CONTROL OF ELECTRICITY THEFT USING ARM7 BASED PREPAID METERING SYSTEM AND GSM MODULE

B.Manisha Sanghamitra[1], S.Krithiga[2]

[1, 2] *Electronics and Communication Engineering, SRM University, (India)*

ABSTRACT

Electricity theft is one of the reasons that cause huge financial loss to the government. Few customers are resorting to electricity theft to enjoy free electricity services without paying the bills. This paper proposes a solution to prevent some of the kinds of electricity theft using ARM7 (Advanced RISC Machines) microprocessor and GSM (Global System for Mobile Communications) module. An energy meter is designed using ARM7 to detect the amount of current being used. GSM module is used for the communication between the consumer meters and the power station. It is a bidirectional communication process. A consumer can easily recharge his/her energy meter by sending an authenticated pin to the power station. We use SIM in the GSM module for the communication purpose through SMS. This paper also proposes few measures to prevent electricity pilferages like tampering, meter bypassing, removal of meter. So the proposed system not only helps in prepaid recharge system but also to reduce the different kinds of electricity pilferages.

Keywords: ARM7, Electricity Theft, , GSM Module, IAR Embedded Workbench, Prepaid Metering System ,SMS.

I. INTRODUCTION

Pilferage of electricity causes huge loss to the government. Electricity pilferage can be defined as dishonest or illegal usage of electricity equipment or service with the intention to avoid billing charges [1]. The problem challenging power utilities worldwide is the electricity, in other words using electricity from utility company without the company's consent [2]. Practice of electricity pilferages is considered as illegal and as a crime. Electricity theft is closely related to governance indicators, with higher levels of theft in countries without effective accountability, political instability, low government effectiveness and high levels of corruption [3].As a result of practicing electricity theft by dishonest customers, honest customers and poor people suffer from high electricity charges imposed by the government.

There are many kinds of electricity pilferages like tampering the meter, whole meter bypassing, showing low meter reading, billing irregularities and unpaid bills [4]. Some customers try to take out the meter from the system so that no reading will be recorded in the meter even though the appliances in the home are being used. Different nontechnical methods and technical methods were proposed in the past to detect electricity pilfering. Nontechnical methods may include inspection of the customers with suspicious load profile [5]. Recently, prepaid energy meters based on GSM network has been proposed [6], [7]. Unpaid billing system happens

because of dishonest staff of electricity board that do not properly collect the respective electricity bill from consumer's house. Irregular billing system happens if the customer is dishonest in paying the bills. So manual billing results in inappropriate collection of bills from the customers. Due to the kind of electricity stealing and actual demand of preventing electricity stealing based on that equipment of electricity stealing with remote monitoring is designed, which not only monitors the time electricity stealing occur but also offers the electricity stealing quantity and sends the SMS to the local field man to catch the thief with positive proof to handle lawbreakers with the behavior of electricity stealing [8].

Electricity pilferages can be reduced by using many technical methods. But these can be properly implemented with better communication between the customer and power station. So the proposed system helps in communicating with the help of GSM module. For the purpose of recharge an SMS can be send from the customer GSM module to the power station GSM module. If any pilferage occurs then an SMS will be send automatically from the customer's meter to the power station. So, from the overall scenario the dishonest customer can be caught and punished.

II. SYSTEM DESCRIPTION

The proposed system consists of energy meter, ARM7 microprocessor, current transformers, potential transformers, bidirectional GSM module as shown in Fig.1, LCD module. A relay is also included in the system for control of flow of electricity in to the system. The overall block diagram of the proposed system is shown in the Fig.2.

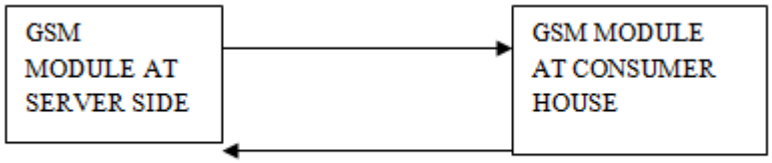

Figure 1 Bidirectional GSM module

The energy meter traces out the amount of energy used by the appliances in the consumer's home. The meter reading depends upon the output of two current transformers(CT1 and CT2) and two potential transformers(PT1and PT2).The ARM7 microprocessor calculates the charge depending upon the output of the current transformers.

