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Smart Prepaid Energy Metering System to Control Electricity Theft

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Abstract: *In this Smart Prepaid Energy Metering System to Control Electricity Theft, a meter is installed in every consumer unit and a server is maintained at the service provider side. Both the meter and the server are equipped with GSM module which facilitates bidirectional communication between the two ends using the existing GSM infrastructure. Consumers can easily recharge their energy meter by sending a PIN number hidden in a scratch card to the server using SMS. The bidirectional GSM communication using SMS ensures the effectiveness of these measures.*

Keywords: GSM, Meter.

1. INTRODUCTION

Electricity theft has emerged as a serious problem in power sectors especially in the developing countries. A huge amount of revenue is lost due to electricity theft. In some countries this is so severe that governments are incurring losses instead of revenue. In some cases government has to provide subsidies to the power sector to maintain a reasonable price of electricity. The financial loss results in shortage of funds for investments to expand the existing power capacity and as a result governments are failing to satisfy the ever increasing demand of electricity. Stealing electricity bypassing a meter, billing irregularities and unpaid bills. Billing irregularities comprise inaccurate meter reading taken by bribed service man and intentional fixing of the bill by office staffs in exchange of illicit payments from the consumer. Different non technical and technical methods were proposed in the past to detect electricity pilfering. Some of the technical ways to detect pilferage are use of central observer meter at secondary terminals of distribution transformer, harmonic generator, genetic support vector machines, extreme learning machine, and power line impedance technique.

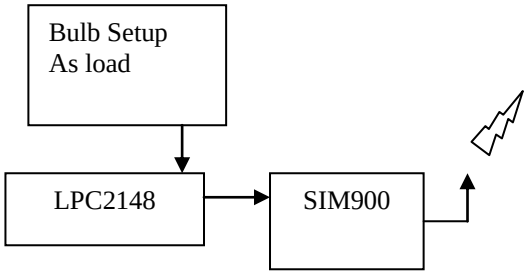

Fig1. *Proposed System*

2. PROPOSED SYSTEM

In the proposed system the power utility maintains a server and each consumer are provided an energy meter. The energy meter consists of a Microcontroller (ARM7), GSM module, current transformers, potential transformers, LCD display and a relay. The Microcontroller calculates the energy consumption by counting the output of current and potential transformers on an interrupt basis. The household meter then receives the corresponding unit and is activated. As the user consumes energy, the corresponding units are deducted from the total balance and the remaining units are displayed

using LCD. After the consumption of the allocated energy, the meter automatically disconnects the load from the main power line using the relay until the user recharges again. Thus the system avoids the irregularities associated with traditional billing system and ensures revenue collection.

3. THEFT CONTROL MEASURES

3.1. Protection against Tampering

Consumers or professional ones may try to open the energy meter and tamper it to show low or no energy consumptions. To get rid of this problem, one Switch is used at opening side of the proposed energy meter. Output of Switch is connected to external interrupt pin of the Microcontroller. In normal conditions, the Switch will be closed and the Microcontroller will detect 5V at its external interrupt pin. If consumer tries to open the energy meter the Switch will be opened and the Microcontroller will detect 0V at its external interrupt pin. If this occurs, the Microcontroller immediately notifies the server and disconnects the load from the supply.

4. HARDWARE IMPLEMENTATION

The voltage level is then converted into digital form by the inbuilt ADC peripheral of the LPC2148. The power line current is measured by passing it through a current transformer, output of which is a current proportional to the line current, the turns ratio being the constant of proportionality. A precision resistor converts the output current into equivalent alternating voltage. The voltage across resistor passes through precision rectifier, ripple eliminator and voltage divider stages before being finally fed to the inbuilt ADC peripheral of the Microcontroller. Current transformer, for current measurement, is an efficient measurement technique compared to shunt resistor (which changes the line voltage at higher line current), thus having higher linearity and virtually zero burden current.

The microcontroller used is the LPC2148, featuring a 10 bit ADC, which enables measurement of minute changes in line voltage and current. Power consumption is computed, every second, using the measured values of voltage and current. Summing power consumption over a given period of time gives energy used by the consumer. The on chip Timer interrupts the controller every second. This is extremely important since if this time duration it self has error then the measurement would be erroneous as it is calculated at an interval of every 1 second.

The process of getting values from inbuilt ADC and computing power takes a fraction of second, thus controller switches into ultra-low power mode saving energy and consequently decreasing the burden power. The controller deducts the no of units consumed.

Global System for Mobile Communications GSM is a digital wireless network standard designed by standardization committees from major European telecommunications operators and manufacturers. The GSM standard provides a common set of compatible services and capabilities to all mobile users across Europe and several million customers worldwide. The basic requirements of GSM have been described in five aspects.

- Services: The system shall provide service portability, i.e., mobile stations or mobile phones can be used in all participating countries. The system shall offer services that exist in the wire line network as well as services specific to mobile communications. In addition to vehicle-mounted stations, the system shall provide service to Mss used by pedestrians and /or on board ships.
- Quality of Services and Security: The quality for voice telephony of GSM shall beat least as good as the previous analog systems over the practical operating range. The system shall be capable of offering information encryption without significantly affecting the costs to users who do not require such facility.
- Radio Frequency Utilization: The system shall permit a high level of spectrum efficiency and state-of-the-art subscriber facilities. The system shall be capable of operating in the entire allocated frequency band, and co-exist with the earlier systems in the same frequency band.
- Network: The identification and numbering plans shall be based on relevant ITU recommendations. An international standardized signaling system shall be used for switching and mobility management. The existing fixed public networks should not be significantly modified.
- Cost: The system parameters shall be chosen with a view to limiting the cost of the complete system, in particular the MSS.

5. HARDWARE & RESULTS

Hardware result of the project has designed using LPC2148 microcontroller based on ARM7 Microprocessor. For the communication we are using GSM for sending and receiving commands.

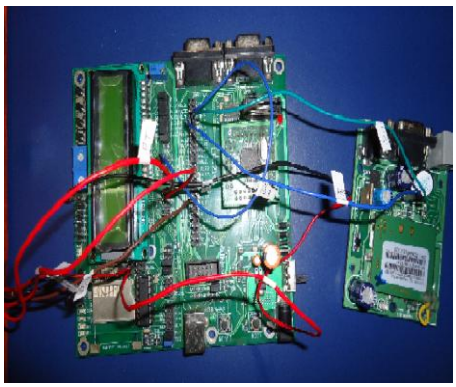

Fig6. *Hardware of the Proposed System*

Current and voltage Transformers are used for calculating the voltage and current consumed by the load. Here we are using 60, 100, 200 Watts bulbs for the load consumption.

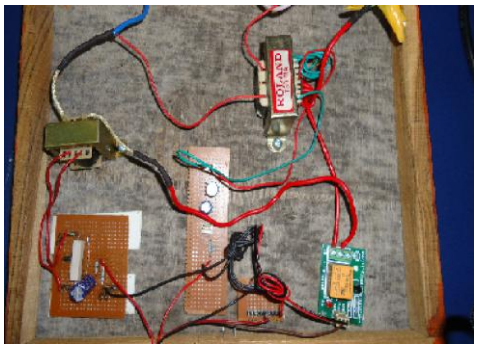

Fig7. *Internal Connections*

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