



### ADVANCED SMART ENERGY METERING USING GPRS

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#### Abstract

Now a day, the modern utilities are in process of automation in order to achieve the energy management in order to monitor, control and optimize the performance of the generation, transmission and distribution. Lots of development is going on in order to achieve centralized control and monitoring in energy meter reading and billing system. In this project we have designed and developed a smart energy metering system in which the real time data of energy consumption, distinct characteristics and status from energy metering device is collected and delivered into a central data base by using a GPRS module. The central database unit can use that data for billing, troubleshooting and analysis purposes. The data collection is done through the unique GPRS ID's provided to the distinct consumers. Visiting each and every consumers premises after certain interval of time is not only hectic but also expensive process which require skilled and trustworthy manpower in order to avoid errors and collection of real data. The smart meter eliminates the cost required for the physical data collection and saves time. The billing process can be made transparent by means of providing consumer bill for only real data consumption instead of providing bill based on past consumption history and predictions. The Utilities can use the collected data for analysis of Supply and Demand, Load analysis and load forecasting. A LCD display is provided as user interface which will be providing the real time values of different energy characteristics. The Billing process is simplified and digitalized through prepaid payment of energy consumption which can be paid through online system or GPRS module.

**Index terms:** Smart meters, GPRS, Arduino, Prepaid Meters, Power theft.

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#### 1. INTRODUCTION

The developments in the electric meter are very vast and have history and available infrastructure more the 100 years old. It is replacing the tradition mechanical meter from the consumer premises by advanced meters having the advanced metering infrastructure commonly known as AMI System. The technology has been upgraded from the mechanical disc rotating meters to static meters basically implementing the electronic parts and now to the smart/intelligent meters. An electric meter is a device commissioned in the consumer premises on their request of electric supply in order to measure the amount of consumption of the energy by the particular consumer. Each and every consumer having an electric service connection must have an electric energy meter installed and maintained by the utility. The available infrastructure of mechanical meters is old and need to be integrated as there are numerous flaws and faults that are

causing power theft which ultimately results in economical losses to the utilities over the years. Moreover as real time data is unavailable it becomes difficult for utility to do analysis of the demand, Supply, Load forecasting. The Smart Meter provides time to time data with appropriate analysis proves useful for the utility as well as the consumers. The smart meters also provide the data logging system that can capture, stores, and transmits the data to central control unit and as well as provided to the customer on request through GPRS or LCD user interface. The data logging can be done on dedicated webpage which will be useful in following aspects

- Control on Time of use and also rate of use
- Profiling Energy Uses
- Time of Use Billing
- Demand Forecasting
- Demand Response
- Imposition Of Energy Conservation.

## 2. LITURATURE SURVEY

### 2.1. Conventional Metering System

In the existing electric metering system there is either a electromechanical meter or electronic meter is installed in the consumers premises.

#### 2.1.1. Electromechanical Meters:

The electromechanical induction type energy meter is also known as watt hour meter. It consists of an aluminium rotating disk mounted on a spindle in between a pair of electromagnets. The speed at which the disk rotates is proportional to the power and the power is integrated by the use of counting mechanism and gear train drive. The two electromagnets in between which the conducting disk is pivoted namely series magnet and the shunt magnet comprises of silicon steel laminated electromagnets. A coil of few turns of thick wire connected in series with the line is placed on the series magnet whereas shunt magnet carries a coil with many turns of thin wire connected across the power supply. To move the disk at balanced position and stop the disc while power is off a Breaking magnet is used which applies the force opposite to the normal disk rotation. The breaking magnet is a permanent magnet. Tampering is one of the most happening case cause malfunction of the meters and ultimately results in economical losses to the supplying company

#### 2.1.2. Electronic Energy meters:

The electronic meters are of accurate, reliable and high precision type of measuring devices as compared to the conventional mechanical meters used. The power required for the electronic meters is less and operates instantaneously when connected across the load. These meters can be analog or digital. In the analog meters the power is converted into frequency or pulse rate and it is then integrated by the counters placed inside. By using high end processors the digital meters can measure the power directly and then integrated by logic circuits. The electronic meter are provided with a LCD display show the various parameter on the display that can be used by the for billing purpose. These meters are also provided with such protection and seal that no one can temper the measuring device and care is taken that the device should work in all severe atmospheric conditions

### 2.2 Automatic Meters

Automatic meters is an advanced technology used for the metering which involves placing intelligent meters to read, process and feedback the data to consumers. It measures the energy consumed by the customer and remotely switches the supply to consumers and remotely controls the maximum electricity consumption. For better performance Automatic meters uses advanced metering infrastructure. In these meters bidirectional communication is possible. They can transmit to the utility such as consumption of the energy, parameters value, alarms, indications and warnings. The firmware of the Automatic meters is upgradable and can be upgraded remotely from the data centers. These meters eliminate the need of visit

to the consumer premises to take the readings on monthly basis. The meter facilitates the communication options such as wireless, telephone, fiber optic cables, PLCC (Power Line Carrier Communication). The most important and highlighting feature of the Automatic meter is that it avoids the possibility of tampering of the measuring device.

## 3. PROPOSED SYSTEM

In Conventional metering system to measure electricity consumption the energy provider company hire persons who visit each house and record the meter reading manually. These meter readings are used for electricity bill calculation and this bill sent to consumer house by post. This is only a sluggish and laborious. So we designed An Advanced Smart Energy Metering System.

