International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 03, March-2019

PREPAID ENERGY METER WITH SYNCHRONIZED UNITS WITH ARDUINO CONTROLLER FOR ADVANCE BILL PAYMENT SYSTEM

Mayuresh Shiravadekar[1],Karishma Patil[2],Ankita Hujare[3],Prof. Prasan Kamble[4]

[1]*Electronics & Telecommunication Engg. Dept., Shivaji University Kolhapur,*
[2]*Electronics & Telecommunication Engg. Dept., Shivaji University Kolhapur,*
[3]*Electronics & Telecommunication Engg. Dept., Shivaji University Kolhapur,*
[4]*Prof. Electronics & Telecommunication Engg. Dept., Shivaji University Kolhapur,*

Abstract— Lots of problems are faced by electricity service providers due to conventional bill payment system. The company goes in debt as lots of capital has to be invested for processes like generating bills by sending authorized personal to each and every house to manually note the readings on meter and submitting the same data to the office for data entry. This process consumes lots of time and money. The solution to such types of problems is prepaid system for electricity. To consume electricity, a prepaid recharge has to be done on consumers system. The project allows consumer to use electricity till the account balance is more than the cut off balance. Depending upon the electricity consumption, the balance goes on decreasing. Electricity automatically shuts down once the account balance reduces beyond the cut off balance.

Keywords— Prepayment System, Synchronizing Energy meter with controller, Arduino Uno, Optoisolator, Optocoupler

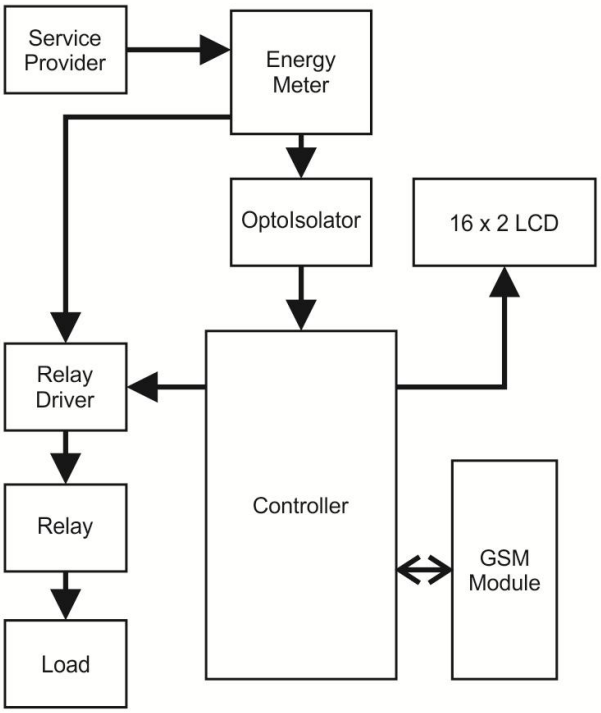
I. INTRODUCTION

The project mainly focuses on solving the problems faced by electricity service providers due to conventional Bill payment method. Lots of capital and time is wasted for generating a bill as it is manual process.
The authorized personal of electricity service provider has to go door to door to each house, take a snap of units present over the meter and submit these snaps to the office. These snaps are then uploaded to the software to generate bill. With the help of this project, this entire process is cut down.
The project uses conventional energy meter to determine the load attached to the system. This energy meter is also called as KWH (Kilo Watt hour) meter. According to the standards, for 1kW load for one hour generates 1 unit. For each and every KWH meter, there consist of a led which works on the pulses depending upon the units generated. According to the standards, 3200 impulses compute one unit. So by measuring these same pulses, we can synchronize the unit with the controller.
The project uses arduino for measuring, monitoring and controlling the units. The optoisolator is used to isolate meter form the arduino. The pulses generated by energy meter are then transferred to arduino via pullup to remove any ac content in it.
The digital display controlled by arduino displays current unit with respect to energy meter, account balance, no of blinks, balance used (in Indian rupees).
Depending upon the load attached, the meter generates readings. These readings are synchronized with the arduino. The account balance reduces as per the load attached. Once the account balance reduces beyond cut off balance, the arduino sends the control signal to relay to cut off the electricity supply. To assign new balance, a GSM module is used. An encrypted message is sent to the module which consists of new balance amount.
This message is decrypted by the arduino and the amount is added to the initial account balance.

