IoT based Home Automation System for Electricity Usage

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Abstract: One of the important scientific discovery of all time is of electricity. Electricity has many uses in our day to day life and provides comfort to people. The existing system for Electricity meter reading has many drawbacks such as real time data is not available, huge human resource requirement, difficulty in construction etc. This research proposes an IOT based system to overcome drawbacks and provide additional benefits. The proposed system uses Arduino microcontroller, to read the no of units consumed by electrical appliances. These data is than send to a remote server using Ethernet shield. At the user end, an android application is created which allows the user to fetch data in real time and represent it graphically. In an effort to overcome the energy crisis, these systems send an SMS to the user when his/her home electricity usage crosses a threshold. To notify the user about his daily electricity usage a notification will be sent to the android application every day. The above system has been designed to overcome drawbacks of the existing system, ease of accessing real time data and to reduce energy crisis.

Keywords: Android, Arduino Microcontroller, Ethernet shield, Internet of Things (IoT),

I. INTRODUCTION

In the existing system, the electrical energy units consumption data is gathered by visiting every residential every month by a representative from the electricity board. He then manually notes the energy units consumed on a piece of paper along

with the screen shot of energy meter alongside. This gathered data is then submitted to the local electricity board for the next step. At the electricity board, the official verifies the gathered information and submits to a software for bill generation [1]. Thereafter, the bill is dispatched and we receive the electricity bill. We as a consumer then make the payment for the received bill. This process is too hectic. Same work had to be performed every month and huge man power is used. Also, the possibilities of human error are countless [1].

With the current technological development as well as ease of accessing the internet, we have created an IOT based home automation system for electricity usage, with an objective to allow users to access their electricity consumption data in real time using an android application. Daily notifications will be delivered to an android application installed on user's phone. Whenever the user's electricity consumption crosses a threshold an SMS will be delivered. With the above implementation, it is expected to increase public awareness to save electricity.

II. DESIGN TOOLS

A. Overview of System

Fig. 1 shows the block diagram of the proposed system. The Arduino microcontroller is used to read the electric consumption data from energy meter when the electric appliances (load) are connected to energy meter. Whenever a specific amount of energy is utilized by the load, the calibration led of energy meter will blink.
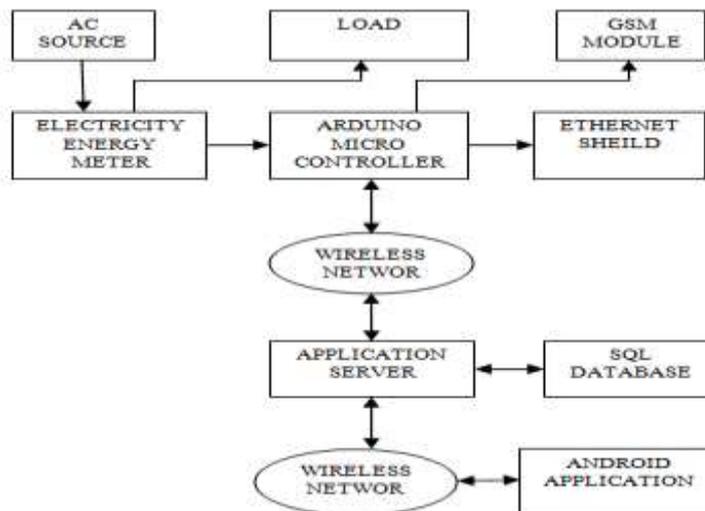
Fig 1. Block Diagram of Proposed System

The Arduino microcontroller will sense it and units consumed will be calculated using a sketch (program in Arduino). Further, the data captured will be sent to an application server and stored in SQL database.

At the user's end, an android application will fetch these data at a real time and represent it graphically. The user can view the consumption data on a day to day basis as well as a whole.

Further, whenever a user's household energy consumption has crossed a threshold, an SMS will be sent to users mobile, to alert him to use energy wisely else he will be charge more in his electricity bill. Also, to notify users no a day to day basis, about his household energy consumption android Firebase Cloud Messaging (FCM) service is used.

