

Prepaid Electricity Billing System using Arduino

J. Godwin Ponsam, G. Geetha, P. Selvaraj

Abstract: *The World is changing very fast. With the advancement in technology, the needs and demands for various resources is increasing too. Earlier, when the technology was not that advanced. We, Humans, never thought about saving resources and never thought about efficiency, as everything was abundant. However, with this fast growing world and increasing demands, Scientists have started worrying about the Sustainable Development. The pace at which all these resources are being used, soon they will be fully depleted. Already the need for saving the resources like Petroleum and Natural gas has been understood and alternate resources are like electricity are used to power the devices dependent on Petroleum and Natural Gas. The main thing is that we are not realizing the fact that shifting to some other resource like Electricity and ultimately getting dependent on it will endanger that resource too. Today, Electricity is used as a major resource in our day-to-day lives. Electricity is powering every machine used by us daily. From Powering Fan, Ac, TV, Refrigerator to powering microwave, electric chimney, Induction Plate, and even Vehicles. We are overusing Electricity so much that there is a need to reduce its overuse. Otherwise, the day is not far when Scientists will have to start looking for some other alternate resource also. Being renewable resource, it is cheaper and easily available at this moment but soon the situations might change. In today's Electricity Distribution System, there are many flaws. There is no measure for reducing the overuse, no measure for people not paying their bill, no measure for people who secretly steal the electricity. All this can be solved by using a Prepaid System that will enforce customers to pay before use, so no defaulters*

Keywords : Smart Card, Arduino, Machine learning

I. INTRODUCTION

In the current system, each month a person from the electricity board goes to every registered home with a meter and note down the meter reading and then the bill is sent via post based on the reading. Now, This system has many flaws like consumer might alter the electricity meter readings, or the board member might be bribed and moreover, If the user is not able to pay the bill, then supply is cut after 2 months which leads to loss. Apart from all this, the electricity board person has to manually go to each house and note down the reading, which is very tedious. In addition, the current system cannot detect the peak hours of maximum demand. This prepaid electricity billing system will overcome all these issues and will provide peak maximum demand timings for further research. The purpose of the proposed system is to design a system that can provide consumers with flexibility like a mobile recharge where consumer can recharge for a specific price and gets the equivalent amount of units to use that in turn would help both consumer and Electricity Board to measure peak usage, recharge whenever needed.

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This will be achieved by using Smart Card technology. The Smart Card will act like a token that will contain the recharge amount and upon interfacing it to the meter, the recharge details will be fetched by Smart Meter and equivalent units will be allotted. The user will be notified when the allotted units are about to be fully consumed. The User can recharge immediately to get uninterrupted service. If the User is not able to recharge, the supply is cut off automatically when units are fully consumed.

II. LITERATURE SURVEY

The idea of Prepaid Electricity Meter is very beneficial for Smart Cities. The Survey reveals that current system has many flaws. The current system cannot prevent thefts, has no measures for bill fraudsters, requires a lot of manpower and time, has unreliable meter readings. To overcome all these drawbacks,

the prepaid electricity billing system is introduced. In this System, the user has to pay first and then consume just like a mobile recharge. It is more efficient than conventional electricity billing system. It can provide per minute consumption details sent over to server. User can access these details via mobile network through an application just like your mobile recharge application. This provides user ease and flexibility to gather its electricity consumption details. Moreover, the proposed system makes the whole electricity billing process transparent. All this will lead to a user-oriented design, which will encourage user to use electricity efficiently. The proposed system is built on Arduino mega that acts as heart of the system.

The Proposed system will increase the operational efficiency as the need of manpower for collecting the reading will be removed. It will also replace the tedious paper bill system to online or from Electricity Board as suitable. There will be no late bills and no Bill Fraudsters. The extra manpower required for disconnection and reconnection will also be removed with no delays. Thus, User can better manage its energy usage with very ease, flexibility and transparency.

Apart from all this, moving to online billing will reduce the wastage of paper and will eliminate the tedious process of bill generation and circulation. The user will get the bill via Email or can view its usage bill in the application. Thus, This system will leave a green footprint and not only help in manage power crisis but also save paper.

III. PROPOSED METHODOLOGY

Predictive Algorithm :- The Proposed System would also be able to detect which appliance has got out of order or is damaged by using a simple machine learning usecase algorithm. The Algorithm Proposes that whenever an appliance stops using electricity abruptly, the system will detect and notify it to the user.

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The idea behind this algorithm is the system continuously measures the usage data. So, The system will calculate the daily average and if any device goes out of order unlike the daily routine, the proposed system will note down the amount of less usage. Based on that data, amount of electricity used lesser than average and the duration of time for it went down, the system will predict which appliance from available appliances went out.

The proposed system can be explained using four different modules. These modules are User, Microcontroller, Analytics and the output to presentation layer.

