# Prepaid Energy Meter Using GSM Module

## Rahul Barange[1] Mangal Kumar[2] Arati Mahajan[3] Sakir Khan[4] Prof.Umar Siddiqui[5]

[1,2,3,4,5]Department of Electrical Engineering

[1,2,3,4,5]Thakur Shivkumarsingh Memorial Engineering Collage, Burhanpur (Affiliated to RGPV Bhopal), India

*Abstract—* It is realized that one of the defective subsystems adding to the tremendous budgetary loss in Power Supply Company is the conventional metering and charging framework. Mistakes get presented at each phase of charging the energy rates, similar to blunders with conventional meters, reading errors by human while noticing the consumed energy; and blunder during the preparation of paid and the due bills. The solution for this downside is a prepaid charging or billing framework of consumed energy. Most of the developing countries are shifting their conventional energy management practices to the modern one by replacing the old and conventional energy meters with the smart meters outfitted with the prepaid facility to quantify the power consumption so as to decrease the income deficits looked by utilities because of customer unwillingness to make consumed energy payments on time. Our proposed design embedded with Arduino and GSM technology is advancement over conventional energy meter, which enables consumer to effectively manage their electricity usage. The system performance is good with the acquired results. An earlier charging will undoubtedly get rid of the issues of unpaid bills and human mistakes in meter readings, along these lines guaranteeing justified income for the utility.

*Keywords:* Arduino; energy meter; smart meters; GSM

## I. INTRODUCTION

### A. Overview

In India electromechanical energy meters were used for a long time. These meters work by checking and figuring the quantity of turns of an electrically directing metal plate which is made to rotate at a speed in respect to the power experiencing the meter. Those electromechanical energy meters are being supplanted by the newly digitized meters due to different problems like there is no way to upgrade those energy meters, its accuracy was limited and those meters were easy to manipulate because direction of revolving disc can be easily reversed. Nowadays, digital energy meter can measure voltage, current and power also but electromechanical energy meters can only measure active power. Digital meters measure energy usage by highly integrated circuits, by capitalizing the voltage and current that gives the instantaneous power in watts. Digital meters show usage of electricity in digits on a liquid crystal display and those meters are highly accurate, inexpensive, theft reluctant, etc. In existing system either an electronic energy meter or an electro-mechanical meter is fixed in the premise for measuring the usage. The meters currently in use are only capable of recording kWh units. The kWh units used then still have to be recorded by meter readers monthly, on foot. The recorded data need to be processed by a meter reading company. For processing the meter reading, company needs to firstly link each recorded power usage datum to an account

holder and then determine the amount owed by means of the specific tariff in use.

## II. LITERATURE REVIEW

A paper suggests a design of a system which can be used for data transmission between the personal computer and smart card. The device will transmit the data in half duplex mode (Kwan, 2002). In this paper, an Intelligent Prepaid Energy Meter has been designed, modeled and simulated using Matlab/Simulink tools. Koay et al (2003) in their work (Koay .B.S, 2003), designed and implemented a Bluetooth energy meter where several meters are in close proximity, communicated wirelessly with a Master PC. Distance coverage is a major set-back for this kind of system because the Bluetooth technology works effectively at close range. In their paper, (Scaradozzi, 2003) Scaradozzi and Conte (2003) viewed home- automation systems as Multiple Agent Systems (MAS). Hong and Ning (2004) in their paper (Ning.L, 2004), proposed the use of Automatic Meter Reading (AMR) using wireless networks. Some commercia AMR products use the internet for data transmission. Stanescu et al (2006) present a design and implementation of SMS based control for monitoring systems (Stanescu, 2006). Prepayment poly-phase electricity metering systems have also been developed consisting of local prepayment and a card reader based energy meter (Ling Zou, 2010). In their paper, Maheswari and Sivakumar (2009) (Maheswari & Jejanthi, 2009) aimed to develop an energy efficient and low cost solution for street lighting system using Global System for Mobile communication [GSM] and General Packet Radio Service [GPRS]

## III. ELECTRICITY BILLING SYSTEM

Bill is that which the end consumer pays the supplier according to a tariff agreed between the consumer and supplier. The tariff may include pass-through costs. A pass-through cost is a cost that is charged to the energy supplier, but is then 'passed through' directly to the consumer. Electricity bill usually contain transmission charges which is paid to National Grid to cover the expense of running the grid and distribution charges which is paid to the Distribution Network Operator (DNO) on whose network the meter point is located. Other charges may also be included according to government or supplier's policies regarding billing. Billing system is one of the most important part of electricity network. This keeps as the importance of backbone in economy of supplier and tights consumer and supplier in an agreement. Correct implementation of this system has mutual benefits for supplier as well for consumer