The proposed system constitutes a sensing unit comprising of a voltage measurement unit and a current measurement unit. These two units are controlled by a Arduino UNO R3 Controller. The LCD is also interfaced with the Arduino in order to display the real time data and other functional menu. The data collected and recorded on the smart meter is transferred to utility data centre by using a GPRS (General Packet Radio Service). An alarm is used as warning signal to the consumer as when the energy equivalent to the prepaid amount of money is exhausted it will give warning signal to consumer in order to recharge their unique GPRS ID to get benefits of the uninterrupted service. As the utility company is having the statistics of amount of dispatched load and amount of real time data consumption of the load by the consumers the analysis of the power theft can be done easily and the location of power drain can be located at earlier stages and loss of economy due to power theft can be avoided. As the data is transmitted over the GPRS module the need of the workers is also eliminated and cost is saved. The web pages or SMS system can be used for alerts for both the utility and consumers to get the updates about the systems.

## 4. BLOCK DIAGRAM

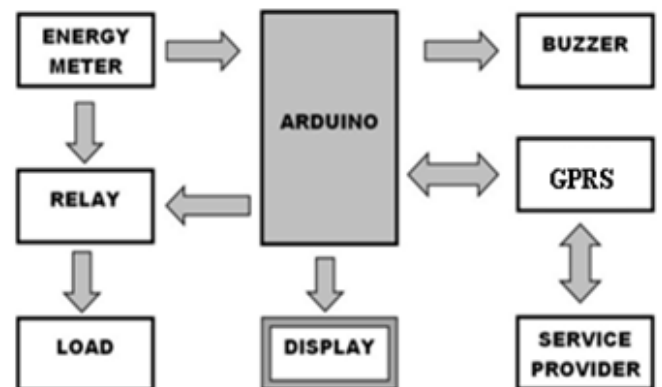


Fig-1: Block Diagram

## 4.1 Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It has simple and accessible user experience, Arduino has been used in thousands of different projects and applications. It runs on Mac, Windows, and Linux. The Arduino UNOR3 is used the control and coordinate the different components such as GPRS module, LCD display, Relay and Energy meter. The programming of Arduino is simple and can be done using Arduino IDE.

## 4.2 Energy Meter

An Energy meter is and device used for monitoring controlling and data acquisition of the energy consumed. The logged data is then transmitted to the server by means of some communication medium. The energy meter consists of a voltage sensing unit and a current sensing unit in the project.

## 4.3 Relays

The relays are electrically operated switch. Generally relays are electromagnetic type. In the project the relays are used to connect and disconnect the load from the energy meters in case of running out of the prepaid balance. The utility can command the smart meter to cut off and turn on the supply by giving the commands to the meter and the relay operates accordingly.

## 4.4 Display

The LCD Display is used to real time parameters of the smart meters such as voltage level, current level, Energy consumption, Prepaid Balance, Date and time etc. a 16×2 LCD display is used in the project for the above mentioned purpose.

## 4.5 GPRS Module

A GPRS module compatible with Arduino Uno R3 is used. The Quad-Band is 850/ 900/ 1800/ 1900 MHz. It is 10/8 multi- slot class. The module requires 12v supply and Low power consumption about 1.5mA (sleep mode).The Operation temperature is -40°C to +85 °C

## 4.6 Buzzer

The buzzer is used as a warning indicator. The buzzer makes sounds when the prepaid balance of the Unique ID is low and required to be recharged in order to get uninterrupted supply.

## 5. CIRCUIT DIAGRAM

Software Used

- Proteus
- Arduino IDE

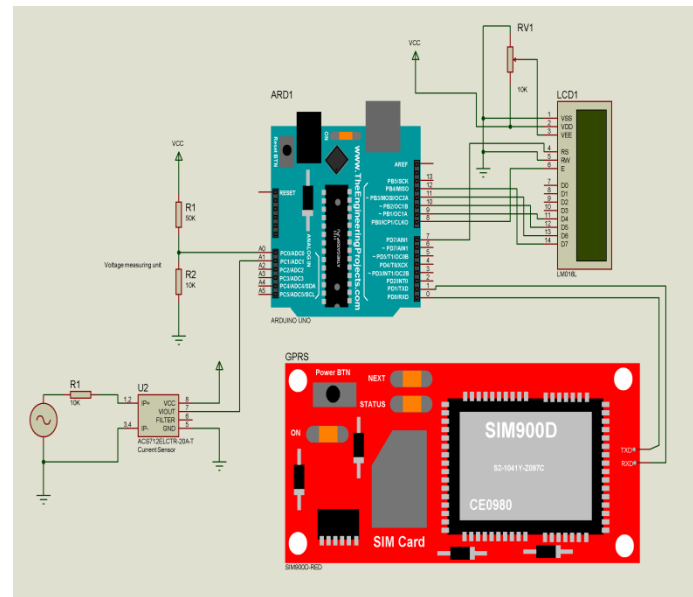


Fig-2: Simulation Circuit Diagram

## 6. CONCLUSION

The implementation of the smart meters can help the consumers and the utilities to get the bills according to the real time data collected. The hectic, Cost and the manpower required for taking the readings of the meters by physically visiting the consumer premises can be eliminated and the most importantly tampering of meters and power theft can be prohibited.

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