Prepaid Energy Meter using GSM Module

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Abstract: *The aim of the project is to minimize the queue at the energy meter billing counters and to restrict the usage of energy meter automatically, if the bill is not paid. The project also aims at proposing a system that will reduce the loss of power and revenue due to power thefts and other illegal activities. The work system adopts a totally new concept of "Prepaid Energy Meter". The 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 implementation of this project will help in better energy management, conservation of energy and also in doing away with the unnecessary hassles over incorrect billing. The automated billing system will keep track of the real time consumption and will leave little scope for disagreement on consumption and billing.It is observed that one of the faulty subsystems contributing to the huge revenue loss in Nigerian Power Sector is the metering and billing system. Errors get introduced at every stage of energy billing, like: errors with electro-mechanical meters, human errors while noting down the meter reading; and error while processing the paid bills and the due bills. The remedy for this drawback is a prepaid energy billing. There are clear results from many countries, where prepaid system has reduced the revenue loss by a large amount. A GSM-based Energy Recharge Interface which contains a prepaid card equivalent to a mobile SIM card. The prepaid card communicates with the power utility using GSM communication network. Once the prepaid card is out of balance, the consumer load is disconnected from the utility supply by the latching Relay (contactor). The power utility can recharge the prepaid card remotely through GSM/SMS mode base on customer requests. The results obtained shows good system performance. A prior billing is bound to do away with the problems of unpaid bills and human error in meter readings, thereby ensuring justified revenue for the utility.*
Keywords:*Prepaid, Energy meter, GSM module*

I. Introduction

The Electrical metering instrument technology has come a long way from what it was more than 100 years ago. From the original bulky meters with heavy magnets and coils, there have been many innovations that have resulted in size & weight reduction in addition to improvement in features and specifications. Resolution and accuracy of the meter have seen substantial improvements over the years. Introduction of the digital meter in the later part of last century has completely changed the way Electrical parameters are measured. Starting with Voltmeters & Ammeters, the digital meter has conquered the entire spectrum of measuring instruments due to their advantages like ease of reading, better resolution and rugged construction. Of particular significance is the introduction of the Electronic Energy Meter in the mid-eighties. Now a days, the energy consumption and energy distribution has become a big subject for discussion because of huge difference in energy production and consumption. In this regard, energy consumers are facing so many problems due to the frequent power failures; another important reason for power cuts is due to the un-limited energy consumption of rich people. In this aspect, to minimize the power cuts and to distribute the energy equally to all areas, some restriction should have over the power consumption of each and every energy consumer, and according to that the Government should implement a policy, by introducing Autonomous Energy Meters everywhere in domestic sector. Hence, the need has come to think on this line and a solution has to be emerged out.

II. Problem Statement

The Energy metering instrument technology has come a long way from what it was more than 100 years ago. From the original bulky meters with heavy magnets and coils, there have been many innovations that have resulted in size & weight reduction in addition to improvement in features and specifications. Resolution and accuracy of the meter have seen substantial improvements over the years. Introduction of the digital meter in the later part of last century has completely changed the way Electrical parameters are measured. Starting with Voltmeters & Ammeters, the digital meter has conquered the entire spectrum of measuring instruments due to their advantages like ease of reading, better resolution and rugged construction. Of particular significance is the introduction of the Electronic Energy Meter in the mid-eighties. Now a days, the

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Objective of the project
- To avoid more consumption of electricity.
- Reduction of man-power.
- Increase the accuracy of the meter reading.

Scope of the Projects:
In the present time of 21st century we have no space for errors or faults either in any technical system or in general applications. Prepaid energy meter is an advantages concept for the further. It's facilitates the exemption from electricity bills. Electricity coupons will be available at nearby shops. The word prepaid means "pay before use" one of the advantageous feature of this concept prepaid energy meter is used to prepaid the ongoing supply of electricity to homes, offices etc.

Introduction to Automation System
Everything in today's world is getting automated. In fact there is a feature of auto-pilot in airplanes giving additional help to pilots during their cruise. Not only in airplanes but also in day to day electronic like washing machine, microwave oven etc. automation feature is like a blessing. Automation feature is being added in this project as well as there is no need of any man to take reading manually.

