FUTURE SYSTEM FOR ENERGY MONITORING AND CONSERVATION

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Abstract—Accurate metering, detection of energy theft and implementation of proper tariff as well as billing system are vital in wise energy management. We introduce the design of a simple low cost wireless GSM energy meter and its associated web interface. A GSM based wireless communication module is integrated with electronic energy meter of each entity to have remote access over the usage of electricity.
The usage is transmitted to a central server using a smartmeter which is designed to sendthevoltage usage reading in regular interval of ti me.The meter is designed in such a way that the output of the meter should be a Comma Separated Values (CSV) which contains the information like date, consumer id, start time, end time usage etc. These data are analyzed and then are stored in the database. From this database the data is being viewed in the form of graphs and visualizations for the easy understanding and analysis. The UI is being provided using the help of libraries. There will be two logins: one for admin and the other for consumers. The consumers can log in to view their regular usage and admin can login to view the usage section wise. The usage can be viewed hourly,daily,monthly etc. This analysis can give an idea about the time of peak voltage usage, and also shows which area consumes the power most. The GUI provides a feature for online payment of the consumer bills. The proposed system replaces traditional meter reading methods. It can be used to monitor the meter readings regularly without the person visiting each house. It can be used to monitor the faults in the electricity line by analyzing the readings.

Keywords: GSM, Smart meter, AMR

I. INTRODUCTION

In the past years electric meter reading has gone through changes with which the electromechanical induction watt-hour energy meter or the electricity meter is now automated in many countries.

An electricity meter is a device which measures the total electrical energy consumed. Electricity meters are a common sight in the households today. And the electricity bill is entirely dependent on this meter.

Automatic meter reading is the technology of automatically collecting data from metering devices and transferring that data to a central database for billing, troubleshooting, and analyzing. This technique has many advantages. It saves energy providers the expense of periodic trips to houses for a meter reading. Billing will based consumption rather than on estimates based on predicted consumption value as in old meters. This can help both energy providers and customers to control the use and production of electricity. There are different types of electricity meters which measure electricity:

a) Electromechanical meter

Electromechanical meters were very common in India until now in few rural areas. The working of electromechanical meters is fairly simple. There is a non-magnetic metallic disc attached to it internally which rotates depending upon the power passing through it. So if the power passing through is high, then the disc rotates faster and when the passage of the power is low, the disc rotates slower. The rate of the rotation in turn decides the reading on the electricity meter. Higher the number of rotation, higher is the reading and vice-versa. Since there is rotation of a disc involved, it is bound to consume some electrical energy itself to facilitate the rotations. The power of around 2 Watts is consumed to make it rotate and this power consumption is not registered on the meter.

b) Electronic meter

Electronic meters are becoming increasingly popular now-a-days in urban areas. An electronic meter has a LED/LCD display on which the readings of the electricity consumption of the connected appliances. The readings are digital in the electronic meters .Electric meter do register every small unit of electricity consumed.

c) Smart meter

Smart meters are the newest addition to the type of electricity meters. They look similar to electronic meters but they are better than both the electromechanical meters and the electronic meters in the sense that in addition to providing the usual services of a regular meter, they are connected back to the utility through the internet. It means that there is no need of an reader manually taking the meter readings. The readings are automatically sent by the internet.

Electronic meters are a better than other traditional meters, they provide not only the consumed units but they also provide other information like the instantaneous and maximum rate of usage demands, <u>voltages</u>, <u>power factor</u> and so on.

Problems with the electromechanical meter

Although the electromechanical meters have been quite common in the past years, there are certain problems that are attributed to them.
1) Since electromechanical meters consist of moving parts, they are bound to undergo some wear and tear with the passage
2) The accuracy of a electromechanical meter decreases bye the various environmental factors such as humidity, dust and dirt which significantly affect the operating accuracy of the electromechanical meter.
3) Factors like corrosion, worn out gears and insects can render the electromechanical meter unable to capture the electricity consumption of a property accurately.
4) The mechanical gear lubricants may dry up resulting in the breaking in the gear teeth .

