status sensed in the remote location.

For manual monitoring mode of operation, connected/available power source, health condition of battery,charging status of battery and load ON/OFF status,also we can remotely make the load ON/OFF after typing IP address the main page of online monitoring using raspberry pi will be open and displaying the connected power sources and Battery voltage values.The proposed method uses client server architecture for monitor and controlling conditions at remote location. Controller is the responsible part for measuring signals and controlling the devices remotely. Measurements can be done by DACS mode and the data are shared with clients through embedded web server. The real time operating system manages all the tasks such as measuring signals, conversion of signals, sending HTML pages and connecting/communicating with users. The 1A load is used to demonstrate the source of the power supply.

Using uninterrupted power supply in an automated mode, we always have a substitute arrangement as backup to take place of main power supply in case of power-cut in an emergency case, where the power cut cannot be avoided. In many cases load can be changed as per the requirements, it could be a motor, lamp or anything else which is essentially required at the time. In manual mode the provision of selection of input power source other than prescribed priority list is made available on remote pc.This is helpful during some unwanted situation.
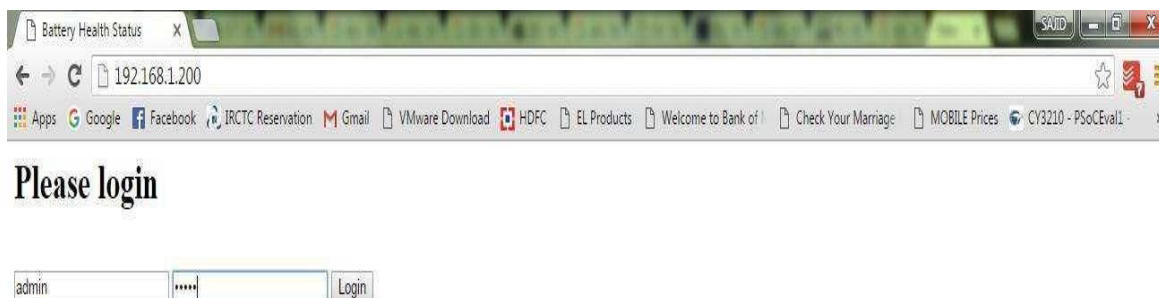
IX. EXPERIMENTAL RESULTS

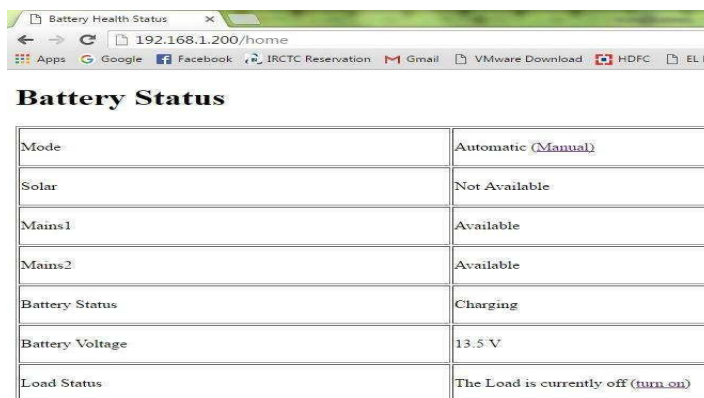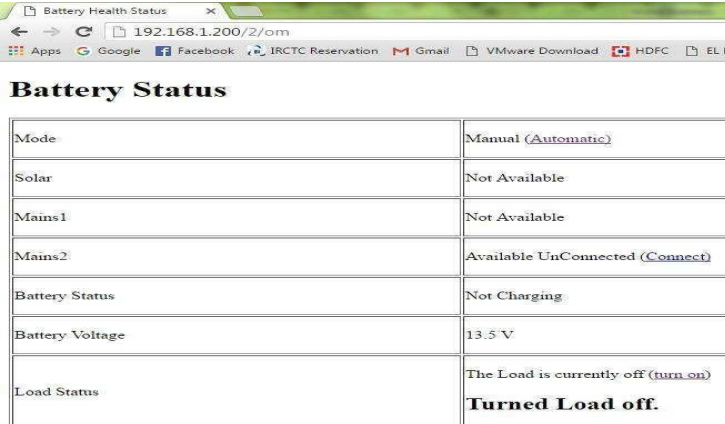Fig.2. Remote Login Page through internet with Password/User Id.