## IV. DRAWBACKS IN CURRENT BILLING SYSTEM

Many electric supply companies face serious problem of lean revenue collection as against energy supplied due to energy

thefts and network losses. All the steps taken so far in India, regarding the improvement of the revenue collection did not yield satisfactory results. It is reported that the faultiest sub system is the metering and meter reading system. The traditional billing system is still in use in spite of its disadvantages. So, this system Therefore, several attempts were made to automate the billing systems. Even though accurate and fast readings are obtained, bill payment is still performed based on the old billing procedure. This procedure of billing depends on man power so this increases economic load on energy suppliers. Current billing procedures have its many drawbacks like:

– Highly unreliability
– Inaccurate
– Costly
– Slow
– Discrete
– Increase man power

These disadvantages of billing system are causing problems not only for customers but also are the main hurdle in progress of electric energy suppliers.

## V. OBJECTIVE

This work is intended to gather the information about the data which is consumed energy of a specific user or consumer through a wireless communication system (not required to visit consumer premises), and the system is called as AMR (Automatic Meter Reading). The AMR system is proposed to remotely accumulate the meter readings of a locale using a relating remote wireless system without individuals physically going to and taking note of the readings of the meters GSM technology is used so that the consumer would receive messages about the consumption of power (in watts) and if it reaches the minimum amount, it would automatically alert the consumer to recharge. This technology holds good for all electricity distribution companies, private communities, IT parks and self-containing housing projects. The development of GSM infrastructure in past two decades made meter reading system wireless. The GSM infrastructure, which has national wide coverage can be used to request and retrieve power consumption notification over individual houses and flats. Apart from making readings using GSM communication, billing system is needed to be made prepaid to avoid unnecessary usage of power.

## VI. EXISTING SYSTEM

In existing system either an electronic energy meter or an electro-mechanical meter is fixed in the premise for measuring the usage. The meters currently in use are only capable of recording kWh units. The kWh units used then still have to be recorded by meter readers monthly, on foot. The recorded data need to be processed by a meter reading company. For processing the meter reading, company needs to firstly link each recorded power usage datum to an account holder and then determine the amount owed by means of the specific tariff in use.

## VII. PROPOSED SYSTEM

The present power usage reading is made manually by moving to the consumer locations. This requires large number of labour operators and long working hours to accomplish the task. Manual billing is sometimes restricted and delayed by bad weather conditions. The printed billing also has the tendency of getting lost. Over the last few years, Smart (Prepaid) Energy Meter has been proposed as an innovative solution aimed at facilitating affordability and reducing the cost of utilities. This mechanism, essentially, requires the users to pay for the electricity before its consumption. In this way, consumers hold credit and then use the electricity until the credit is exhausted. If the available credit is exhausted then the electricity supply is cut-off by a relay. Readings made by human operators are prone to errors. This project addresses the above-mentioned problems. The development of GSM infrastructure in past two decades made meter reading system wireless. The GSM infrastructure, which has national wide coverage, can be used to request and retrieve power consumption notification over individual houses and flats. Apart from making readings using GS communication, billing system is needed to be made prepaid to avoid unnecessary usage of power. The use of Prepaid Energy meter is still controversial. On the one hand, those that support the diffusion of prepaid meters claim that they benefit both consumers and utilities because they help users to consume more efficiently and to improve the management of their budget, while allowing firms to reduce financial costs.
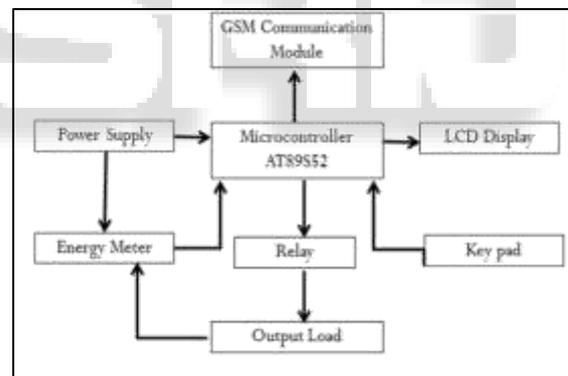
### A. *Block Diagram of Prepaid Energy meter*



