

IoT Based Power Consumption Monitoring

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Abstract: Electricity is the most requisite energy in modern times. IoT based energy tracking and bill estimation system discussed in this paper has an objective to build awareness among household and industrial consumers about their usage of this energy. It does so by displaying real-time estimated electricity consumption by each load connected to it and real - time estimated bill of total consumption on a monitor unit. The novel approach used in the proposed system is the integration of a cloud-hosted database and control unit. A smart power meter is usually an electronic device that records the consumption of electric energy in intervals and communicates that information at least daily back to the utility for monitoring and billing. Smart meters enable two-way communication between the meter and the central system. To save energy when unused, users can operate the control unit to transmit switching instructions for loads. The proposed system also uses Node MCU, 4-channel relay module, and android application. Node MCU fetches average consumption detail of loads from and logs estimated bill to the cloud-hosted database, monitors the duration for which each relay in a 4-channel relay module was switched-on, performs calculations, and transmits real-time results to an IoT cloud interface. This paper provides highlights on cloud-hosted database details, hardware design, IoT cloud interface application design, and working principle with mathematical modelling of the proposed system and tested results of this system are discussed, with the cloud-hosted database and IoT cloud interface. The potential of smart metering relies profoundly on the policy and decisiveness of the legislative bodies mixed up. Energy savings and an improved security of supply are the major drivers and deems in smart metering as huge targets of a nation. In our project, the smart meter is implemented with control over the usage of current and payment via internet.

Keywords- records consumption; monitoring and billing; smart metering.

1. INTRODUCTION

The crisis of power is one of the fundamental problems which is being faced by the modern era. Modern technology is developing for ensuring the use of efficient power to deal with crisis of power. So, it is very much important to have a system that can ensure the proper consumption of energy and also can control a device for anywhere. The concept of the Internet of Things (IoT) provides interconnection of the system's ability to transmit data over the internet. The energy tracking and bill estimation system discussed in this paper utilizes this concept with a microcontroller, binary actuators, cloud-hosted database, and IoT cloud interface to build awareness among consumers about their electricity usage. Deployment of this system using the concept of IoT provided the scope of reading real-time results from anywhere in the world, which only has constraints of having the right credentials and internet access. It also enabled the simple design and implementation of additional features in the proposed system.

This paper comprises a section of Proposed Work, which contains system architecture, hardware design, IoT cloud interface application design, working principle, and system implementation and Result Analysis, which consists of tested results of the intended system.

2. RELATED WORK:

Electric energy meters are used for tracking electricity consumption. Earlier, they required several manual efforts. Although, with the advancement in technology came postpaid/prepaid energy meters into implementation but even these were not fully automated and did not provide a convenient way of viewing real-time electricity consumption from sitting anywhere. Hence, several researchers and developers came with electricity tracking systems using the concept of IoT. These systems provided the benefit of viewing multiple real-time varying parameters of electricity on their user interface, which was accessible from anywhere in the world with an internet connection.

Although, several of such IoT based systems are dependent on conventional energy meters or use electric energy measurement chips, current and voltage sensors, and smart plugs, which are expensive. Some of these systems also hold constraints on monitoring different phases of the electrical system, need to be installed for each wiring phase of an electrical panel, and limit user interface to a single platform and system to domestic consumers only. Not all these systems provide features to view real-time updated electricity consumption by each load and real-time billing amount of total consumption on their user interface. IoT based energy tracking and bill estimation system discussed in this paper uses only binary actuators, which are affordable, and a cloud-hosted database for tracking electricity usage. It can monitor electrical devices and appliances which run on different phases of electricity.

It has an IoT cloud interface, which is supported on every mobile device, and it can be implemented for both household and industrial sectors. The proposed system displays a real-time estimated electricity consumption by each load connected to it and a real-time estimated bill of total consumption on monitor unit built -in IoT cloud interface. It also has additional features of logging the final estimated bill of each month to a cloud-hosted database and transmitting switching instructions for loads via a control unit built-in IoT cloud interface.

