

# Smart Energy Meter Based, Prepaid Electricity Distribution System

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**Abstract-** In case of omnipresent cellular communication and satellite TV systems activation of the user facility is done almost instantly on demand by using scratch card or other on line facilities whereas no such progress is made in respect of electrical energy consumption system. As a result both the consumer and provider are required to put up with the inherent problems of meter reading, billing, payments and receipts, disconnections and reactivations, delays and disputes there of etc., Therefore an innovative system is conceived and developed in this project. The main aim of the project is to design and develop an embedded system that can be attached to the existing digital energy meter at the user premises and establish communication and control between the consumer and service provider through GSM. The system would then accept authorized scratch card of different denominations for pre-paid activation of power supply, continuously monitors the units being consumed and disconnects the supply remotely when the entitled number of units are consumed. The supply can again be got restored by consumer by using a new scratch card. The system consists of an Energy Meter, integrated with ARM7 microcontroller, key pad, LCD display and GSM modules. GSM network is used to transmit the energy usage reading using Short Message Service (SMS). Current pulses from transformer in the meter are used for the energy measurement .

**Key words-** GSM, SMS, LPC2148, Scratch card and software tool like keilµvision

## I. INTRODUCTION

The conventional metering system requires the supplier company to send personnel who manually read and record the energy consumption and submit to office for billing. The manual reading system suffers from a wide variety of disadvantages, which tenders it inefficient. It requires a large number of meter readers. Moreover, it is prone to human errors as well as tampering of records. Even subsequently thereafter the dispatch of bills, receipt of payments and resulting build up of documentation adds to the operation costs for energy provider which, in turn, reflects on the increase of unit cost of consumption to the consumer. To devise an efficient metering system, that benefits both the service provider and consumer and more importantly, to conserve the crucial power, the innovative idea of Smart Energy Meter Based, Prepaid Electricity Distribution System was conceived. It provides an effective means of energy consumption information, easy recharge and saves lots of botheration and indirectly conserves power since the consumer becomes more conscious about the consumption pattern and its analysis. Prepaid electricity is a unique and new concept which saves lot of time and power for electricity department. Prepaid meters are used, for the recording of customer and help the supplier to monitor the demand and consumption.

## II. RELATED WORK

There are few systems developed on the concept of Automatic Power Meter Reading System, which is an effective mean of data collecting, that allows substantial saving through reduction cost of meter re-read, greater data accuracy, allowing frequent reading improve and compute the billing cost, update the database, and to publish billing notification to its respective consumer through SMS, e-mail, Web portal and printed postage mailing, more timing energy profile and consumption updates, thus reducing human operator meter reading and operation cost.[1] A plethora of technologies can be utilized for the implementation of such a system, each having its own pros and cons. Radio frequency based EPS can make use of Handheld, Mobile, and Fixed network. In handheld and touch based EPS, a handheld computer equipped with a transceiver is used (radio frequency or touch) to collect readings, but it does not make optimum use of the AMR capable meters, as meter reading personnel are required. Mobile or Drive-by meter reading is another approach where a reading device is installed in a vehicle. Due to the short range of mobility, it again requires a team for collection of meter readings. AMR can also be implemented by making use of Power Line Communication (PLC) [3-4], but it has an inherent disadvantage of interference and noise, which makes it unreliable. Wi-Fi, ZigBee and 3G technologies [5-6] have also been used for transmission of metering information, but have not been widespread as they require installation of facility/ access points to cover the designated areas and thus do not provide a cost effective solution in existing environments. Traffic profiling using Global Positioning System (GPS) to indicate the location of consumers which is extremely beneficial if used in collaboration with sensor circuits to indicate meter theft are developed.[7]. Most of these features were not available with system developed here.

## III. FRAME WORK

In this project we developed a Smart Prepaid energy meter and transmission module to induce transparency in the current meter reading system, by facilitating low cost time monitoring of consumer energy consumption by removing human errors .Our system

also allows the energy supplier company to remotely control the supply of energy to consumer. A major feature is the inclusion of a user consumption profiling system, accessible to users and the energy supply company. By incorporating control coupled with profiling, the project aims at creating some degree of awareness among users, encouraging them towards conservation of energy.