Fig. 1.1: Block Diagram

## VIII. WORKING

The power is measured by the energy meter with respect to time and is calculated by multiplication of voltage and current signals. The IC of energy meter generates pulses according to real power utilization. This energy meter calculates 1KWh form 3200 impulses, so rated as 3200imp/KWh, and there will be blinking of an LED for its every pulse. An Optocoupler has been connected to this LED so Optocoupler will be switched whenever LED blinks. We cannot directly connect energy meter's LED with Arduino because LED possesses analog signals while we are feeding Arduino on the digital side. The pin number(D8) of Arduino is attached to the switching side of an Optocoupler for detecting pulses coming from energy meter. When a pulse occurs from energy meter, optocoupler is switched, pin D8 of Arduino detects a digital 0, otherwise it is not active and is in undefined state. There

will be a count 1 to a data when there will be change on the state of the pin from digital 1 to 0. We have interfaced GSM module with Arduino UNO. The data communication pins are RX and TX, Arduino's RX pin is connected with GSM module's TX pin and vice-versa. Before connecting GSM module with Arduino, a valid SIM card must be installed in SIM card port of GSM module. All ground pins GND are connected together. For switching purpose (ON/OFF) to supply a relay is being used. We cannot connect Arduino directly with relay because as Arduino has ATMEGA328P processor and its pins can supply roughly 25mA, Processor pins have large effective resistance and a high voltage will "drop" as increasing current is drawn and a low voltage will rise as load increases. Pins may be specific with a maximum short circuit current but at that point a high pin will be pulled low and a low pin will be pulled high so short circuit current has limited applicability. So, relay is connected with Arduino through ULN2003 IC or relay driver, ON/OFF instructions are sent over to relay driver by Arduino and it can turn ON/OFF relay. LCD is also interfaced with Arduino digital pins (7, 6, 5, 4, 3, 2) on which we can see how much units are purchased, remaining units and balance, etc. Fig. 1.1 shows the flow diagram of processes involved in prepaid energy meter scheme.
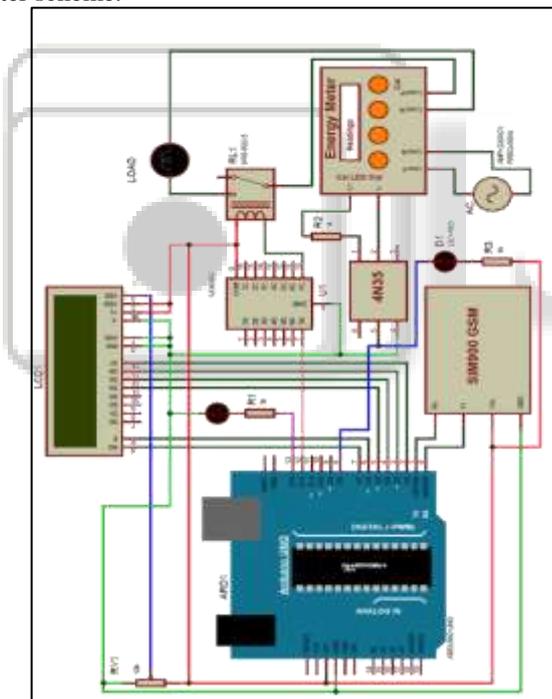


Fig. 1.2: Circuit diagram

### IX. ALGORITHM

1) Step 1:Start the program.
2) Step2:Interface the LCD and the Keypad to the PIC Microcontroller.
3) Step 3: Initializing the LCD.
4) Step 4: Enter the card number.
5) Step 5:Configure the GSM and send number to the service provider.
6) Step 6: If the number is valid then receive the recharged amount from the service provider.
7) Step 7: If the number is invalid then enter the correct number.
8) Step 8: When the electricity is consumed, then the recharged amount will get decremented.
9) Step 9: When 80% of the recharged is consumed, then the user will get a warning message to recharge the Energy Meter.
10) Step 10: When the recharged money gets over, the relay cut-off the household power supply.
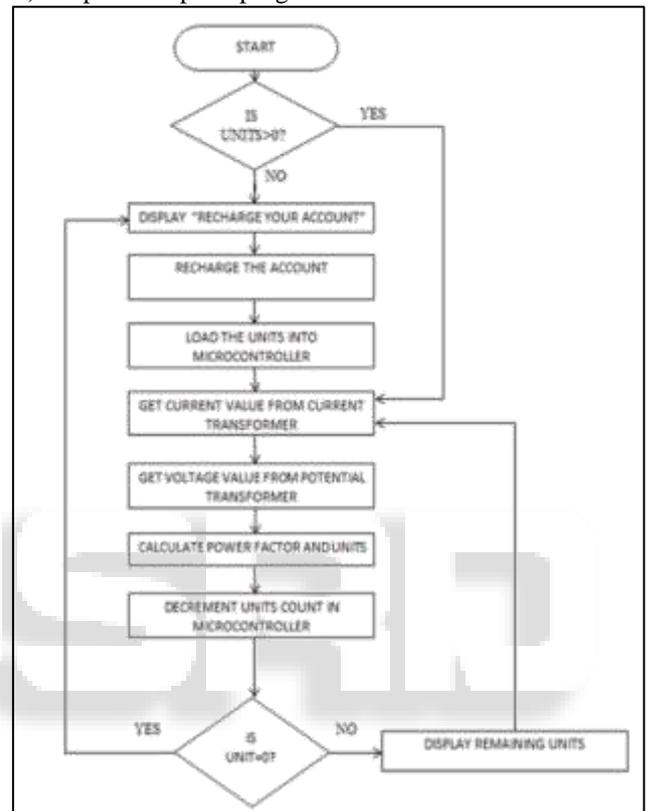11) Step 11: Stop the program.



