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Proposed System for Iota Based Prepaid Electric Billing Meter

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Abstract: *The curve for the demand for electricity in India has always been on the increasing side while the curve for the supply has been on the decreasing side. This paper proposes an IoT based prepaid electric billing meter with an objective to let the end user know his/her real time consumption of electricity. This will enable users to make a conscious effort to reduce consumption. The end user can track his/her real time consumption of electricity on the web interface with a unique login id and password. The end user can also recharge from the same interface. This real time awareness of consumption will also help end user to control his/her electricity theft.*

Keywords: *cloud-based infrastructure, IoT based electric meter, prepaid electric meter, Raspberry Pi.*

I. Introduction

The electricity billing system has been post-paid over the years in India. While in case of mobile system it is both, prepaid and post-paid, and the analytics shows that prepaid users have lesser phone bills as compared to post-paid. With this analogy of telecom system, the electricity billing system can also be made prepaid and can prove helpful for keeping a check on the consumption of electricity in India.

The non-linearity in the graph of availability versus requirement for electricity has been eventually increasing in the past few years in India. Due to the post-paid billing system, people are not aware of the way or amount of electricity (real-time) they are using it on daily/monthly basis. Real time statistics can be very helpful for this. The consumption of electricity and the above scenario can be controlled by introducing the prepaid billing facility in the electric meter.

The IoT based prepaid electric billing meter will be connected to the web-interface through a cloud-based infrastructure. In addition, the same interface will be used for recharging and tracking real time electricity purposes. The whole system is designed in such a manner that null balance will lead to electricity cut-off. Also, special measures are provided in times of emergencies when payment of bill is not possible.

II. Existing Systems

The post-paid electricity billing system already involves a lot of labour work and efforts. The major disadvantage with this system is the possibility of human error, the person taking readings may make a mistake. In addition, the current system is a post-paid one; we know the bill only at the end of the month. There is huge scope for electricity theft [2]. Accuracy is also an issue. In spite of this post-paid billing system, few prepaid systems have been proposed and developed.

One of the method that has been proposed [2] was based on using Microcontroller and which uses the Recharge Card of various ranges like □50, □100, etc. and meter can be recharged using keypad present on it. The measures taken to reduce the control the electricity theft by developing the prepaid system [1] using GSM/GPRS infrastructure in which the recharge can be done through SMS and here as well the Microcontroller is used. Getting the readings from the electric meter is one of the challenging tasks in developing such prepaid systems and hence one of the ways that is proposed in one of the existing system[3] is by using camera to capture the image (of reading), captured image is pre -processed to get display plate and characters are recognized by processor Raspberry Pi using contour algorithm, by taking difference between two readings of consecutive months billing is done and is sent to the consumer using GSM / GPRS[4] wireless technology. Another system[8]] integrates the ZigBee protocol in Raspberry Pi using Python and using Python the raw data is converted into a .CSV file which acts as input to the MySQL database and the data is uploaded on the website.

The technologies like GPRS has almost become outdated and the internet is getting cheaper day by day especially in a developing country like India. Hence, the prepaid system with cloud infrastructure is necessary to

be developed, as the sending real time track of consumption is quite an easy task using cloud, at least easier than building the GSM/GPRS infrastructure.

III. Proposed System

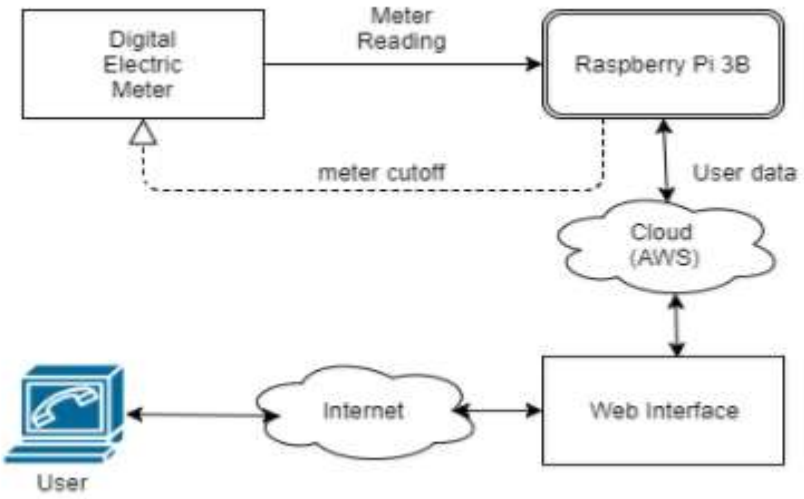

Fig. 1 Block Diagram

The IoT based prepaid electric meter will be developed using the Raspberry Pi model 3B [6] and other few electric components will be used to maintain the contact with the electric meter. The front end of the system will be web-interface based and connected to the cloud infrastructure and the same cloud infrastructure will be connected to the Raspberry Pi. The block diagram shows the complete overview of the project.