5) Also, the electromechanical meters may get mis-calibrated if they experience a sudden shock or vibration which may cause a jolt or a sudden stoppage of the rotating disk.

II. EXISTING SYSTEM

AMR system and several related works are available. Many e metering systems have now been proposed, based on GPRS,Bluetooth, GSM as explained in [1], [3], [4], [5], [6], [7] and[8].

2.1. GPRS

Design of an Electric Energy Meter for long-distance data transfers based upon GPRS is proposed in[1]. These systems can't be implemented so easily because the regular use of GPRS is still a dream to the common people .

2.2. Bluetooth

A Bluetooth Advanced Metering infrastructure is an existing one for automatic meter data collection and energy auditing and management. The system operates with multiple channels and frequency hopping. In this method if any tariff variation occurs, the new tariff rate will be changed only through reprogramming otherwise the previous tariff rate will be displayed on the LCD display. This causes major problems in billing. No information is given to the consumers about the status of energy consumption and no details about the previous month's consumption and the amount of bill paid.

2.3. GSM

A GSM Energy meter with instant billing facility is introduced in [2] and [3],but still the problem of missing SMS will be an issue.So a new approach of using an energy measurement technique that encompasses the GSM network as a mean of transmitting energy data is more relevant. The GSM/GPRS network offers most coverage in most developed and developing countries. This method is also effective in rural areas, which are not densely populated, and in which, most people do not have access to a fixed telephone network. So in a country like India we need to focus more on this method as it can be implemented very easily and effectively.

III. EQUIPMENTS REQUIRED

The components required foe development of our project are:

1) Arduino
2) GSM
3) CT Sensors

ARDUINO

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without working too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Microcontroller	ATmega328P
Operating Voltage	5V
InputVoltage	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 Ma
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

CURRENT TRANSFORMER (CT)

CT (Current Transformer) is used to measure the flowing current inside the conductor. The amount of current flowing is used to calculate the power consumed. This can be directly connected to the arduino through the aux jack and values can be analyzed.

A current transformer (CT) is a transformer that is used to produce an alternating current (AC) in its secondary which is proportional to the AC current in its primary. Current transformers, together with voltage transformers (VTs) or potential transformers (PTs), which are designed for measurement, are known as an Instrument transformer.

When a current is too high to measure directly or the voltage of the circuit is too high, a current transformer can be used to provide an isolated lower current in its secondary which is proportional to the current in the primary circuit. The induced secondary current is then suitable for measuring instruments or processing in electronic equipment. Current transformers have little effect on the primary circuit. Often, in electronic equipment, the isolation between the primary and secondary circuit is the important characteristic.

Current transformers are used in electronic equipment and are widely used for metering and protective relays in the electrical power industry

GSM

GSM module is used to transfer the data collected to the central server by means of internet or SMS.It collects data from the meter and sends it via internet to the EB database.

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

Features of GSM Module:
- Improved spectrum efficiency
- International roaming
- Compatibility with integrated services digital network (ISDN)
- Support for new services.
- SIM phonebook management
- Fixed dialing number (FDN)
- Real time clock with alarm management
- High-quality speech
- Uses encryption to make phone calls more secure
- Short message service (SMS)

IV. PROPOSED SYSTEM

Smart meter is a fully automated meter which sends the reading in an interval of an hour or less. This is introduced to monitor the electricity usage from a single place and reduce the manual labour.

