IMPLEMENTATION OF PREPAID SMART ENERGY METER

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Abstract: Electricity is an essential requirement for humans. It is generally used for domestic, industrial and agricultural purposes. Now a days power theft has become a major problem specifically in India. This causes a considerable loss to electricity boards, so this can be prevented by using Smart Energy Meter (SEM). Theft cases are signaled to local authorities through SMS sent by GSM. The present system of energy billing in India is prone to error and also time and labor consuming. This pre-paid meter converts conventional meter reading methods and enables remote access of existing energy meters from energy suppliers. They can also monitor meter readings on a regular basis without having to visit each home by a person.

Keywords: **Arduino UNO, GSM module, Relay, Theft detection, Prepaid meter**

I. INTRODUCTION

Electricity is one of the vital requirements for sustainment of contents of life. It should be used very judiciously for its proper utilization. But in our country, we've got lot of localities where we've surplus supply for the electricity while many areas don't even have access to that. Our policies of its distribution are also partially in charge of this because we are still powerless to properly estimate our exact requirement and still power theft is prevailing.

Need for Prepaid Energy Meter System:
The conventional method of electricity billing involves an individual from the distribution unit reading the quantity of units of electricity consumed within the energy meter, conveying this information to the distribution unit, so preparing the bill in line with the units consumed for a set amount of your time. this could prove quite tedious because it involves various tasks like reading, then preparing the bill. Still, accuracy cannot be guaranteed as there will be errors in human reading. Despite this, the task of billing for each consumer could be a time-consuming job for the distribution grid. Also, the buyer can deliberately consume more amount of power than required and still refrain from paying the bill and zilch will be done to severe the electrical power supply.
To eliminate of these problems, the foremost convenient method is making the full system prepaid kind of like a mobile phone recharge or a DTH recharge.

Defining a Prepaid Energy Meter System:
Basically, like during a mobile recharging, the patron buys a recharge card and gets some energy units equally for the balance amount. The balance amount will keep reducing for each unit of energy consumed and once zero, the power supply will be cut-off automatically.
GSM technology is employed so the patron would receive messages about the consumption of power (in watts) and if it reaches the minimum amount, it might automatically alert the buyer to recharge. This technology holds good for all electricity distribution companies, private communities, IT parks and self-containing housing projects. the event of GSM infrastructure in past twenty years made meter reading system wireless. The GSM infrastructure, which has national wide coverage are often wont to request and retrieve power consumption notification over individual houses. aside from making readings using GSM communication, billing system is required to be made prepaid to avoid unnecessary usage of power. It replaces traditional meter reading methods and enables remote access of existing energy meter by the energy provider. Also, they'll monitor the meter readings regularly without the person visiting each house.

Existing prepaid metering technologies:

• SMART CARD based prepaid Energy Meters:

Smart card is a credit card sized plastic card implanted with an integrated circuit (IC) and generally it consists of a ROM, EEPROM and a CPU.A smart card provides both the memory capacity and the computational capability. Access to data stored on the card is under the control of the smart card operating system. In this method consumer have to recharge the smart card for the amount he selects and enter the card into the card reader of the energy meter. Then the meter store the number of units recharged and start to measures the energy consumption. When purchased units are used up the power supply will be disconnected by the meter until the next recharge.

• Radio-Frequency Identification (RFID) based Prepaid Energy Meters:

RFID (Radio-frequency identification) 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 tag and an RFID 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. Some tags can be read from several meters away and beyond the line of sight of the reader. In this method RFID cards which are issued by the electricity suppliers to individual consumers are used. This RFID card is unique with a code in it and consumers are free to make flexible recharge. When the consumer wants to use the system, he needs to show the card to the reader, then the unique code inside the card is recognized by the reader, and starts deducing the amount of the RFID card as per the quantal unit charge. When the usage completes the consumer has to recharge the RFID card again.

II. LITERATURE SURVEY

Ashna.K "**GSM Based Automatic Energy Meter Reading System with Instant Billing**" Proposed a simple, low-cost, wireless GSM energy meter and its associated wave interface design to automate billing and manage globally stored data.