Proposed system
Project Features
User friendly
Can be Controlled from anywhere in the world
Daily energy limit
Reduce financial risk
Better customer service

Project Specifications
To generate units consumed from the wireless energy meter simulator and send the values to the DES agent.To calculate the balance units of each household. The balance units are calculated as: Balance units = Total balance units after topping up- units consumed.To send a reminder to user of his balance units hits certain ranges.

Block Diagram:
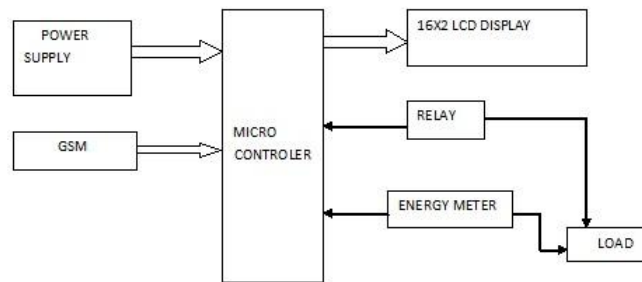
Block diagram of Prepaid Energy meter system

The block diagram consist of GSM module, microcontroller, Power supply 16 x 2 LCD Display, Relay , Energy meter , Load . GSM (Global System for Mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated. LCD Display is 16 x 2 .liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other. A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. A relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

Software Flowchart
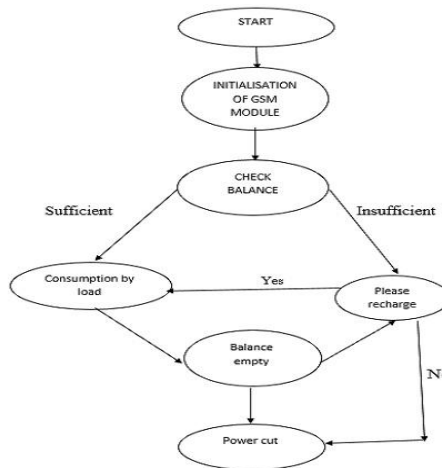
Applications:

To control a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers,To control a high-current circuit with a low-current signal, as in the starter solenoid of an automobile,To detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers (protection relays),To isolate the controlling circuit from the controlled circuit when the two are at different potentials, for example when controlling a mains-powered device from a low-voltage switch. The latter is often applied to control office lighting as the low voltage wires are easily installed in partitions, which may be often moved as needs change. They may also be controlled by room occupancy detectors in an effort to conserve energy,To perform logic functions. For example, the boolean AND function is realised by connecting NO relay contacts in series, the OR function by connecting NO contacts in parallel. The change-over or Form C contacts perform the XOR (exclusive or) function. Similar functions for NAND and NOR are accomplished using NC contacts. The Ladder programming language is often used for designing relay logic networks.Early computing.

Before vacuum tubes and transistors, relays were used as logical elements in digital computers. See ARRA (computer), Harvard Mark II, Zuse Z2, and Zuse Z3.

Benefits:

Improved operational efficiencies:

The prepaid meters are likely to cut the cost of meter reading as no meter readers are required. In addition, they eliminate administrative hassles associated with disconnection and reconnection. Besides, going by South Africa's experience, prepaid meters could help control appropriation of electricity in a better way than conventional meters.

Reduced financial risks:

Since the payment is up-front reduces the financial risk by improving the cash flows and necessitates an improved revenue management system.

Better customer service:

The system eliminates billing delay, removes cost involved in disconnection/reconnection, enables controlled use of energy, and helps customers to save money through better energy management.

Recent Initiatives

The Sabah Electricity SdnBhd (SESB), Malaysia, has awarded a contract to a local manufacturer to supply 1,080 prepaid meters

Countries such as Thailand, Bangladesh, Singapore, and Iran have been showing increased interest in adopting prepaid system