The features are:
  i. Fully automated
 ii. Current measured through CT so less creep effect
iii. Readings can be viewed through smart phones or computers
 iv. Readings are automatically uploaded to the database
  v. Easy online billing
 vi. Malpractice in meters can be monitored
vii. Graphical representation of data
viii. User and official logins

The proposed system is fully automated. Al the process from measurement of the voltage consumed till the billing and payment is carried out through computers. The current is measured using a CT which is connected to a raspberry pi. The reading is sent to the central server in a CSV file format using a GSM module. The data is decoded at the server side and analysed. The data is graphically visualized in a web interface. This system contains mainly 2 accounts: consumer and officer. The consumer can view their usage details and can pay their bills online. The officers can log on to view the section wise usage. Power theft, faulty line, peak usage levels can be viewed by using this system
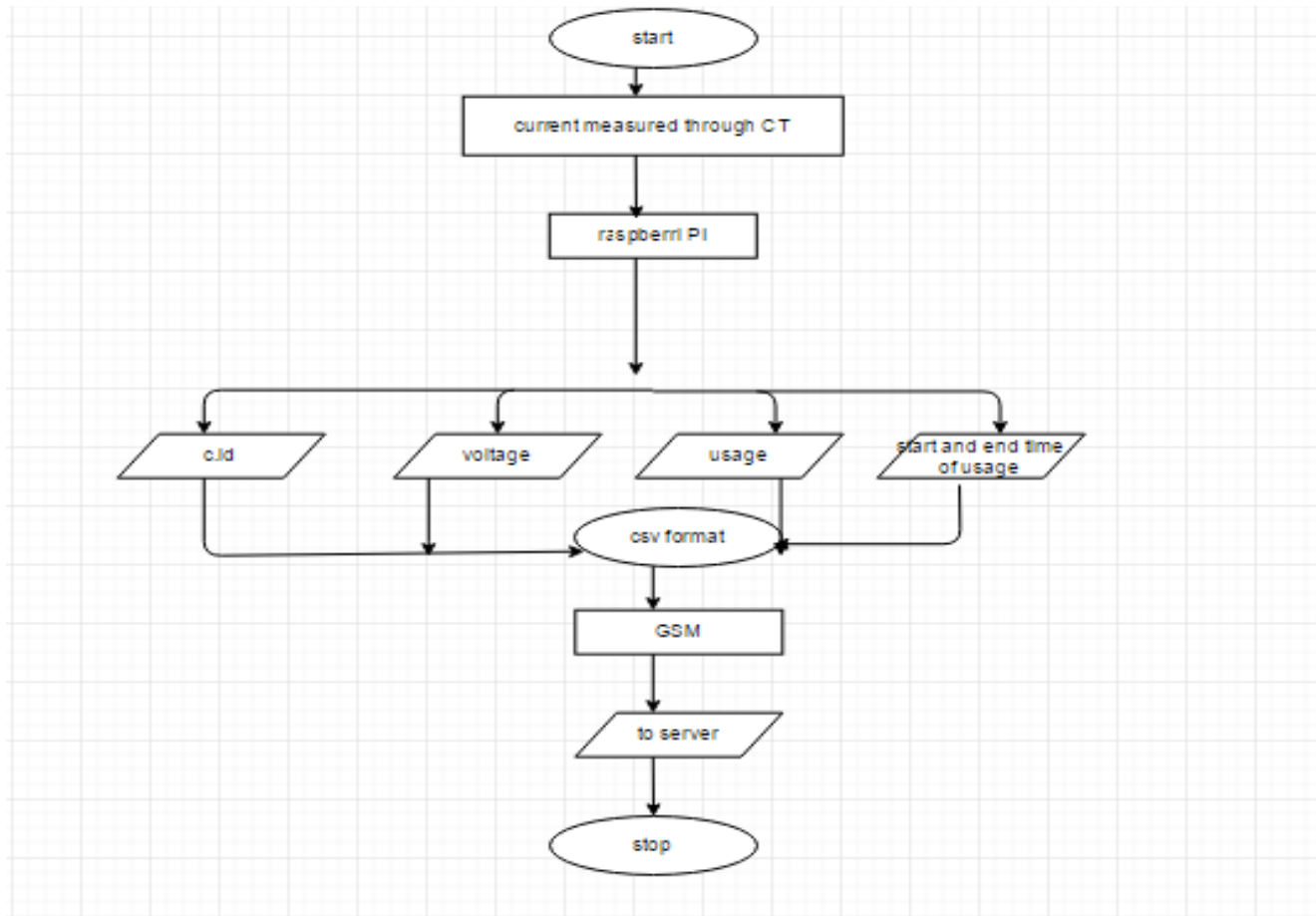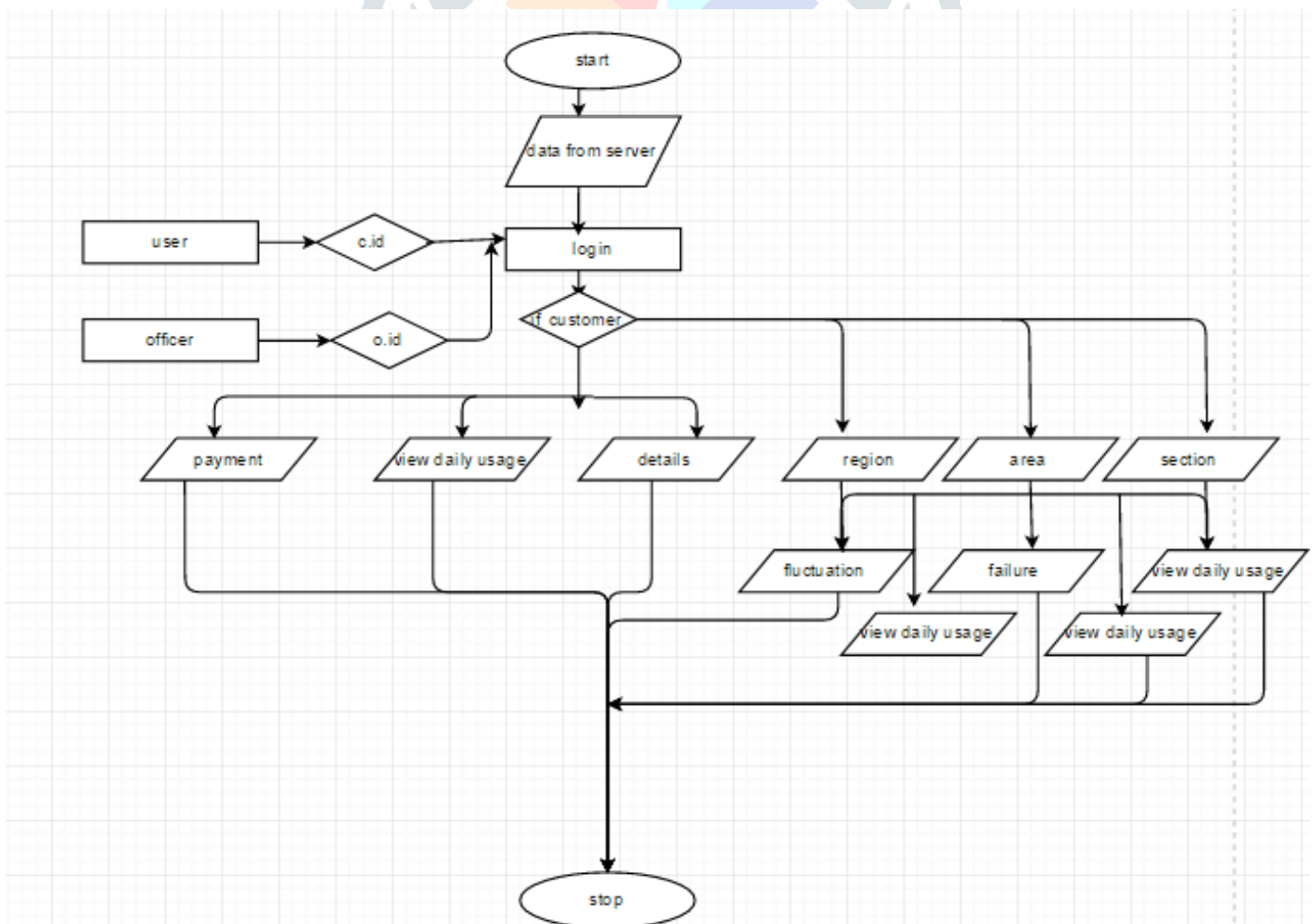
V. BLOCK DIAGRAM
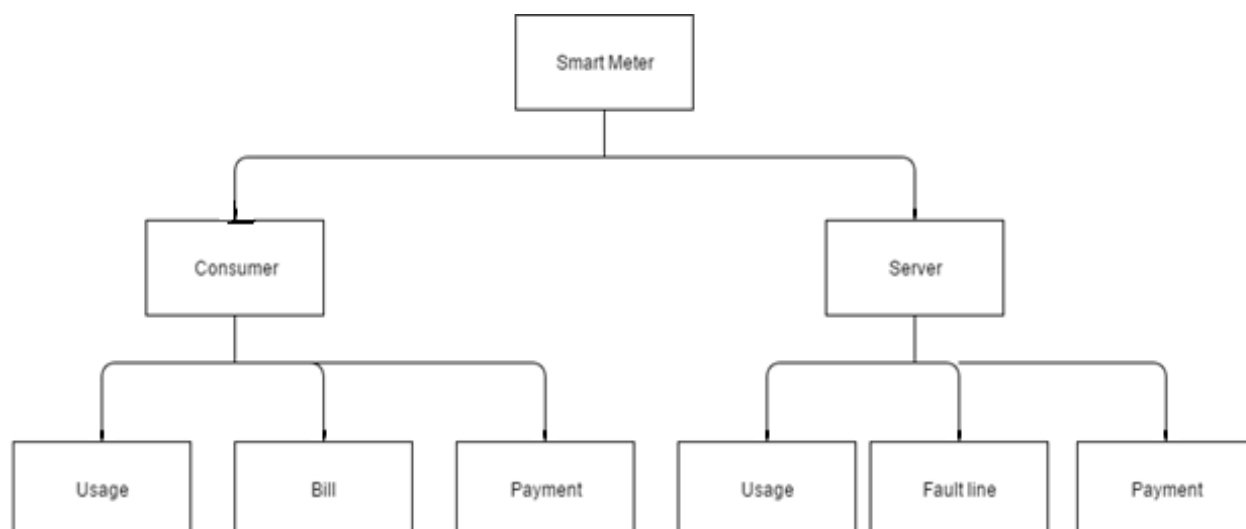
VI. FLOW CHART