IV. Methodology Applied

One of the important challenging in developing the prepaid systems is getting the readings of the digital meter and further these values are used for controlling the meter. The entire methodology for the construction of the same is as follows:

A. Getting the Meter Reading :

The Raspberry Pi has like more than 20 GPIO (general-purpose input output) pins [9] structure which can be used to connect different modules to the Pi. The digital meter contains the seven-segment LED display. The same LED system will be connected to the raspberry pi and readings taken can be used for the further manipulation of the electric meter.

B. Controlling the electric meter :

Relays are one of the best electric components when it comes to switching the electric circuits. The proposed system bridges the end user and the electric meter with raspberry pi with the cloud infrastructure [7]. The cloud infrastructure contains the whole user info like his/her remaining balance details, recharging details etc. and these same details are used to switch the electric meter on/off. The null balance can lead to the electricity cut-off and will be automatically switched on as soon as the recharge is done.

C. Web-Interface :

The UI/UX part maintains the connection between the hardware and software. The front-end [4] of the system will be totally web-interface based. The web-interface will contain the end users' login/registration details and users' balance details. The interface will show/track the real time consumption of the registered users and will show the usage/consumption details till particular date in a graphical manner. The recharge of the electric meter can be done through same interface. As discussed, the interface is connected to the cloud and further the cloud infrastructure is connected to Pi. The figure below shows the architectural design of the proposed system.

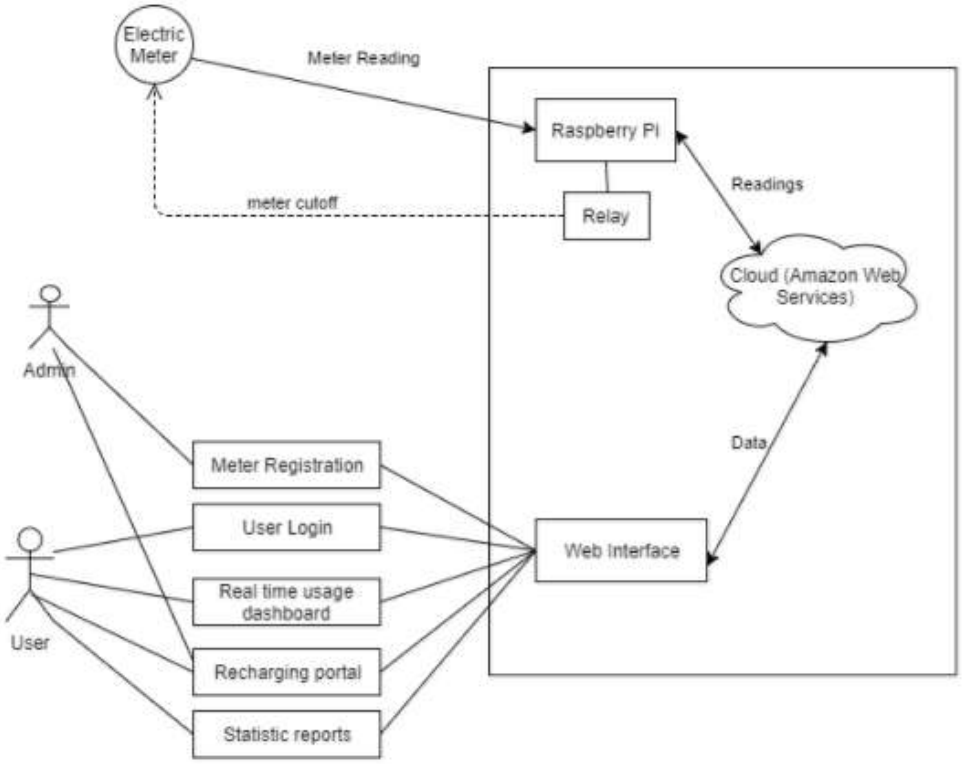

Fig. 2 Architecture Diagram

V. Proposed Results

As discussed above, the end user of the system will be connected through the web-interface and he/she will be having unique registration id to access the interface. The interface will include the available or left units and will also display the real-time usage. The interface would be much helpful for generating reports of consumption on daily/monthly/yearly basis. The user will be notified about consumption and left units in the frequent intervals through push notification service linked with the interface. In addition, the SMS medium will also be used for notification purposes. Graphs and pie charts for better visualization of the reports/usage will also be generated through the system.

VI. Conclusion

This paper proposes an IoT based prepaid electric meter, which tracks the real-time consumption of electricity and display the same over the web-interface. The main advantages of the Proposed System is that the users will aware of their electricity consumption and control their consumption. Another advantage is controlling/avoiding the electricity theft, as the user will be notified for the units consumed. The analytics of generated reports and data would be helpful for taking the appropriate steps for controlling consumption. With the help of cloud platform as a medium, the system will be faster and reliable.

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