

IOT Based Smart Energy Meter Monitoring with Theft Detection

Ramkrishan Nishad, Deepali Salunkhe, Mayur Thorat, Prof. Sachin Desai

Dept. of Computer Engineering,
Smt. Indira Gandhi College of Engineering,
Navi Mumbai, India

2014c31@sigce.edu.in, 2017c40@sigce.edu.in, 2017c52@sigce.edu.in, sachin.desai@sigce.edu.in

Abstract- In India, the demand for energy, especially electrical energy, is sky-rocketing and posing several problems for policy-makers, administrators, industrial and house-hold consumers. The hardest hit is the common house- hold consumer who not only has to pay the rapidly increasing prices for electricity, but also has to put up with frequent power-cuts, load-shedding, fluctuating voltages, power theft, faulty meters and most of all suspiciously high bills. When consumers know in real-time the pattern of consumption of their house-holds, they will be able to control their usage and guarantee savings. World's main focus is to make a smart home to take advantage in providing comfort for human life. Web technology is a thing which is growing all the time. Embedded systems with Internet of Things (IoT) is becoming important and necessary part in the current IT industry and exhibiting potential market. Power consumption and efficiency with a user's comfort level is most important issue during this stage while performing various operations. This system gives the information on meter reading, power cut and the alert systems for producing an alarm when energy consumption exceeds beyond the specified limit using IoT. This idea is being implemented to reduce the human dependency to collect the monthly reading and minimize the technical problems..

Keywords- Energy Meter switch Box, NodeMCU, IOT, Relay, Current Sensor, Adaptor.

I. INTRODUCTION

The electronic system which integrates the hardware circuitry with the software programming techniques for providing project solutions is called as embedded systems. By using this embedded system technology the complexity of the circuits can be reduced to a great extent which further reduces the cost and size. An embedded system is basically an electronic system that can be programmed or none programmed to operate, organize, and perform single or multiple tasks based on the application. Embedded system with web technology provides remote management and controlling of embedded device via network interface.

The Internet of Things (IoT) is a revolutionary communication paradigm that aims to bring forth an invisible and innovative framework to connect a plethora of digital device with the internet, thus it is pervasive. The emerging IoT market is continuously gaining momentum as operators, vendors, manufacturers, and enterprises begin to recognize the opportunities it offers. Internet of Things IOT based energy meter reading through the internet is an innovative application of real time embedded systems. Using this project user can avail the facility of displaying (in the format of chart and gauge) units of power consumed and the cost of consumption over the internet.

Internet of Things devices are controlled by web controller or E-controller which is a bundle of embedded system and software stack. Remote login and monitoring by building a distributed web control system. Web control system with IoT has characteristics of (1) Energy Saving (2) Comfort, and (3) Efficiency.

Energy meter or watt-hour meter is an electrical instrument that measures the amount of electrical departments, which install these instruments at every place like homes, industries, organizations, and commercial buildings to charge for the electricity consumption by loads such as lights, fans, refrigerators and other home appliances. It also can detect the fault if occurs in the electric system overloading and warn the consumer of overload usage of electricity by sending the message.

II. RELATED WORK

1. Existing Method:

In India, energy distribution, keeping record of energy consumption is an essential part. Each time the required person is needed to come from the electricity department to record the reading of meter and create an appropriate bill based on the units consumed for the consumer. Person takes the photo of the meter or record the units consumed and generate the bill accordingly.

In some developed foreign countries, the reading is measured with the help of RF meter.

2. Proposed Method:

This system principally monitors units consumed by the appliances/devices and subsequently gives output on web portal. It facilitates direct communication between the consumer and the service provider. It also detects the theft as well as exceed consumption and informs about it to the concerned authority via email. It also has the facility to Reconnect and disconnect the power supply online.

The data about energy consumed by each user is stored on website using IOT for further details. User can also read the data in the form of graphs of day wise consumption, monthly consumption, etc. on IOT.