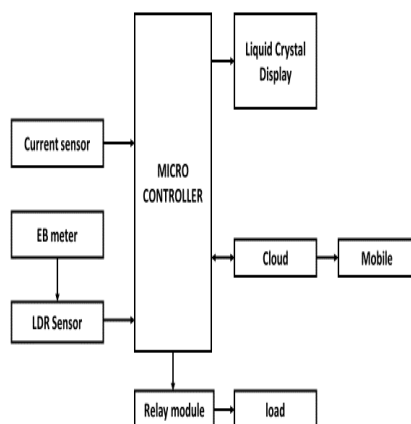
3. LITERATURE SURVEY

1. “Design and Implementation of Website based Energy Consumption Monitoring and Controlling” has been developed by Sohan U Alam. In this project, the way of proper monitoring and controlling energy has been achieved. The sensors send analogue data to the ADC, it converted it in digital form and send it to We MOS, then it up load to the server.
2. “Internet of Things (IoT) based Energy Tracking and Bill Estimation System” has been designed and developed by Rishi Mathur. In this project, the integration of a cloud-hosted database and control unit is used. The hosted database in Google Firebase enabled the simple design of this system, which is without the use of any electric energy measurement chip or current and voltage sensor, and it also gets logged with the final estimated bill of each month.
3. “IoT Based Power Management System” has been developed by Akshay Yeola In this project, the system makes use of the internet in making the monitoring of power consumption available to all. For monitoring abnormal behavior, it is very much important to maintain a proper data on energy. When a device got some problems than it is very much important to ensure the proper treatment of that device. If it is not possible then it will create abnormal behavior in the monthly bill. Here, A graphical representation will be presented of overall energy consumption. By that it will be easier to predict the bill of the month and the overall usage of energy.

II. OVERVIEW OF THE SYSTEM

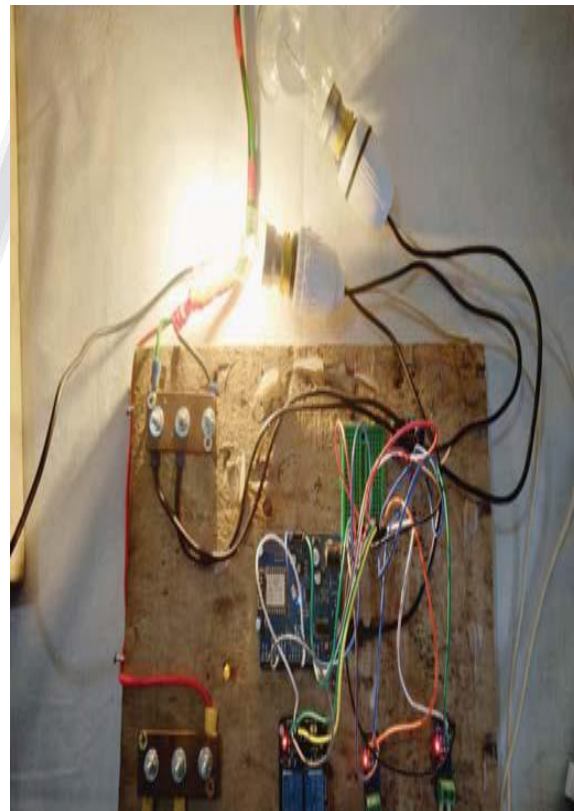
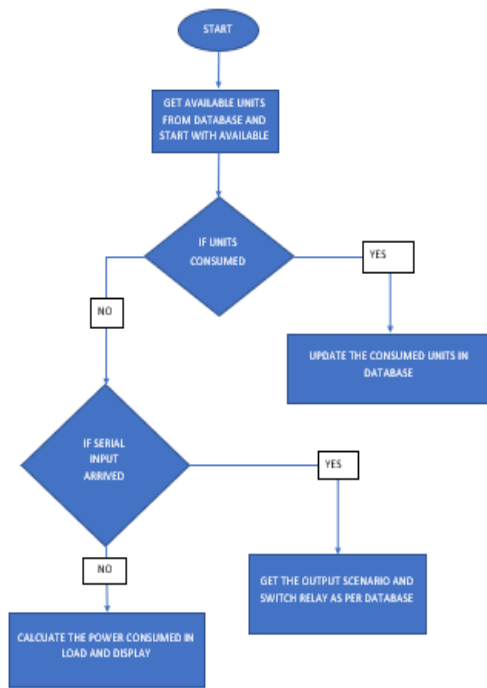
In our proposed system we are implementing a cloud hosted and control unit for our daily needed electricity. In order to use our system to provide electricity to the users we must recharge it first, we are implementing prepaid system to pay the electricity bill. In our cloud database we must register the user and provide them options to recharge as per their needed. To do these prepaid systems we are using asp dotnet based web application.