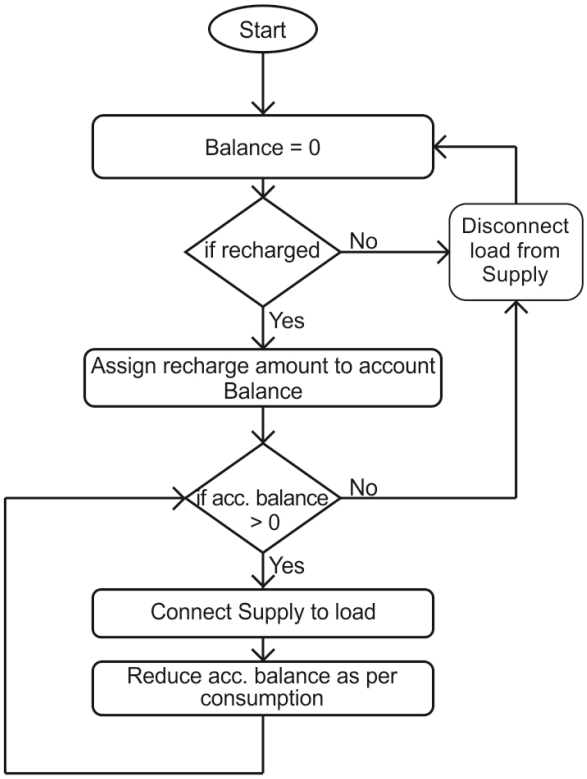
II. BLOCK DIAGRAM

The input to the energy meter is the electricity supply provided by the electricity service provider. One of the outputs of energy meter is the electricity which will be consumed by the load and the other is pulses generated by energy meter depending upon the consumption of load.
The electricity output is connected to the load through a relay switch. This switch is controlled by the controller depending upon the account balance.
For monitoring the units, the pulses generated by energy meter are transferred to controller via optoisolator to isolate the analog section from Digital modules.
The controller used here is Arduino Uno board consisting of Atmega 328 controller. The controller counts the pulses from energy meter and generates equivalent units as on energy meter. It also maintains the account balance which consists of deduction of balance as per the units consumed and also addition of balance when the account is recharged. The controller also performs decryption of incoming message to determine the amount of recharge made.
The GSM module is used to receive recharge amount. The received message is then serially fed to the Arduino board.

The 16 x 2 LCD connected to the Arduino shows the real-time data of number of blinks/pulses, units generated by the pulses, Account balance and balance consumed by the load attached. This information is helpful for the consumer to schedule the next recharge or determine the consumption of load attached.



III. PROGRAM FLOW



At initial stages when controller boots up, its account balance is assumed to be zero. In such case, the controller checks for new recharge amount. Till then, the load is disconnected from the electricity supply. Once the recharge is made, the

controller moves into interrupt priority mode and stops all other processes and decrypts the input serial message from electricity service provider received by GSM module and determines the recharge amount.
This recharge amount is then assigned to the account balance after decryption process. The controller checks whether the account balance is greater or less than the cut off balance. In this flow, the cut off balance is 0 rupees. If the balance is greater than 0, the electricity supply is connected to the load and simultaneously the controller reduces the account balance depending upon the received pulses from energy meter.
This cycle goes on repeating till the account balance becomes 0. Once the account balance becomes 0, the controller disconnects the load from electricity supply. The flow again starts when new recharge is made.
If a new recharge is made even if the account balance is more than the cut off balance, the new amount gets added to the present available account balance. So to enjoy uninterrupted electricity supply, one should recharge at regular basis depending upon its usage.

IV. CALCULATIONS

Following is the calculation for pulse time taken by Energy Meter for 200W load:

1000 WHr - 3200 pulses
200 WHr – x pulses

According to the standards of energy meter, for 1000 Watt load for one hour gives 3200 pulses. So calculating pulses for 200 Watt load.

$$x = \frac{3200 \text{ x } 200}{1000}$$
$$x = 640$$

So we get 640 pulses within one hour for 200W load.
Now calculating the time required for single pulse:

640 pulses - 3600 seconds ……(One hour = 3600 Sec)
1 pulse – $x1$ seconds

$$x1 = \frac{3600 \text{ x } 1}{640}$$
$$x1 = 5.625$$

So for 200W load, the pulse time is 5.625 Seconds. So the Energy meter and the controller are synchronized with the help of these pulses