Since the proposed system is a prepaid method of recharging the meter, the customer enjoys the supply of the power until the amount exists in the meter. The coding of the program is done using embedded C language. IAR embedded workbench is used in this method for developing C program for ARM7.Flash magic software is used for dumping the developed C program in to the ARM7 microprocessor. The LCD is also connected with the processor which displays the amount to be available for the usage [9].

The proposed recharge process happens with the bidirectional GSM module installed in the consumer's house and in the server station. The consumer sends the PIN from his/her mobile the server station. Once the PIN reaches the server station, it is checked for its validity. If the sent PIN is an authenticated one, then the meter gets recharged. The amount recharged will be displayed in the LCD module used along with the authenticated PIN number. If the PIN is not an authenticated one, then no amount is recharged. The proposed prototype for recharging is shown in Fig.3.

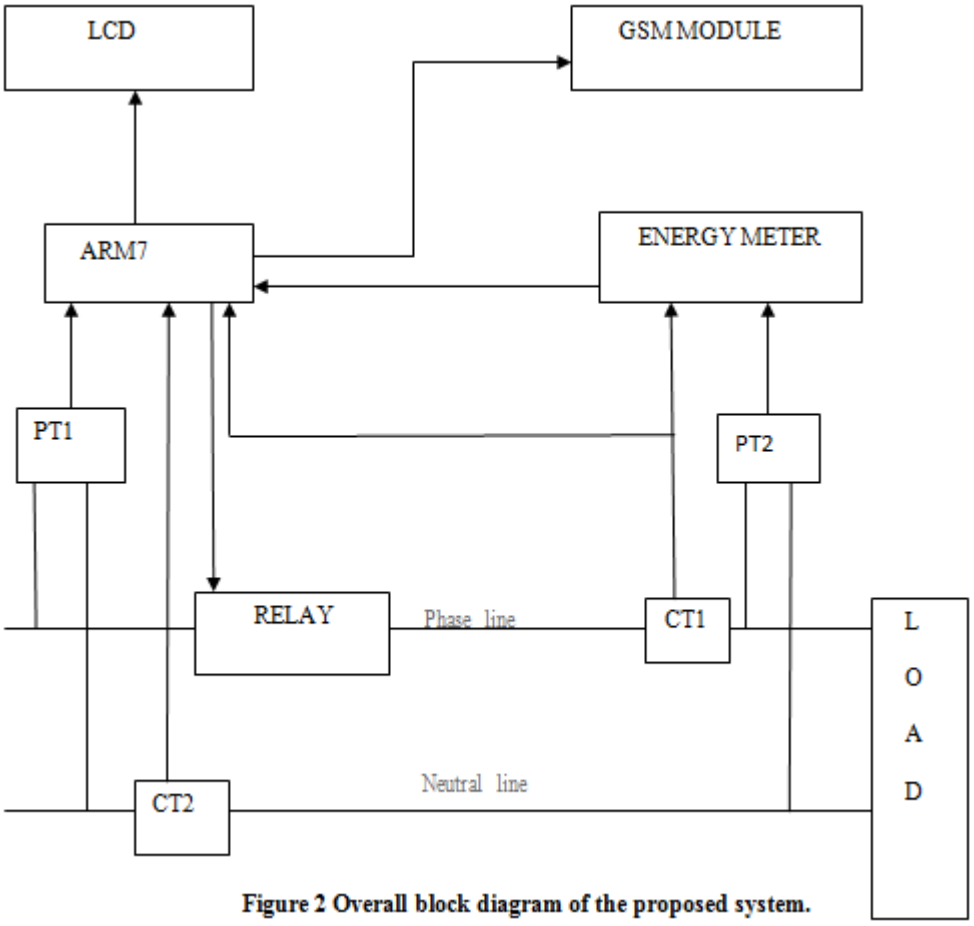

Figure 2 Overall block diagram of the proposed system.