B. The Design of Software

Fig. 2 represents the software design flowchart to read the consumption data from energy meter using arduino microcontroller and send it to the application server for its storage. The system needs to initialize components like ethernet shield and GSM module, and then establish a connection with the application server. When a load is connected to energy meter and it consumes energy, the calibration led of energy meter blink's and this sensor value is read +by arduino microcontroller.
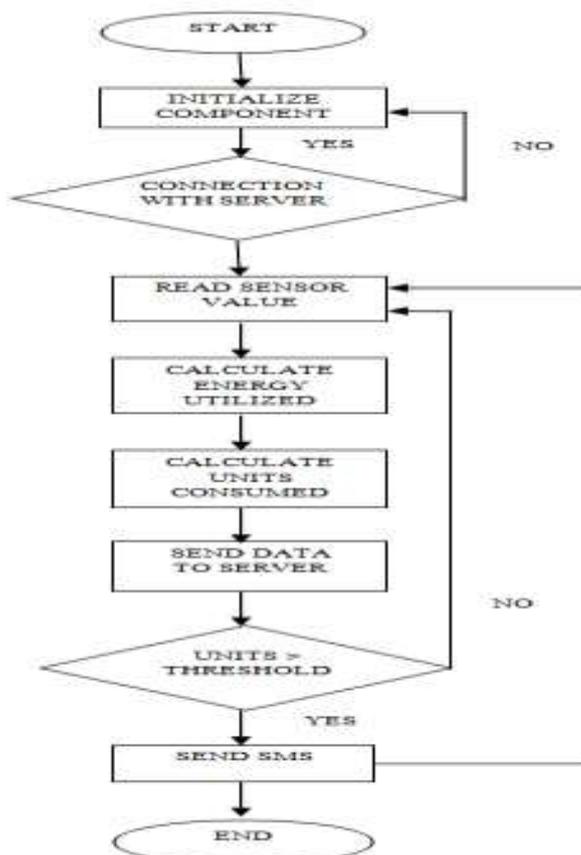

Fig 2: Software Design Flow Chart

Thereafter, the total energy consumed is calculated. This form the input to calculate units consumed. Once the data is available it is sent to the application server, using Ethernet shield, where is it stored in SQL database. Then the system checks whether the user's home energy consumption data has crossed a threshold. If yes, than an SMS is sent to users phone number alerting him about the energy usage so that he could wisely utilize energy and reduce his monthly bill and then the process is repeated again. If not, the microcontroller waits for next sensor value. In addition to this, an android application is created to show the energy consumption data graphically. Also, this system sends a notification to user everyday on his daily energy consumption. We have used Google Firebase Cloud Messaging (FCM) service for sending a notification.
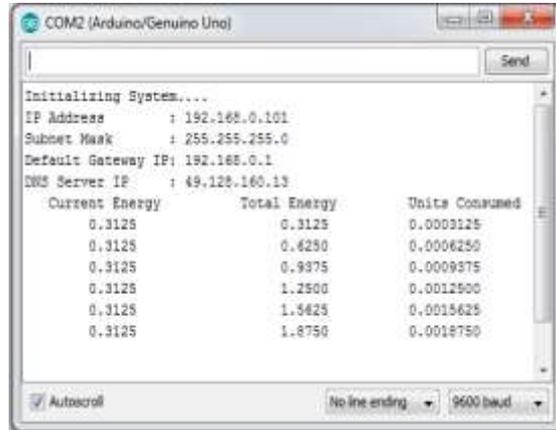
III. RESULT

Fig 3: Units Utilized by Electrical Appliances

Fig 3. Shows the energy units utilized by users' home appliances. Whenever the calibration led by energy meter blinks the data is represented in the above fashion. Here, we are using energy meter with 3200imp/kwh. Therefore, 0.3125 watts of energy will be consumed in a single blink of calibration led, represented in the first column. The second column shows the total energy utilized and the third column represents the corresponding units utilized.
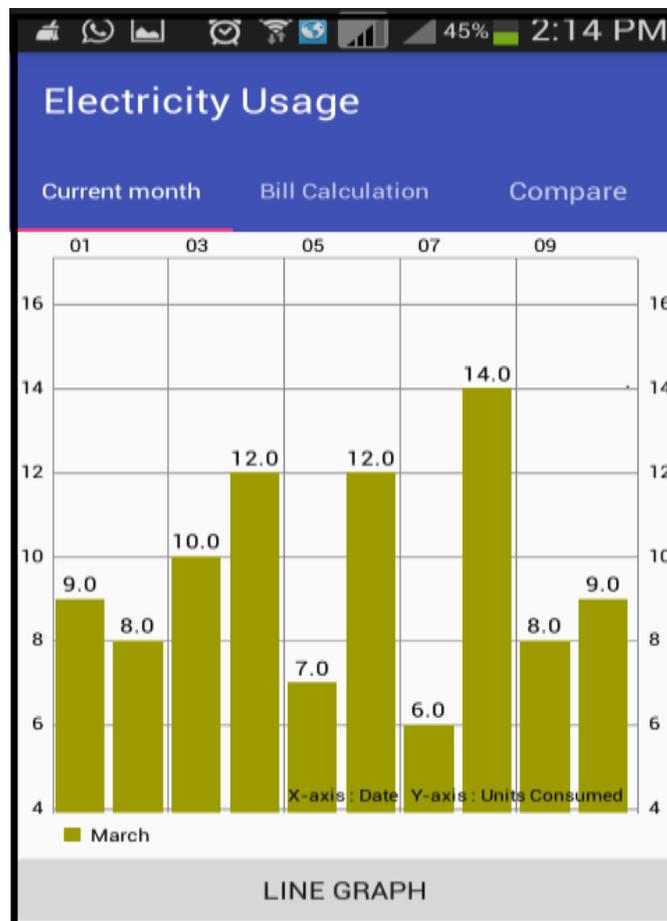