BLOCK DIAGRAM:



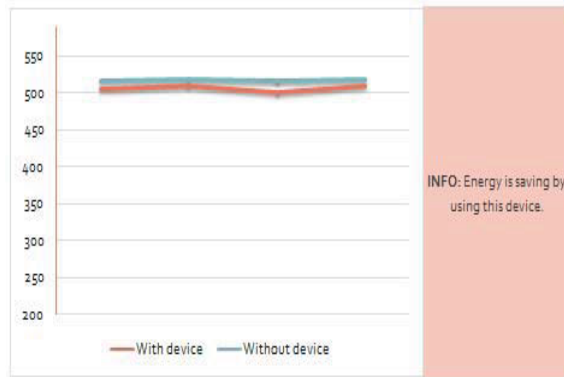
Then the hardware part will speak with the cloud database to check whether the users have enough amount to run the electricity. To capture the units consumed by the users, a LDR sensor is located near the Electricity meter, which will provide change in trigger whenever a unit is consumed. By calculating this trigger, we can get the units consumed by the user. After we get the unit trigger it has to reflect in the cloud, in order to do that we are using nodemcu. This micro controller board has Wi-Fi based data connectivity. The nodemcu will connect to home Wi-Fi network and send data to the cloud server. Nodemcu has the ability to do both post and get data with cloud server. Thus, nodemcu is efficient way of communication we have implemented for our system.

We have one more power monitoring system to show real time power consumption. We have ACS current sensor and Arduino for this. The current sensor gets the actual current consume by the load, which is then calculated and converted to the power. The Arduino controller board calculate the poser and send to it the node mcu board to show it in the cloud. Thus, having two controller board, we have easy and synchronous work between calculation and web-based actions. Once the assigned cost is reduced by consuming it all the load must disconnects, to approach that we have connected the whole load system via relay module. So, whenever the controller finds the units has been fully utilised, it will send a signal to turn the relay to off condition.



Implementation and Results:

Comparative Study Using The Device & Without Using The Device.



CONCLUSION:

IoT based energy tracking and bill estimation system discussed in this paper with various sections is successful in building awareness about electricity usage by displaying realtime estimated electricity consumption by each connected to it and real-time estimated bill of total consumption on monitor unit built-in IoT cloud interface. It has a simple design as it fetches the average consumption detail of loads from a cloudhosted database and not uses any chips or sensors to measure electricity, current, and voltage. It also has additional features of transmitting switching instructions for loads via a control unit built-in IoT cloud interface. The simplistic design and implementation of extra features were possible by utilizing the concept of the Internet of Things (IoT) in the proposed system. Here IoT added a new dimension that to control and monitor from anywhere. This project is very much cost effective and reliable. So, our system is completely appropriate to our country's socio-economic status.

Our energy resources are decreasing day by day. So, monitoring and controlling is very much important this project creates the opportunity for proper monitoring and controlling of energy. Here IoT added a new dimension that to control and monitor from anywhere. This project is very much cost effective and reliable.

FUTURE WORK:

In the present system, IOT energy meter consumption is accessed using internet and it will help consumers to avoid unwanted use of electricity. In future the following objectives can be achieved to save the power.

Power Factor ($\cos \phi$), voltage and current waveforms, Active Power (P), Reactive Power (Q), Apparent Power (S), average energy (kWh), Total Harmonic Distortion (THD) measurements for each wiring phase are left for future development to help users improve their electrical system and find potential energy savings.

We can make a system which can send SMS to the concerned meter man of that area when theft detected at consumer end. We can send the GPS location of the meter to the Electricity board when theft detected.

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