Module 1 - The User :- User will be Provided with a Smart Card that contains a prepaid amount and interfacing that card to the Hardware Module will activate the meter. User can view the live usage of the consumed unit over the Website.

Module 2 - The Arduino Microcontroller :- Microcontroller act as the Heart that contains all the coding to control the flow of Electricity and cut the Supply as and when the prepaid amount is reached. It contains the linking to all the interfacing modules and contains the logic to send the data periodically to server.

Module 3 – Analytics :- Currently the User has to pay for the whole month. Even Though if he is not using the Electricity the whole month, an average bill based on Power Sockets and appliances in the house is issued. Moreover, In the current system User cannot view its live bill reports but have to wait for the Bill that comes late in next Month.

Using our proposed system, User will be able to recharge it with only the amount of time he needs to use and need not care for the extra bill that come due to average bill reports. Moreover, User can view its live usage, control its use as per the financial status, and thus, reduce wastage.

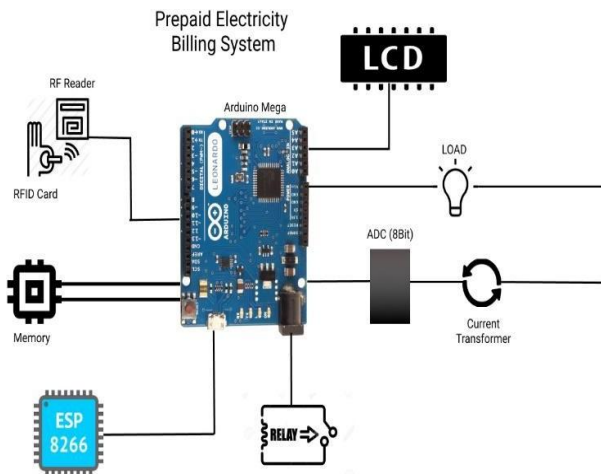


Fig.1

User will also be able to view the graph report of used electricity per day to know the peak usage time and manage its usage.

Module 4 – The Result Output :- Now, All the Data generated in analytics is available to user for viewing over an Website and a Web view App. User can View it anytime and generate reports based on that which can help him to manage the usage and wastage.

IV. IMPLEMENTATION

In this proposed system, various devices are used like Arduino mega, Wi-Fi Module- ESP8266, Energy Meter, LCD, LED, Buzzer, Relay Device, RFID Card, EM-18 Reader Module etc. Apart from this, The Arduino Mega board is coded in embedded C.

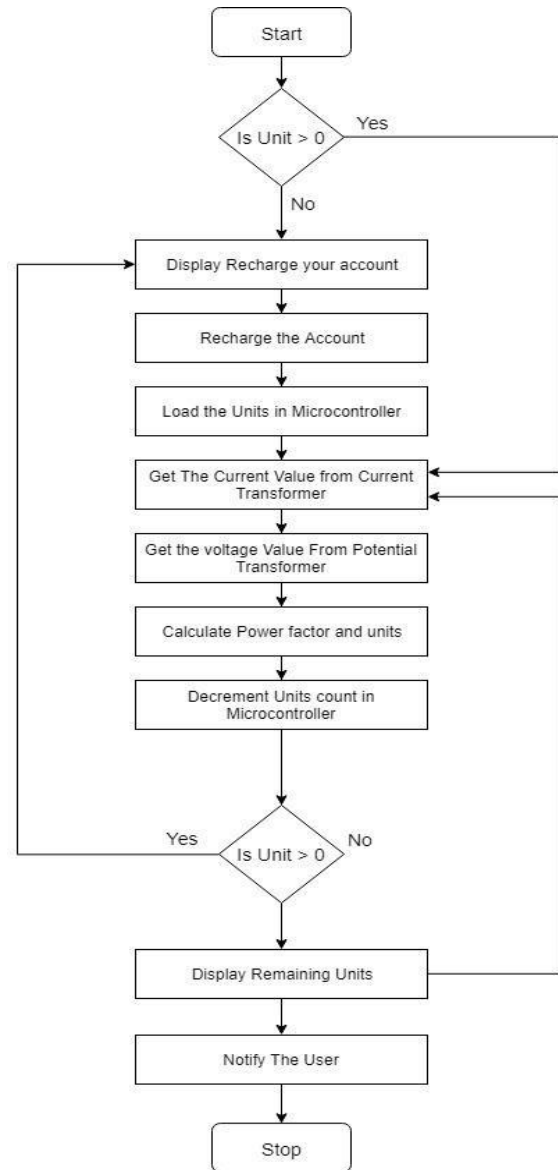


Fig.1

Arduino Mega :- Arduino board is the heart of our system. Entire functioning of system depends on this board. Arduino reacts to the 5v supply given by opto-coupler and keeps on counting the supply and then calculates the power consumed and the cost.