Fig 4. Graph Representation of Daily Energy Utilization

The data captured in the previous step will be sent to a remote server. Then, we have created an android application to represent these data in a graphical manner. The above graph represents energy utilization for the month of March in a day-to-day manner. Similarly, we can have graphical representation for the same data as a whole.

Fig. 5, shows the bill calculation based on the units utilized. A number of energy charges need to be considered to calculate the total electricity bill. These charges are fixed charge, wheeling charge, Energy charge, Regulatory Asset charge and Fuel Adjustment charge. These charges vary as per the units utilized. More the units utilized, higher is the energy bill.

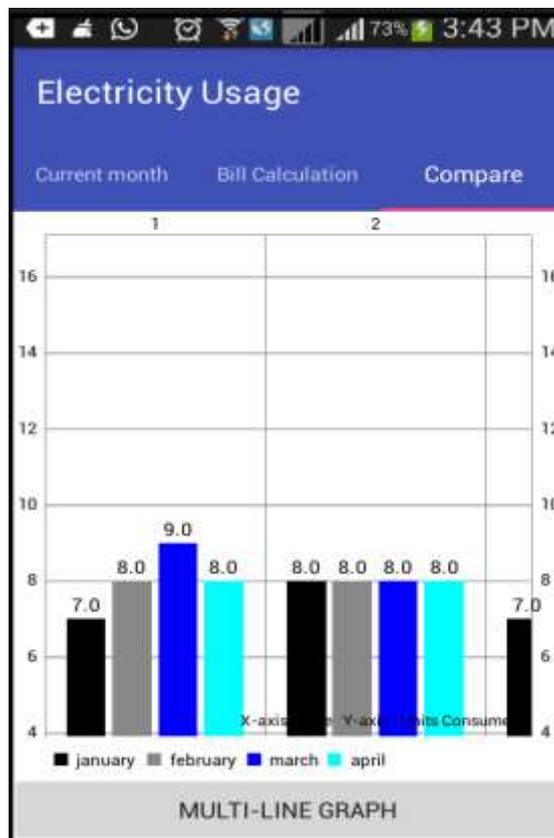**Fig 5. Bill Calculation**

Fig 6: Energy units Comparison

Fig 6 shows the comparison of units utilized for the months of January, February, March, and April on a day to day basis. The values on the x-axis are the date of months and y-axis value represents the units. These feature within android application allow users to select the months they want to compare. The information then will be represented in the graphical representation as shown in fig 6.
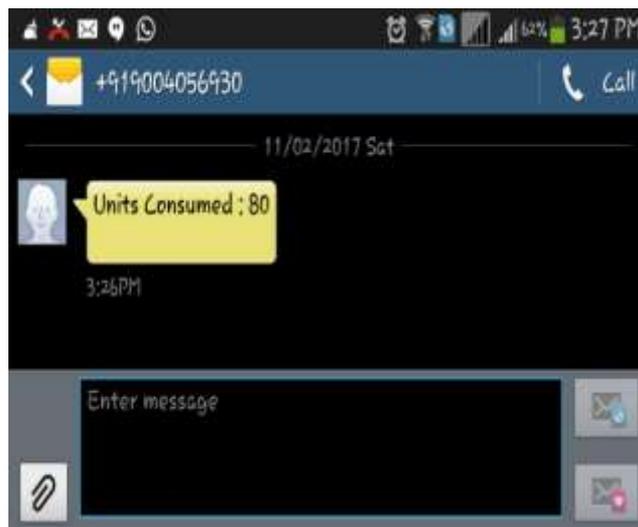
Fig 7. SMS to Alert User

Whenever the user's energy utilization crosses a certain threshold an SMS will be delivered to the user alerting him about his energy utilization. The energy charges changes after 100, 300 and 500 units are utilized. We send alert SMS when 80% of the threshold value is reached i.e. an alert SMS will be sent after 80, 240 and 400 units of energy utilization.

IV. CONCLUSION

From the results, it is clear that the proposed system had overcome the drawbacks of the existing system. It has drastically reduced the human resources required for collecting energy utilization data and thereby avoided the man made errors. Also, it will save a lot of money of electricity boards.

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