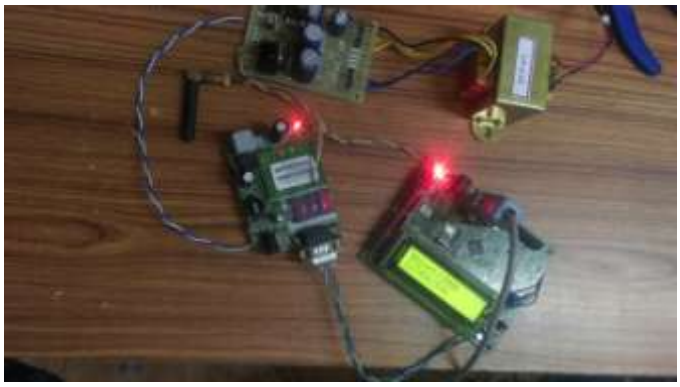

Figure 3.Preraid Recharge System

With the process of prepaid recharge method, the problem of unpaid billing system and false billing system can be prevented. The consumer has to recharge his/her meter using the GSM module to have power supply for the utilization of his house appliances, once if the amount in the meter is exhausted.

III. PROCESS OF CONTROLLING DIFFERENT KINDS OF ELECTRICITY PILFERAGES

3.1 Shorting of Phase Line

To prevent the meter from recording the values of the charge being used, a popular method is widely used i.e. shorting the phase line as shown in Fig.4. If the phase line is shorted, then no recording of values will be done by the meter. In order to prevent this kind of pilferage the proposed system uses GSM module to send an SMS whenever the phase line shorted. If once the phase line is shorted, the values in the two current transformers i.e.

CT1 and CT2 vary. As a result of this an SMS is send to the server station from that particular consumer meter in which the phase line is shorted. The consumer who resorted to this illegal activity can be punished.

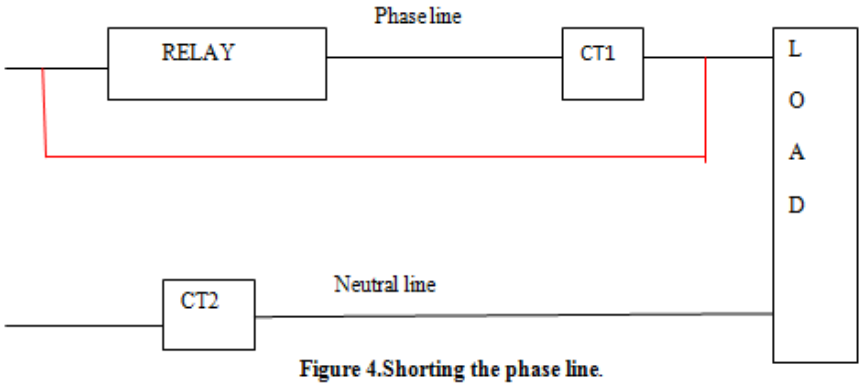

Figure 4.Shorting the phase line.

3.2 Disconnecting the Neutral Line

Disconnecting the neutral line is another method of showing the low meter reading as shown in Fig.5. In this case the potential measured by the potential transformer will be zero and no energy consumptions will be registered by the meter. To prevent these bypassing, two current transformers are used separately in the phase and neutral line in our proposed system . If the reading in the two current transformers vary, the relay stops supplying the power to the load and immediately an SMS is send to the server station through the GSM module

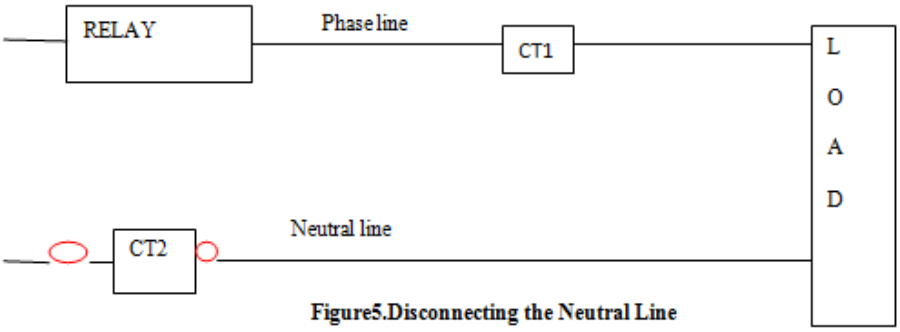

Figure5.Disconnecting the Neutral Line

3.3 Whole Meter Bypassing

This process is nothing but shorting both the neutral line and the phase line as shown in Fig.6. As a result of this the meter does not detect any supply and records no value of the charge being consumed. The output of PT2 is given to the interrupt pin of the microcontroller. When the whole meter is bypassed PT2 detects no voltage and an interrupt is sent to the ARM7 microprocessor. So the load gets disconnected from the supply and then an SMS is sent to the server station.