**IV. PROPOSED WORK**

The system consists of an Energy Meter, ARM7 microcontroller board and GSM modules. Energy meter, EEprom, keypad, LCD display and gsm modules are connected to microcontroller. The user has to purchase a scratch card and enter its serial number into the system using keypad and LCD display. The scratch card number and amount will be transmitted to the Electricity provider through SMS. On authentication, the amount is also stored into the eeprom. The meter calculates the energy consumption and accordingly deducts the amount from the eeprom which is displayed in LCD and through gsm module alert message is sent to consumer.

The system uses a compact circuitry built around ARM 7 microcontroller LPC2148. Programs are developed in Embedded C. Flash magic is used for loading programs into Microcontroller.

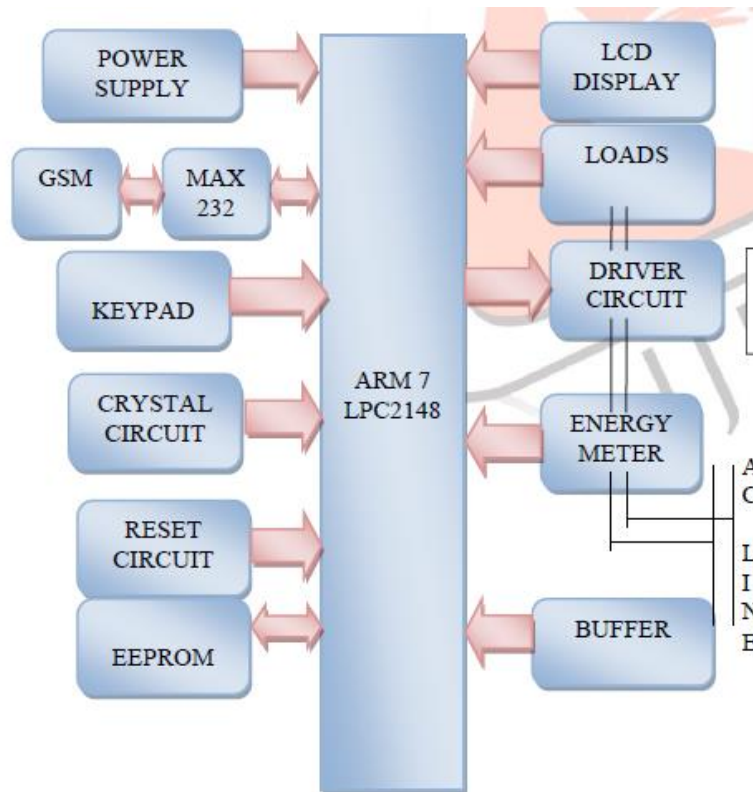


FIG 1: Block diagram

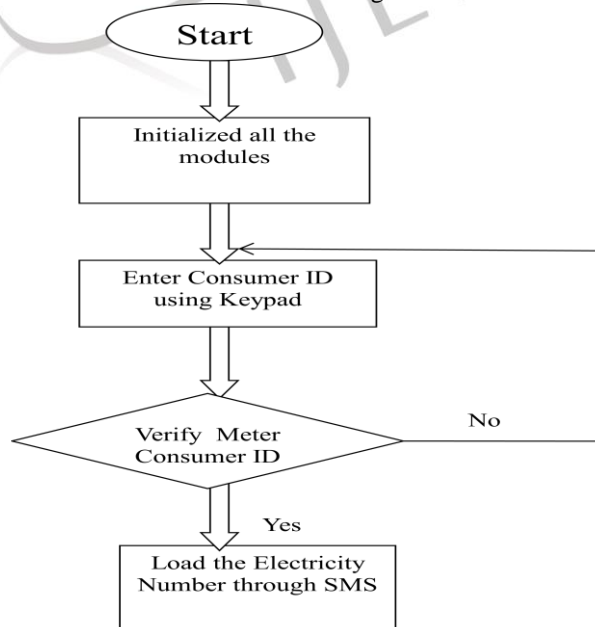


FIG 2: Flow Chart

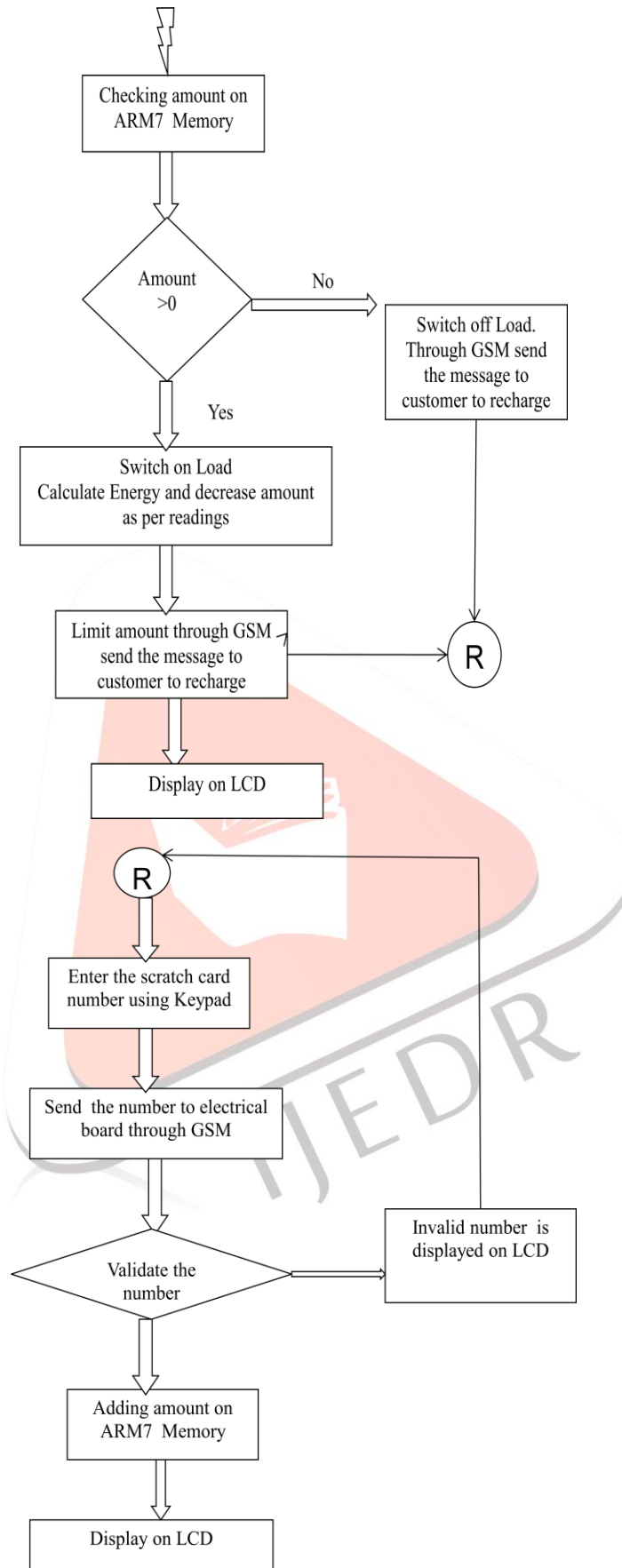


FIG 3: To Recharge Meter

The .Hex file of the code is dumped in the controller using Flash Magic software.