Battery Status

Mode	Automatic (Manual)
Solar	Not Available
Mains1	Available
Mains2	Available
Battery Status	Charging
Battery Voltage	13.5 V
Load Status	The Load is currently off (turn on)

Fig.3.GUI for Automatic Mode of Operation.

Fig.4.GUI For Manual Mode of Operation.

IX. CONCLUSION

We have implemented an web based monitoring system that will select one of the available power source automatically for providing uninterrupted power to the load through battery and provides information of health condition of battery .The information about connected power source, health condition of battery is forwarded to remote PC using internet for a required action to be taken.

In the manual mode the provision of selection of input power source other than prescribed priority list is made available on remote pc. This is helpful during some unwanted situation. Also we can make Load On/Off remotely in both the mode of operation.

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REFERENCES

[1] Boccaletti C.; Fabbri G. & Santini E. (2007). Innovative Solutions for Stand Alone System Powering, Proceedings of INTELEC, pp. 294-301, 978-1-4244-1628-8, Rome (Italy), September 2007, IEEE, Rome.

[2]   Indian Railway Telecom Manual.

[3] Yu-Lung Ke, and Ying-Chun Chuang. A Novel Single-Stage Power-Factor-Correction Circuit With High-Frequency Resonant Energy Tank for DC-Link Inverters. IEEE Transactions on Circuits And Systems—II: Express Briefs, Vol. 53, no. 2, FEBRUARY 2006.pp.115-119.

[4] The Embedded Web server based Electrical Ethernet Monitoring system using ARM, International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 5, May 2013 K.Bharath reddy1, Ch. Rajendra Prasad

[5] Jacek W, "Embedded Internet technology in process control devices," IEEE Internet Computing, Vol. 34, 2000.

[6] Implementation of Tcp/Ip on Embedded Web Server Using Raspberry Pi In Industrial ApplicationBhuvaneswari.S1, Sahaya Anselin Nisha.A2International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 3, March 2014.

[7] Journal Of Information, Knowledge And Research In Electronics and Communication Engineering ISSN: 0975 – 6779| Nov 12 To Oct 13 | Vol–02, Issue - 02 Page 583.

[8] Implementation Of Smart Industrial Automation System Using Embedded Web1 MR. R. C. Aghara, 2 Mr. R. H. Bhuva, 3 Prof. D. S. Pipalia 1.

[9] Yu-Lung Ke, and Ying-Chun Chuang. A Novel Single-Stage Power- Factor-Correction Circuit with High-Frequency Resonant Energy Tank for DC-Link Inverters. IEEE Transactions on Circuits and Systems—II: Express Briefs, Vol. 53, no. 2, FEBRUARY 2006. Pp.115-119.

[10] Manivannan M & Kumaresan N. Anna University of Technology Coimbatore Coimbatore, Tamilnadu, India "Embedded Web Server & GPRS Based Advanced Industrial Automation Using LINUX RTOS",Vol. 2(11),2010, 6074-6081.

[11] Auto Power Supply Control From Four Different Sources: Mains, Solar, Inverter and Generator To Ensure No Break Power Garima Pandey1, Khanda Anum2, Waqar Ateeq3, Vivek Tripathi4IJSART - Volume 1 Issue 4 –APRIL 2015 SN [ONLINE]: 2395-105.

[12] Proceedings of the Second Symposium International Computer Science and Computational Technology ISBN 978-952-5726-07-7 (Print), 978-952-5726-08-4 (CD-ROM) (ISCSCT '09) Huangshan, P. R. China, 26-28,Dec. 2009, pp. 094-097.