Vivek Kumar Sehgal "**Electronic Energy Meter with Instant Billing**" The concept of the post-paid energy meter was introduced, which automatically detects the energy used in the home and cuts the power line when it reaches the value initially assigned to the hardware. The user interface provided in the hardware for the user interacts with the hardware, the user can set the value through the user interface.

Ms. Prajakta B.Murmude, Mr. Sachin G. Jagdale, Ms. Sunita D. Giri "**GSM based Prepaid Energy Meter**" Proposed the design and implementation of the GSM-based remote operation of the power meter, which provides solutions for power theft, consumption control, auto-billing and payment, data logging and manpower reduction in power distribution and management.

Outcome of Literature Survey:

The main problem with conventional meters is that a large number of staff perform other related tasks such as meter reading and bill payment, billing errors by meter readers during meter reading, careless power consumption by consumers who are unaware of its cost, customers are not obligated to pay the bill on time and the main problem is power theft cases.

So, to overcome these major drawbacks we are depicted from the literature survey a prepaid smart energy meter.

III. PROBLEM STATEMENT

There are many benefits of digital energy meters, but there are always opportunities for innovation or modification across different devices for the benefit of consumers and suppliers.

Some of the problems with those power meters should be corrected as follows:

• Meter reading and bill payment are performed by a large number of staff, which means a large number of employees are required.
• Inadvertent billing errors of meter readers during meter reading and sometimes during billing estimates.
• Customers have to stand in queue hours for bill payments.
• Consumers who are unaware of the cost of electricity use it carelessly.
• Customers are not obligated to pay the bill on time
• power theft cases.

IV. OBJECTIVES

The main objectives are to:
• Measure electricity consumption accurately.
• Display account balance.
• Communicate with the user using GSM module.
• Warn the user of low account balance.
• Cut power off when there is zero credit on the account.
• Reduce power theft cases.
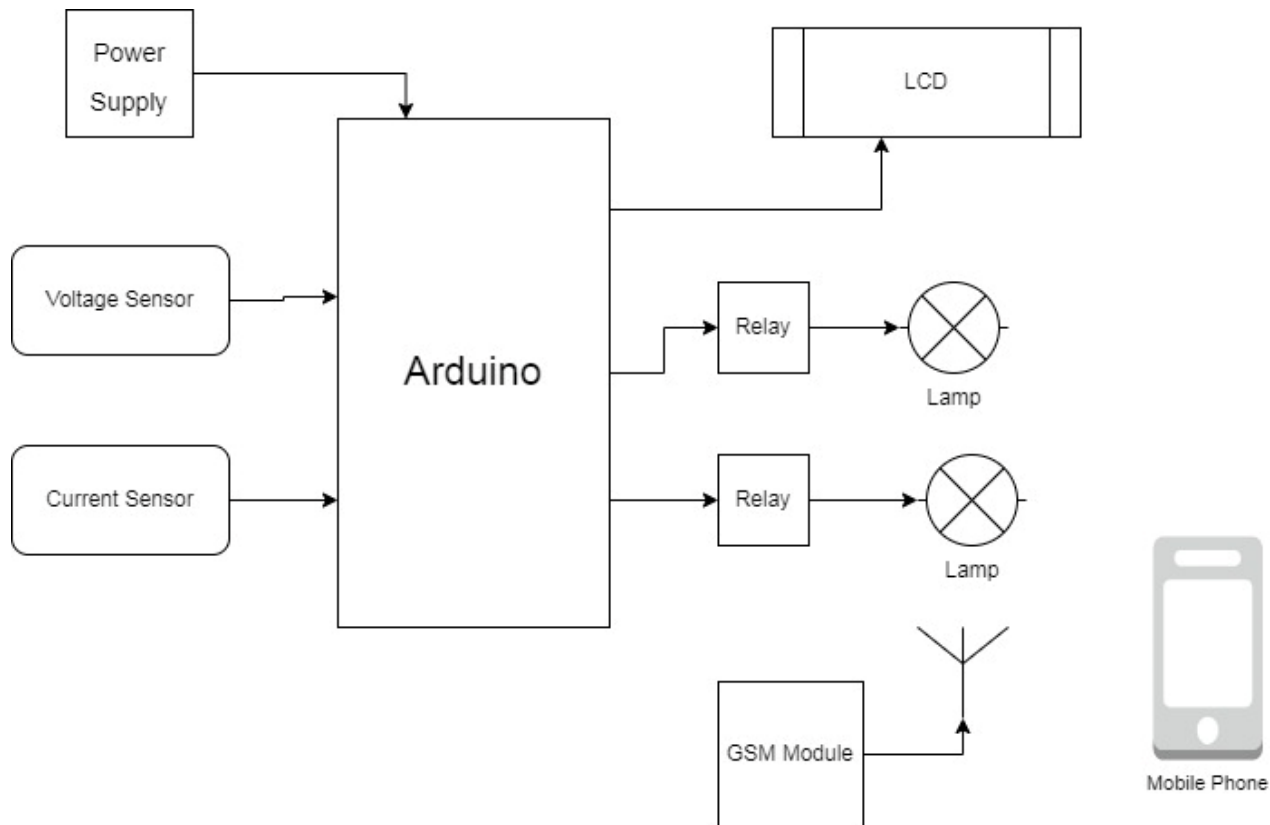
V. METHODOLOGY