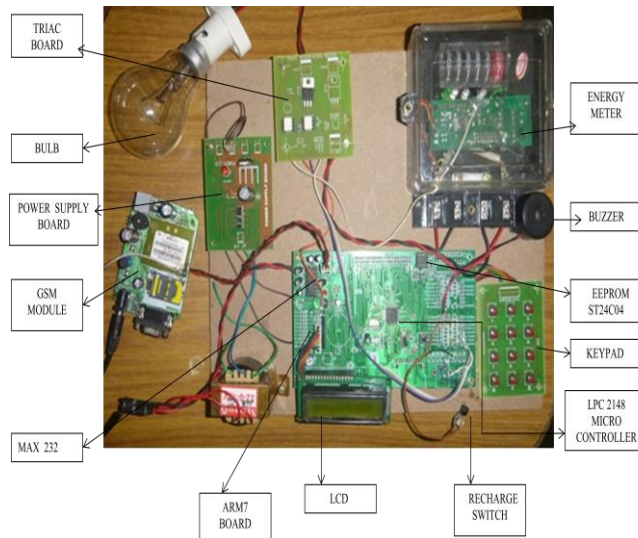


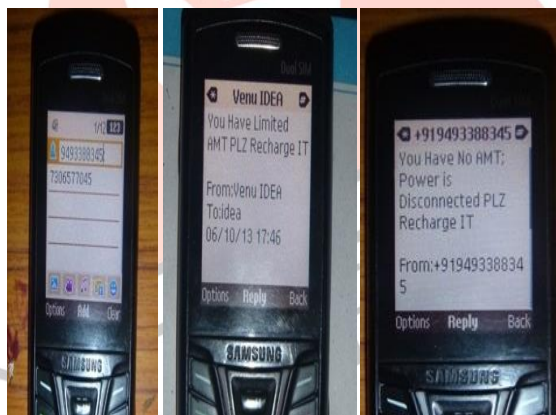
FIG 4: Experimental Setup

**V. TESTS AND RESULTS**

The system is tested with the following procedure.

Two mobile phones are used for communication, one as for customer mobile and another for electricity department. The user has to purchase a scratch card, containing a serial number and amount. In our test a fictitious scratch number was entered into system using keypad. Through SMS the card was van amount has to be stored into the eeprom. The meter calculates the current consumption and accordingly deducts the amount from the eeprom which is displayed in lcd and through gsm module alert message is send to customer and text message is displayed.

**MESSAGES IN THE CUSTOMER MOBILE**



**MESSAGES IN THE ELECTRICITY MOBILE**



The smart meter reading acquisition approach was tested by comparing the pulse readings against the reading displayed by the energy meter through various test loads of 0, 40, 60 and 100 Watts, with different prepaid amounts. Tables... show the energy consumption and balance amount after deducting the amount consumed at particular intervals of time for different loads.

TABLE 1: Load: 100Watts, Amount: 10

S.No.	NO OF PULSE	UNITS CONSUMED	A MOUNT BALANCE	TIME TAKEN
1	0	0	0	0
2	1	0	10	8 secs
3	5	0	10	1 mins
4	10	1	9	2 mins
5	1	1	9	2 mins 8 sec s
6	1	9	1	13 mins 48secs
7	5	9	1	14 mins 40secs
8	10	10	0	15 mins

TABLE 2: Load: 40Watts, Amount: 10

S.No.	NO OF PULSE	UNITS CONSUMED	A MOUNT BALANCE	TIME TAKEN
1	0	0	0	0
2	1	0	10	25 secs
3	5	0	10	2 mins
4	10	1	9	4 mins
5	1	1	9	4 mins 8 sec s
6	1	9	1	37 mins 8 secs
7	5	9	1	38 mins 10 ecs
8	10	10	0	40 mins

TABLE 3: Load: 15Watts, Amount: 10

S.No.	NO OF PULSE	UNITS CONSUMED	A MOUNT BALANCE	TIME TAKEN
1	0	0	0	0
2	1	0	10	65 secs
3	5	0	10	5 mins 10secs
4	10	1	9	10 mins 5secs
5	1	1	9	11 mins 16secs
6	1	9	1	91 mins 48secs
7	5	9	1	94 mins 90secs
8	10	10	0	100 mins

## VI.CONCLUSION

In this paper, the proposed smart energy prepaid monitoring system was presented. Every module has been reasoned out and placed carefully thus contributing to the best working of the unit. System provides elaborate consumer profiling which helps demand and consumption control of resources and thus reduces the human operator meter reading operation cost. The prototype developed is fit for commercial implementation with a requisite packing and environmental testing.

## VII.BIBLIOGRAPHY

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