In India, the State of West Bengal has decided to introduce the smart card operated prepaid energy meters in remote islands of Sunder bans. In Mumbai, pre-paid power is provided by the Brihanmumbai Electricity Supply and Transport (BEST)Undertaking. Tata Power plans to introduce pre-paid electricity in Delhi.
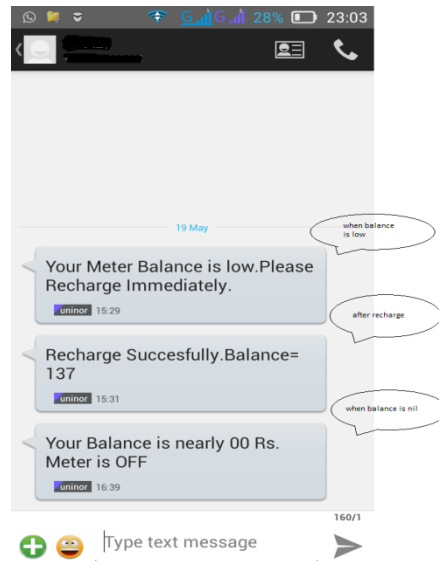
Experimental result
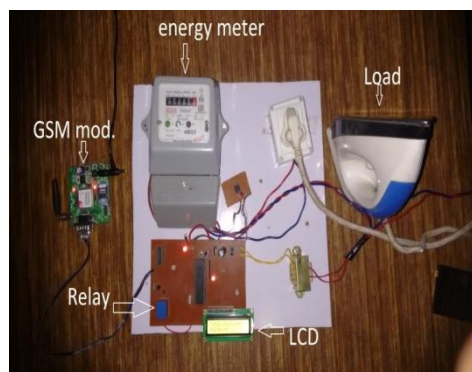
Prepaid energy meter consist of digital energy meter, GSM module, relay, LCD display and varying load. An overall snap of the project with all the described hardware is being shown in the image above.

At the user end

Initially, when the load is connected to the prepaid energy meter the consumption of the energy by the connected load takes place.

The balance reduces simultaneously with the consumption by the load. At a particular balance value, the user is notified through an SMS which is sent via GSM.

"Your meter balance is low. Please recharge immediately"

After the recharge is done by electricity board, the following message of confirmation is sent to user and it will also be showing the current balance.

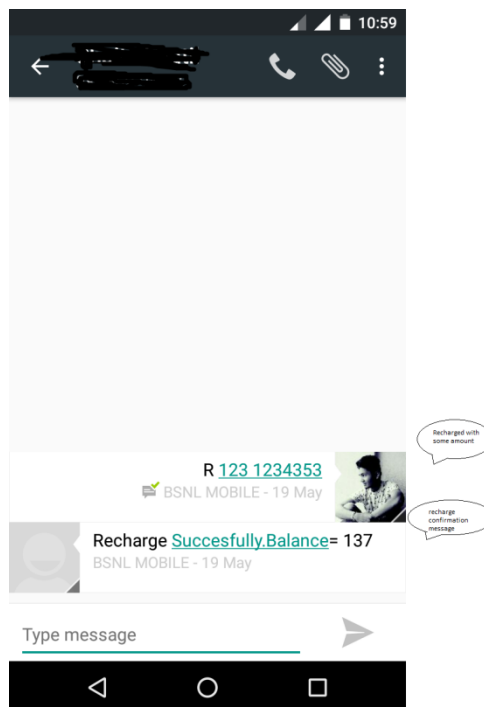"Recharge successfully. Balance = XXX"

XXX is the amount with which the user has recharged the prepaid energy meter + the remaining balance before recharge.

After the notification message to the user, the user has to recharge immediately and in case it happens that the user ignores the notification due to some reasons the prepaid energy meter will cut off with a notification message to the user.

"Your balance is nearly 00 RS. Meter is off"

The notification messages will be beneficial to the user and the user will take quick required actions there by avoiding the cutting off the power supply in tandem with keeping the usage of energy limited.

At the electricity board

At the electricity board end, user has to recharge his prepaid energy meter with some amount of energy in order to continue usage of energy. The message which has to be written in order to recharge has the following format.
"R XXX 1234353"
After the recharge is done by electricity board, the following message of confirmation is sent to the same.
"Recharge successfully. Balance = XXX"
XXX is the amount with which the user has recharged the prepaid energy meter + the remaining balance before recharge.

III. Conclusion

Putting a full stop at the wastage of electricity, the problem of load shedding can be dealt with ease. It is being said that half of India still don't get electricity which no longer will be true.Man power will be limited as there won't be any need of personally visiting each and every electricity meter as it was in the earlier days.The monopolistic power distribution market in asia is gradually transforming into a competitive marketplace. Differentiation in service is going to be the key competitive factor to the improve market share in the deregulated power markets prepaid meters with their advantages over conventional ones are likely to help power distributors to differentiate and offer value –added services to consumers. Encourage consumers to opt for prepaid meters on a voluntary basis and offering tariff or non-tariff incentives to those consumers who prepaid their power changes would help the utilities to implement this system

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BIOGRAPHIES

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