III. LITERATURE SURVEY

“Design of electric Energy Meter for long-distance data information transfers which based upon GPRS”

The above paper focuses on remote power management using GPRS technology for long distance communication with the help of ARM and mu C/OS operating system. This is achieved by creating a link between the energy meter and the GPRS Module. Based on the principle of Peak Electricity or Valley Electricity, a net electric energy meter is used in real time measurement situations.

The overall system is stable and reliable because it is managed by mu C/OS-II operating system. This is especially useful for some outlying areas where the Cable Network hasn't been popularized. The proposed system not only raises the efficiency of electric energy meter data information's acquisition and transition, but also the national measure management of electric energy has improved greatly.

“Design and Implementation of Embedded Web Server” Today Web technologies have become the inevitable choice for embedded system network processes. Because of web, access ability of the embedded devices has undergone a rapid development in fields of communication equipment, information & home appliances, remote management etc. The above research proposes the use of wireless sensor networks and ARM7 Microcontroller for Forest Fire Detection.

The traditional technique for fire detection in large forest areas are usually based on satellite images and forest guard posts. However, these methods are not always efficient or suitable due to the local measurement of the relevant parameters involved in detection of a fire.

The proposed system provides a solution to the issues faced in traditional methods as it doesn't use any electric wiring. The monitoring of environmental parameters like

temperature, humidity, gas, smoke etc. is done in a wireless manner.

“Internet of Things in Home Automation and Energy Efficient Smart Home Technologies”. This paper proposes an IoT-based monitoring system using a tri-level context making model for context-aware services in smart homes. Smart home based on Internet of Things (IoT), data acquisition and information analysis through various sensors will play a crucial role.

IV. PROBLEM STATEMENT

Since IOT is cost effective compared to traditional methods, monitoring of energy usage at lower cost is possible. Daily consumption reports are generated which can be monitored by the user through a web portal. It is a more reliable system and accurate reading values are collected from energy meters using devices. Live readings of devices can be viewed using a web portal.

Also, the readings can be viewed online. Human interference is avoided and everyone's values are kept maintained in the central server. The communication medium is secure and tampering of energy meters or theft of electricity can be identified easily.

If a mistake occurs within the system, the value in the central server will not be updated. Since the values are stored within the central database, the reports are made accessible from anywhere on the world. Also, the server is online 24x7 available.

V. SCOPE OF THE PROJECT

This IoT based energy meter use to access meter reading and bill amount by the use of web server and help consumer to avoid unwanted use of electricity as well as to detect any kind of theft of electricity.

There can be a system where Automatic Switching of electric equipment by the use of IoT is applied. To make a system where user can receive SMS, if one crosses threshold of electricity usage. In Future to make an IoT system where user can monitor energy consumption and pay electricity bill online.

VI. PROPOSED SYSTEM

In proposed system, our main objective of this project is to design an energy consumption meter and a control and monitor system for all service providers.

According to this we have developed technology an user can login and check usage of electricity in real time as well as control devices (home appliances).

VII. METHODOLOGY

The existing model is a time consuming process and it needs a lot of labor. But in this project we have eliminated the need of labor and it is a cost efficient and a time saving process.

The proposed system gives the information about the energy consumption on daily basis, billing and payment through IoT, pre-intimation of shut down details, alert systems when the energy consumption exceeds beyond the critical limit and the disconnection of power through a message when the residential are out of station to prevent the wastage of energy.

The system contains home automation as a smart home with intelligence and provides e-metering system as a smart grid to overcome the issues. The system along with web application is controlling smart devices in home and also all billing features from web application working as a cloud application. The main objective of this project is to design energy consumption meter and control, monitor.

VIII. ALGORITHM DEVELOPMENT

1. Hardware Analysis:

In this section we state the hardware analysis.

Step 1: Arduino IDE:

Before using the IDE, install the USB driver in the operating system, which maybe the CH340 or CP2102, depending on the board version. Run the Arduino IDE Open Board Manager menu and type esp8266 and install.