V. RESULTS

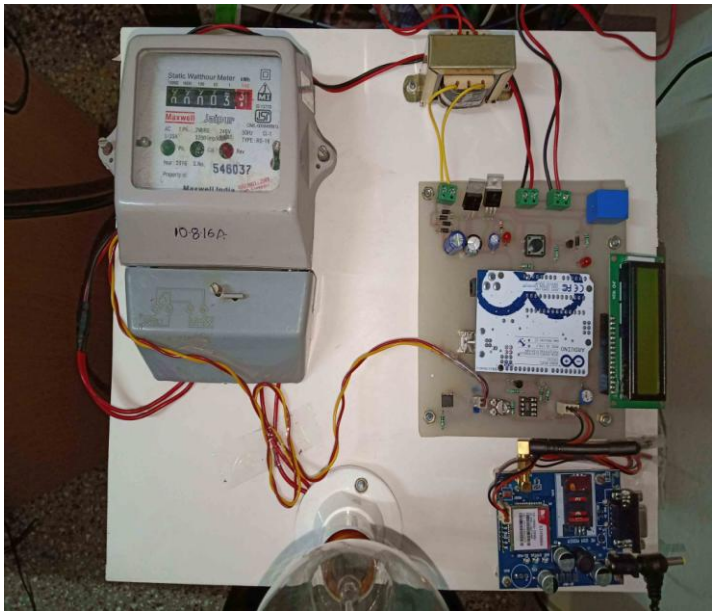


Fig. 1 Complete setup of the system

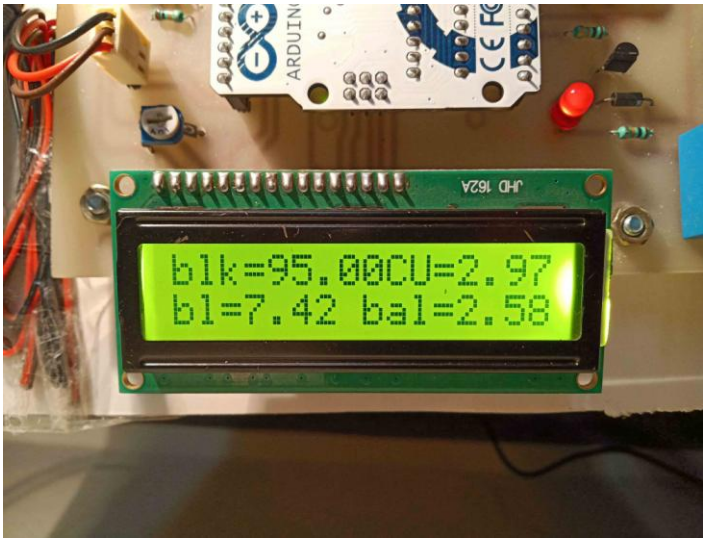


Fig. 2 Parameter Readings

Figure – 1 shows the complete setup of the project which consist of Energy meter, Arduino Uno, GSM module SIM900A.
Figure – 2 shows the readings of number of blinks, synchronized units with respect to energy meter, account balance and balance used in rupees.
blk - determines number of Blinks/Pulses from energy meter.
CU - determines Current unit.
bl - determines balance used in rupees / Consumed balance.
bal - determines account balance available in rupees

VI. FUTURESCOPE

Many things can be done to improve this project. A non-volatile system on chip external memory can used to store the account balance so as to make the project more secure and theft free. Also this system can be attached with IP module. With the help of this module, the project can be monitored and controlled over Internet. Account recharge can be made directly through the internet irrespective of GSM module.

VII. CONCLUSIONS

The system automatically cuts off the electricity supply once the account balance is less than the cut off balance. The GSM module receives encrypted message which is then decrypted by controller to determine the recharge amount. The Energy meter is perfectly synced with the help of digital pulses generated by the energy meter with the arduino board. The same readings are displayed over the 16 x 2 LCD with other additional information. The load and pulse time calculations made theoretically matches practically.

REFERENCES

[1] Shraddha Yadav & Prateeksha Pandey, “Smart Meter for Prepayment Electricity Units and Theft Controlling System,” IJAIEM-2016.
[2] Sharada Ohatkar, Tejashree Tarade, Sonali Thigale, Siddhi Surve, “A Smart Prepaid Energy Meter System with GSM Technology”, IJEECS-May 2017.
[3] F Reni Clenitiaa, E. llakya, G S Preetha, B Meenakshi, “Enhanced digital energy meter”, ICCPEIC-2017.