Fig. 1.3: Algorithm of the system

### X. CONCLUSION

The design of Smart Energy meter using GSM technology can make the users to pay for the electricity before its consumption. In this way, consumers hold credit and then use the electricity until the credit is exhausted. If the available credit is exhausted then the electricity supply is cut-off by a relay. This reduces human labour and at the same time increases the efficiency in calculation of bills for used electricity. Smart energy meters will bring a solution of creating awareness on unnecessary wastage of power and will tend to reduce wastage of power. This module will reduce the burden of energy providing by establishing the connection easily and no theft of power will take place. This paper work exposes the purpose of energy monitoring and controlling by implementing prepaid system. It is hoped that this work helps the consumers for better energy management and its utility in the distribution system for economic liability of the Electrical Boards.

## XI. FUTURE SCOPE

RFID BASED PREPAID ENERGY METERBASIC IDEA: A scheme of Electricity billing system called "PREPAID ENERGY METER WITH TARIFF INDICATOR" can facilitate in improved cash flow management in energy utilities and can reduces problem associated with billing consumer living in isolated area and reduces deployment of manpower for taking meter readings. Every consumer can recharge RFID tag assigned and recharge its meter at various ranges (i.e. Rs 50, Rs 100, Rs 200 etc.).In our project and implementation we have given the name for RFID tag card smartcard. Consumer can check its balance in LCD attached with the module and be prepare for the next recharge in advance. Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. The technology requires some extent of cooperation of an RFID reader and an RFID tag. An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader. An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves.

### REFERENCES

[1] Bhavna Patel, Shrikant Mhaskar, "Voucher Based Prepaid Electricity Supplier With Auto Cut Off", IJIIT|Volume-II|Issue-I|2013-2014 July |Paper-03

[2] K.Sheelasobanarani, S.Dineshraja, B.Dhanaraj, K.Manickam, K.Karthickraja, "An Integrated Prepaid Energy Meter using gsm", International Journal of Industrial Electronics and Electrical Engineering,Volume-2, Issue-5, May-2014

[3] Dr.Boyina.S. Rao, B. Gnanasekaranathan, M. Raguram, S. Pravinkumar, P. Kamalesh, "Domestic Prepaid Energy Distribution System for saving of Power Consumption",IJAET/Vol.III/ Issue II/April- June, 2012/26-29.

[4] Jubi.K, MareenaJohn, "Prepaid Energy Meter with GSM Technology", AIJRSTEM, pp. 195- 98, June-August, 2013

[5] International Journal of Engineering Research & Technology (ERT).

[6] Dr. K. Sheelasobanarani1, S. Dinesh Raja2, B. Dhanaraj3, K. Manickam4, K. KarthickRaja5. "A Prepaid Energy meter for efficient Power Management", International Journal of Emerging Technology and Advanced Engineering, Volume 4, Issue 3, March 2014

[7] Bharat Indorey, M.Lokhande, "ZigBee Based Advanced Energy Prepaid Meter", International Journal of Innovations in Engineering and Technology (IJIET), Volume 3 Issue3 February 2014

[8] Rodrigo, W. D. A. S., et al. "A prepaid energy meter using GPRS/GSM Technology for improved metering and billing." International Journal of Computer Science and Electronics Engineering (IJCSEE) Volume 4 (2016)