Serial Out this object is used to write to the ESP8266; you can use either hardware or software serial.

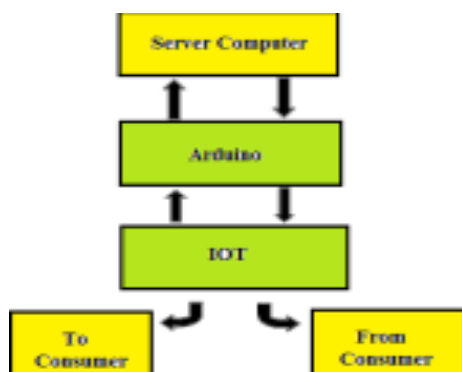


Fig 1. Text Here Your Fig Name.

Reset Pin this pin will be pulled low then high to reset the ESP8266. It is assumed that a CH_PD pin is connected to the pin.

Step 2: Starting the Module:

Boolean begin () calling this method will do an HW reset on the ESP8266 and set basic parameters

Return will return a true or false depending if the module was properly initiated.

Example: `boolean esp8266started = wifi.begin ();` **return** will return a true if the module has a valid IP address

Step 3: Connecting to an access point:

Boolean connect To AP (char * ssid, char password)* tells the ESP8266 to connect to an access point.

SSID the ssid (station name) to be used. Note that this method uses char arrays as input.

Password the access point password wpa/wpa2 is assumed (max 15 chars) **return** will return a true if a valid IP was received within the time limit (15 seconds)

Boolean is Connected To AP() checks if the module is connected with a valid IP

Step 4: Connecting to a server:

- **Ip** the IP-address of the server to connect to
- **Port** the port number to be used
- **Return** true if connection is established within 5 seconds.

Step 5: Final Steps of Hardware implementation:

- NodeMCU continuously Read the output value of the Current Sensor.
- It continuously displays the current value through its serial ports.
- It creates a packet with recent current absorption.
- Now with the help of ESP8266-01 WIFI Module, it sends this packet to the server. • The Server Extracts this current data and saves it in the database.

IX. DESIGN AND ANALYSIS MODULES OF THE SYSTEM

The system module consists of a various module:

1. Admin Module:

In this module we can login in our web portal by putting username and password which we have kept for admin only.

2. Data Log Analysis:

After login, we can see the web application for this system. As soon as admin click on data log section. He/She can see how much unit's current consumed by their appliances / devices which they have connected to that socket.

3. Switch On / Off Module:

In this section admin can manually set which device they want on and which one should be off. As per their requirements they can manually set these things which will help for home automation.

4. Energy Consumption Graph:

How much data consumed by appliances that will show in this section by date and time wise. or we can get the monthly record of units.

5. Set Range Module:

In this module, we can set the particular range with respect to the device which we have connected to the socket. Suppose if we set the range for one device that is 2A. If the current consumed by the device is above 2A then the alert message will occur and it will directly send to the authorized email id that is consumption exceeded above range set. Hence it will also help to detect the theft.

6. Payment Module:

In this module we set the prepaid functionality. Using this functionality user will be able to pay in advance and use the exact amount of energy. As soon as balance becomes zero power cut will be occurred.

7. Logout:

After completion Admin can log out of the session.

X. RESULTS

Firstly, we have to switch on the main power supply. Current sensor senses the power which can be utilized by the load. Which gives output in analog form? The output of the sensor is supplied as input to the analog input pins in the

NodeMCU Board. The ESP-8266 is used to connect the internet with the monitoring hardware system. The power utilized by the load is displayed on the web portal and also monitored from the webpage. It shows time to time power utilization of the load/loads connected to the system.



Fig 2. Data Log Chart.