Fig: Meter-Server
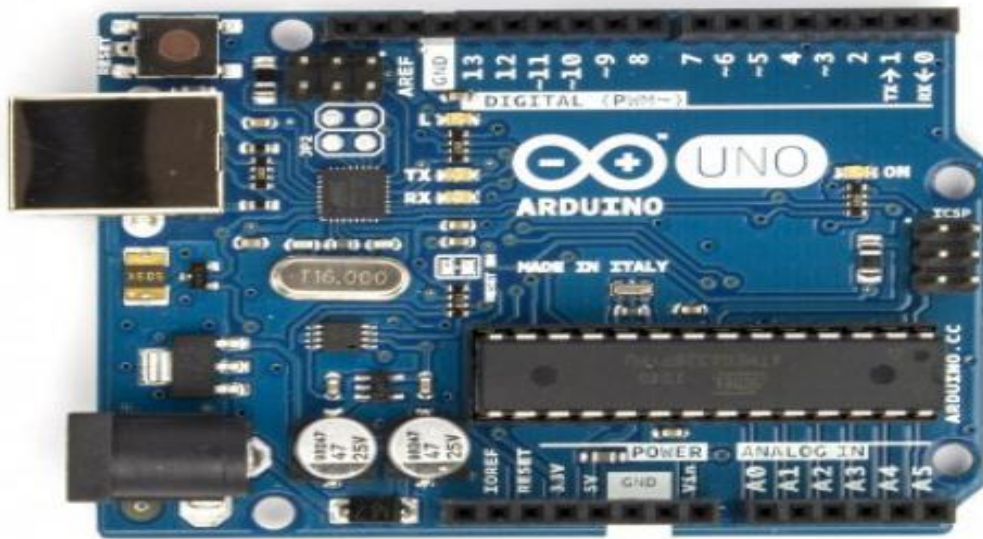

Fig: Server-office

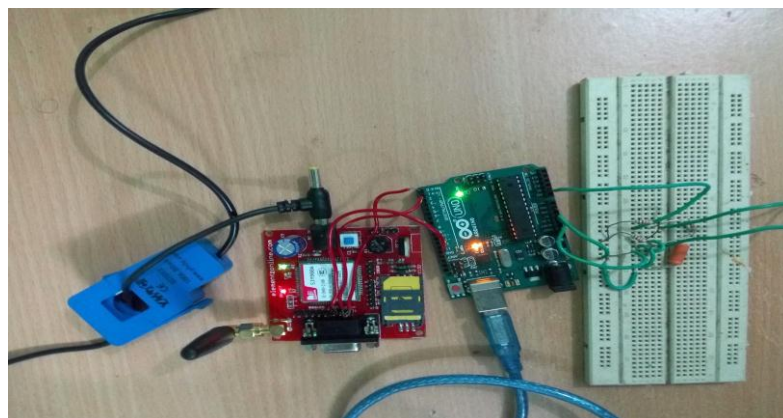## VII. DIAGRAMS

Fig: Arduino Microcontroller

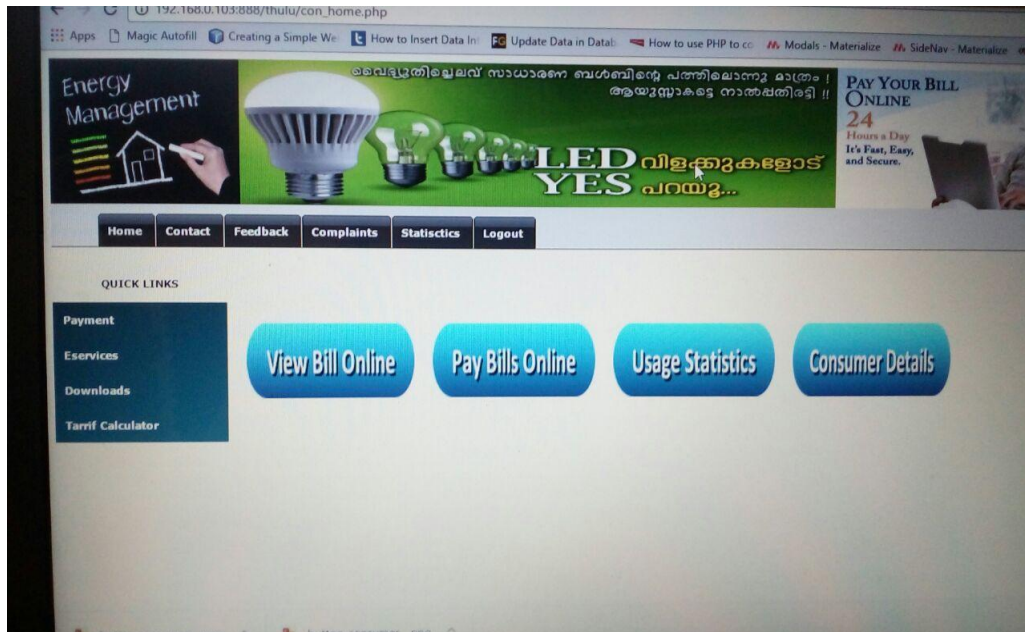Fig: Current Transformer

Fig: GSM module

Fig: Meter connection

VIII. SCREENSHOTS
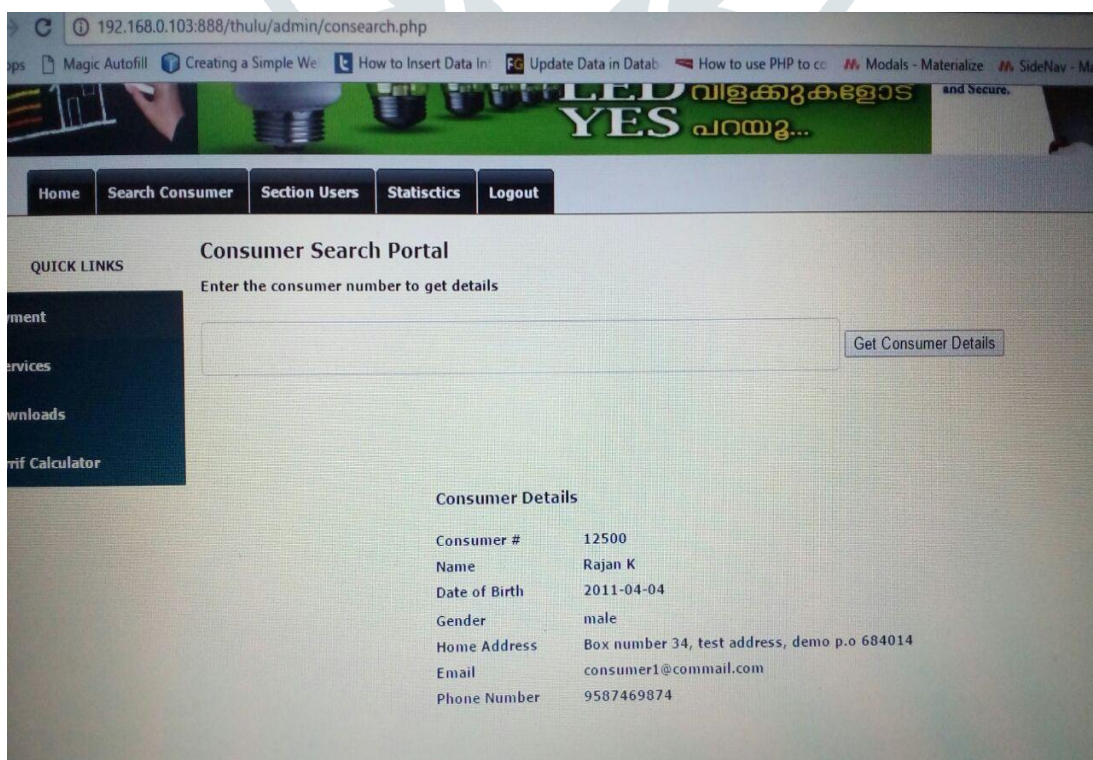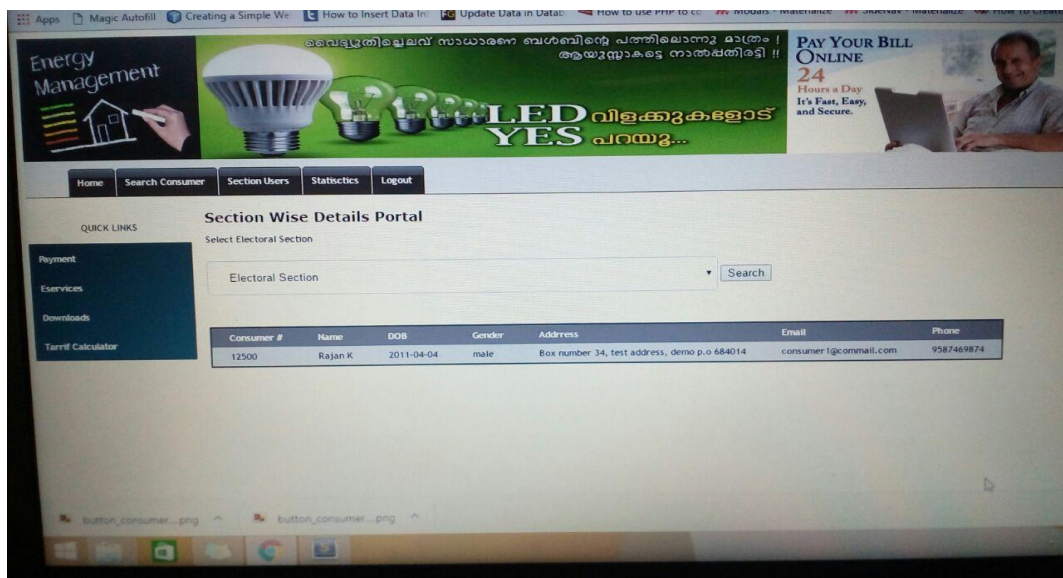
IX. CONCLUSION

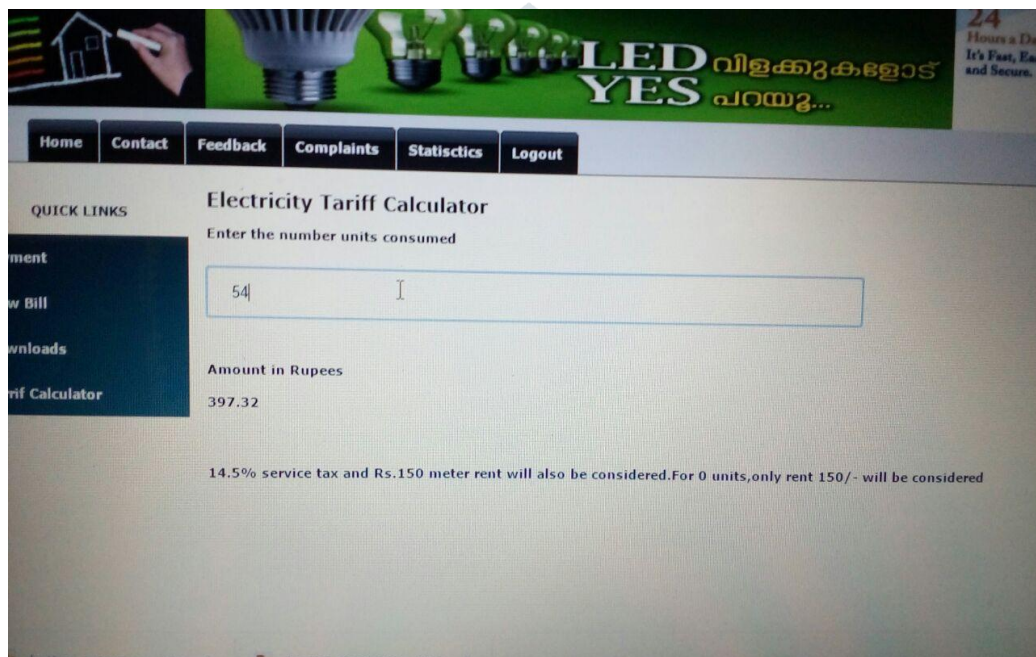Various electronic meters have been developed and are still being developed. However the use of GSM provides numerous advantages over methods that have been previously used. Data transmission is charged at standard SMS rates, thus the charges are not based on the duration of Data transmission. The cost efficient transmission of readings ensures that power consumption values can be transmitted more frequently. Can also be able to transmit readings more often will help to generate timely bills, better understanding of energy demand patterns, manage meter failures more efficiently and manage fraud better. Also helpful in online bill payment that reduces the consumers workload. And also it reduces many drawbacks of the traditional system. It is also risk free because there is no manual reading of any sort as in old electromechanical meter reading.

X. FUTURE ENHANCEMENTS
POWER CONSUMED BY EACH DEVICE

Every system is being in the way of automation. This AMR can be used to find out the power consumed by each household items present. This helps the user to identify the high power consuming device and can be useful to maintain or control the usage of these items. This analysis helps the officials to monitor and regulate the power consumed or warn the consumer about the device. This can also be used to monitor the leakage at the consumer side and can ensure the safety.

MAINTANANCE/ LOAD SHEDDING

From the analysis by the admin the hour at which maximum power consumption can be figured out. Based on these values and assessments load shedding or maintenance works on the sections can be arranged. This method helps to carry procedures without disturbing the users.

XI. REFERNCES

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