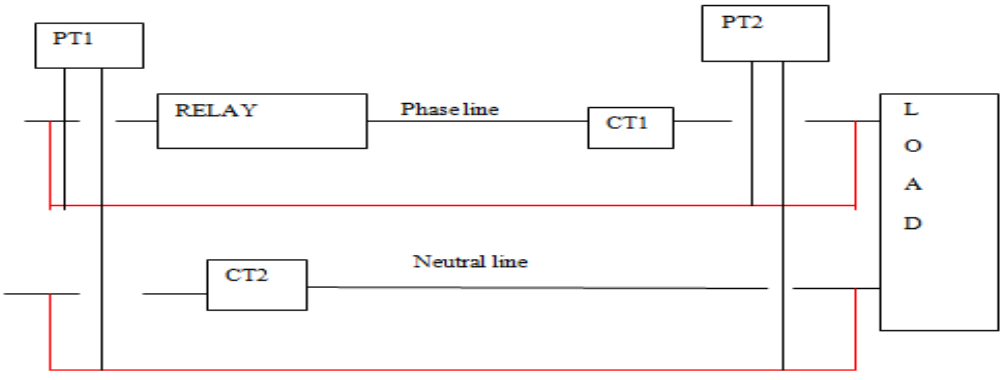

Figure 6.Whole Meter Bypassing

3.4 Connecting Illegal Load

Some consumers try to connect illegal or unregistered load to the existing load, so that the illegal load also gets the power supply. Also radio frequency devices may be used to influence the accuracy of the device [10]. There also exits many named and unnamed engineered ways for electricity theft. These types of theft cannot be detected and controlled using single household meter. Connecting an illegal load to the existing load does not allow the meter to estimate exact usage of the electricity by the appliances in the consumer's home. In this method the illegal load is given the connection as shown in the Fig.7. The neutral line and phase line connections are taken and are given to the illegal load. So the illegal load gets the power supply as a result of these connections. An SMS will be sent to the server, whenever an illegal load is connected to the system.

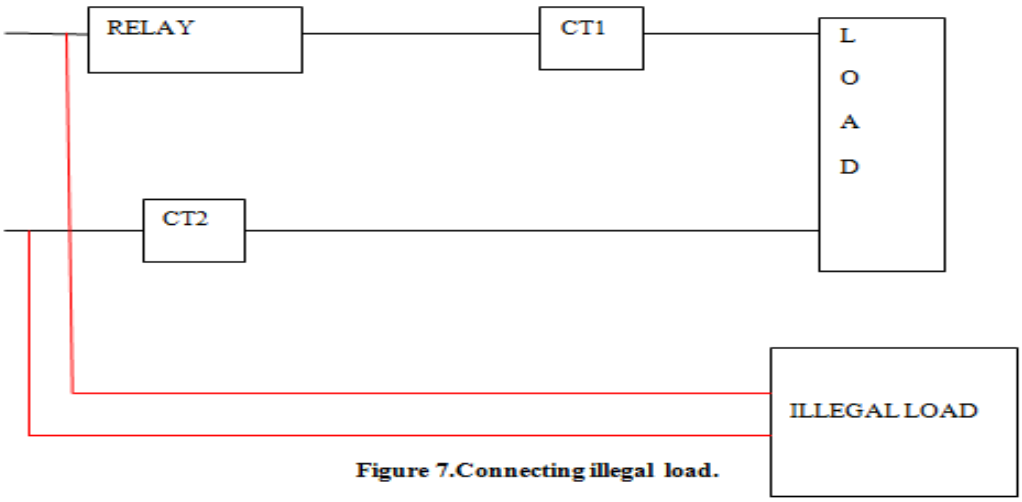

Figure 7.Connecting illegal load.

IV. CONCLUSION

In this paper, the proposed system gives the advantage of prepaid recharge system through which the unpaid billing system and the false billing system can be eliminated. With the usage of GSM module different kinds of electricity pilferages can be eliminated. The SMS system used sends an SMS to the server station immediately if some pilferage occurs. So, legal actions can be taken against the consumers who are resorting to electricity thefts with the help of SMS.

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