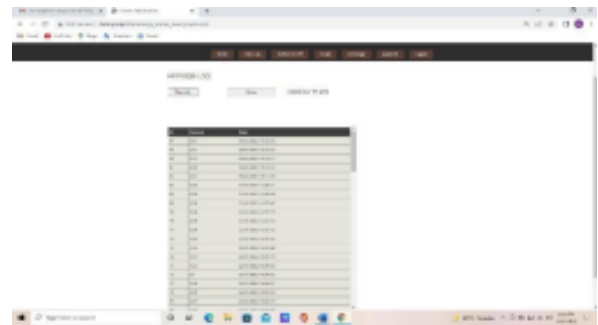


Fig 3. Hardware Design.

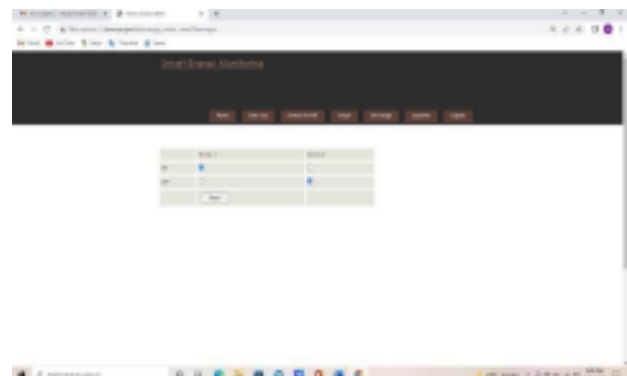


Fig 4. Admin Control Page.

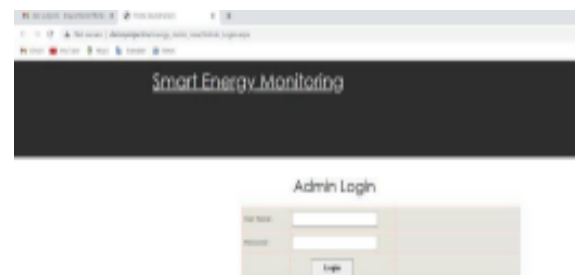


Fig 5. Smart Home Access Facility.



Fig 6. Web Application Home Page.



Fig 7. Energy Consumption Graph.

XI. CONCLUSION

- To reduce power consumption in the web applications
- To make energy metering easy by creating web application
- To make home automated and intelligent and provide comfort to every consumer
- Also the application is real time means the user can monitor real-time data and takes a particular.
- To show energy consumption in the form of graphs and charts.
- To control and monitor electric appliances with the help of handheld devices or a computer

An attempt has been made to make a practical model of 'IoT Based Energy Meter Reading System'. The propagated model is used to calculate the energy consumption of the household, and even make the energy unit reading to be handy. Hence it reduces the wastage of energy and brings awareness among all. Even it will deduct the manual intervention.

Energy Monitoring using IOT is a very innovative application of the internet of things which plays a vital role in upcoming years. It is used to control home appliances remotely over the cloud from anywhere in the world. In the proposed project current sensor is used to sense the current and display it on the web using IoT. The system updates the information every 20 to 30 seconds because it has some delay due to the relay module connecting with the appliances to make the appliances home automated.

Also, a system where a user can receive Email, when he/she crosses the threshold of electricity usage slab can be equipped. Hence; the project mainly focuses on the prepaid, power theft and to save the wastage of electricity.

XII. FUTURE MODIFICATIONS

In future work, we may further enhance this system where a consumer receives text message whenever someone is trying to steal the electricity within a 100m of area.

Also using cloud analytic we will predict future energy consumptions. This system can also perform home automation which is another advantage of making this project. There can be a system where Automatic Switching of electric equipment by the use of IoT is applied. To make an IoT system where user can monitor energy consumption and pay electricity bill online.

The main improvement for the future is going to make energy meter readings, tampering identification techniques, and connection and disconnection and also the pre information providing to the users all is going to happen on wifi internet. Where we are going to develop some Wifi hotspots in each area through which all the energy meters are get connected and set 4 to 5 parameters which is also going to be monitored.

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