fig 5. Block diagram

The working of the project is described in the figure above. At first the GSM module is initialized and it establishes a network for communicating with the user. After initialization the controller checks the balance if it is above optimum balance then the load is turned on. If the balance is below a certain value, then the controller will send a SMS for recharging the energy account.

Working Principle:

This model has the Arduino UNO as CPU. The entire system is interfaced with Arduino UNO. The GSM modem is serially connected with the controller which is used as communication module between User and provider. The GSM uses its own network for the transfer of data. Special coding in Arduino IDE is used for programming Arduino. The relay is used as switching device to cut off and restore power supply. The LCD is interfaced to microcontroller using parallel connection. In this project the Microcontroller based system continuously measures the readings using Voltage Sensor and the current Sensor to measure voltage and current meter reading to calculate Power and No of Units and remaining Balance. LDR is interface to detect the power theft and on it is done the SMS can be sent to the Electricity department. This system also can be used to cut off the power supply to the house in case of non-payment of electricity bills. This GSM modem with SIM card is essential for each energy meter.

VI. ADVANTAGES/DISADVANTAGES/APPLICATIONS

Advantages:
- It is highly accurate as of the whole idea of reading the units and then billing manually or any other means is eliminated.
- The consumer cannot escape from paying the electricity bill and the State Electricity Board gets free from debts.
- On the consumer front, the tedious task of paying the bill and waiting anxiously for the bill is eliminated.
- Wastage of energy is diminished as now only the required energy will be consumed as allotted.
- The power grid can monitor the overall energy consumption and any tampering attempts are actually of no use and can be detected if still prevalent.

Disadvantage:
- Smart meters communicate with energy suppliers using mobile technology (network coverage) and a weak signal can disrupt this connection.

Applications:
- At customers' premises for billing purposes.
- It is useful in Industrial applications.
- State estimation of power distribution networks.

VII. CONCLUSION

These types of models help us to reduce readings taken manually so they can be cost effective. Divergence in service is going to be the key competitive factor to the improve market share in the present power markets prepaid meters with their advantages over conventional ones are likely to help power providers to differentiate and offer value –added services to users. Encourage clients to opt for prepaid meters on a voluntary basis and offering tariff or non-tariff incentives to those users who prepaid their power changes would help the utilities to execute this system. Proposed methodology is used to generate prepaid card for usage of electricity. It is user friendly and we can enhance this project, in which an electricity department can send message to the consumer about the billing information. Power theft cases can be reduced.

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