ESP8266 :- Through Wi-Fi the consumer can set changes in threshold value, he can ON and OFF the energy meter. Time to time the readings of units and cost are displayed on server. User can access this information via application or webpage.

RFID :- Radio-frequency identification tags contain electronically stored information. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object.

They acts as Smart Card to activate the recharge.

EM-18 Module :- Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information.

Whenever any appliance in the house uses electricity, the meter starts reading the usage and records the data. We can see the blinking LED in the meter. This blinking Led counts the meter reading. Meter Reading is linked with blinking LED.

Different meters have different parameters to note down the reading. Mostly, 3200 blinks is considered as 1 unit of power consumption. However, Here in our system for demonstration purpose, we took 5 blinks = 1 unit of power consumption.

In our system, Arduino Mega acts as main controller that controls and manage the passage of electricity through the meter and records useful data and send it to server. The Arduino Board reads the blink of LED and measure the reading accordingly. It than checks for the allotted usage and continuously measure the reading to stop the supply through a relay circuit whenever allotted units are reached. User will receive a notification when the allotted units are about to be consumed to recharge with new units for uninterrupted service.

V. RESULT

The purpose of making a prepaid energy meter that would provide minutely usage data was successfully achieved. The Electricity meter successfully cut the power supply when allotted units were over. All the usage data was successfully sent over the server and was easily accessible via android app. The utility to recharge your electricity via mobile was also provided which will enable the customer to recharge with more units immediately to enjoy uninterrupted service. The system will be able to detect any broken appliance too using the proposed algorithm that will enable the user to look over his house maintenance. The Block diagram of the hardware setup is shown in fig3.

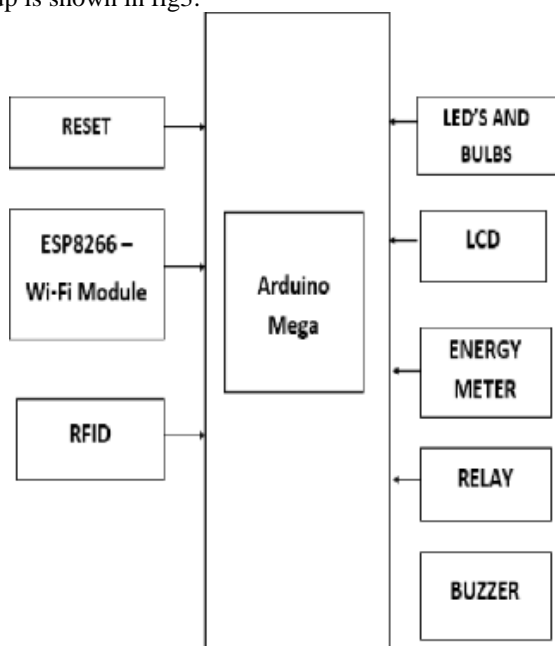
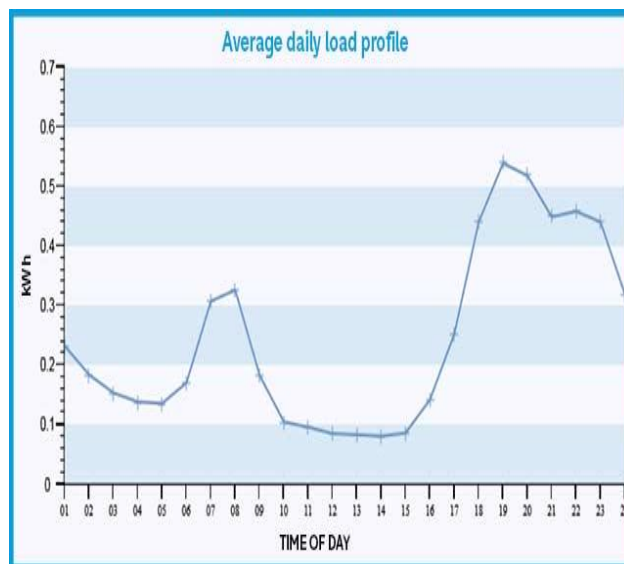


Fig.3



VI. CONCLUSION

This system enables the user to monitor minutely usage and helps Electricity board by removing the need of labour to take out the readings each month. Thus, it helps in saving money, time and manpower. In addition to that, this system will remove disconnection / reconnection cost, prevent power theft and will eliminate bill defaulters. This system makes this whole process transparent for user and thus, encourages user to manage power usage. Ultimately, this system will help to minimize the power crisis by reducing the wastage of electricity. This system will also help in improving the economy of Electricity Board. This system will move the Billing system from print media to electronic media. The generated usage bill that will be calculated from minutely usage will be sent to the user via Email instead of paper bill. This will help in reducing the wastage of paper. Thus, this system not only helps in saving power crisis but also helps in saving the environment by saving paper.

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