

Efficient Energy Distribution with Power Loss Detection

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Abstract:-Global energy crises are increasing every moment. India faces endemic electrical energy and peaking shortages. These shortages have a very detrimental effect on the overall economic growth of the country. Losses could be defined as the difference between the metered units of electricity entering the distribution network and those leaving the network paid for through electricity accounts, whether estimated or metered, in a well defined period of time. Electricity theft is a social evil, so it has to be completely eliminated. The traditional billing systems are discrete, inaccurate, costly, slow, and lack flexibility as well as reliability. Therefore, several attempts were made to automate the billing systems. Even though accurate and fast readings are obtained, bill payment is still performed based on the old billing procedure. They require an individual or agent to physically come and take down the readings and report to house hold/office the amount one has to pay. In this project an attempt is made to develop a system, in which energy meter works as a prepaid energy meter and detect illegal electricity consumption, by GSM based smart energy meter. At this point of technological development the problem of illegal usage of electricity can be solved electronically without any human control. The implementation of this system will save large amount of electricity, and there by electricity will be available for more number of consumer than earlier.

I.INTRODUCTION

Electricity has become life line of industries and household. Electric equipment becomes an integral part of human life and without electricity unthinkable in this modern era. As demand power increases, all possible steps are being undertaken to boost electric power A production but, the biggest threat to electric power management is power theft. Electricity theft is closely related to governance indicators where higher levels are recorded in countries without effective accountability, political instability, low government effectiveness and high levels of corruption.

Merely generating more power is not enough to meet present day requirements. This illegal electricity usage may indirectly affect the economic status of a country. All the steps taken so far, regarding the improvement of the revenue collection did not yield satisfactory results. It is reported that the most faulty sub system is the metering and meter reading system.

II.PROBLEM STATEMENT

Indian power sector is facing serious problem of lean revenue collection as against energy supplied due to technical and non technical losses. Electrical energy generated should be equal to the energy registered as consumed. However, in reality, the situation is different

because losses occur as an integral result of energy transmission and distribution. Technical losses in power systems are naturally occurring losses, which are caused by actions internal to the power system and consist mainly of power dissipation in electrical system components such as transmission lines, power transformers and measurement systems.

Non-technical Losses (NTLs) refer to losses that occur independently of technical losses in power systems. NTLs are caused by actions external to the power system. NTLs relate to the customer management process and can include a number of means of consciously defrauding the utility concerned. More specifically, NTLs mainly relate to power theft[1]. The scarcity and unpredictable supply of electricity are in part results of widespread theft, as well as lack of adequate generating capacity. Power theft leads to lost government revenues, reducing the ability of the public sector to pay for the maintenance of existing facilities or to invest in new power generation.

Non technical losses (NTL) during transmission of electrical energy are a main problem in developing countries. It is so complicated for the utility companies to detect and fight the people responsible for the theft. Electricity theft forms a main chunk of non technical losses (NTL). These losses affect the quality of supply, increase load on the generating station, and affect tariff forced on actual consumers. Even after taking numbers of measure for closing the doors of theft detection and tampering such as introducing the electronic meter, the cost of electricity is still going up.

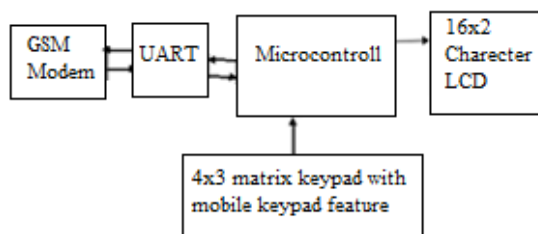
The Present system of meter reading is a boring and an expensive one as a number of meter readers have to go and take the reading manually from the consumer's house to issue energy bill, which will later be, entered into the software to computerize the billing and payment system. Moreover, the opportunity of tampering, the reading details and not exposure the theft attempts are extremely common. Another key problem with the existing system is that if one electronic energy meter breaks down, the office will come to know only after two or even take more months and to repair or replace the damaged meter, depending on the duty of the person who is going to take the meter reading of consumers.

In this project an attempt is made to develop a system, in which energy meter works as a prepaid energy meter and detect illegal electricity consumption, by GSM based energy meter. This helps in theft detection, billing and management system. The energy delivered by the distribution transformer will be measured by GSM based energy meter[2], and it will send this measured value to central station via GSM after a specified interval. To detect whether any kind of illegal load is connected to distribution transformer

energy consumed by all consumers in specified interval will sum up and compared with energy delivered by the transformer in that specified interval. Any difference found between both values will indicate energy theft in that particular interval.

III.METHODOLOGY

Substation unit:

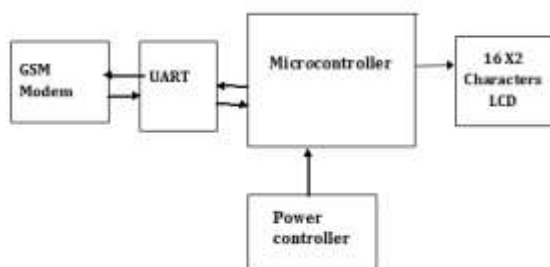


At every substation we should have Main Unit. Main unit is GSM technology based board. Below are the features of this unit.

- This unit can send the prepaid energy units to specific consumer unit.
- This unit also gets the update from consumer units when it consumes the electric unit.
- This unit detects if the one of the consumer unit is not working or it is disconnected from the power.
- This device will display the particular customer details on LCD of which customer unit is not working or disconnected from the unit.
- Detects if any power theft occurs and display on LCD.

Consumer Unit:

At every distribution place (Transformer) we need to install the GSM enabled energy meter. The GSM enabled energy meter unit has the ability to cut the power from line from where it is consuming the more then power purchased in advance. And also it detects if power is not used via energy meter. As soon distribution unit detects the power is not connected and measured from energy meter it will inform to the main unit or electric board unit. This unit ability read the energy unit from unit.



This is a very good microcontroller based application. This unit will accept the number of units recharged by the concerned department person, counts the number of units consumed by the customer and as soon as the customer exceeds the recharged amount, it will disconnect the power

supply to the customer until the next recharge. Whenever the number of units in microcontroller becomes zero microcontrollers Sends a signal to “Contact Maker /Breaker circuit” which is nothing but the relay and this relay cuts off the power supply to the consumer until next recharge.

IV.LOSSES IN POWER SYSTEM

India faces endemic electrical energy and peaking shortages. These shortages have had a very detrimental effect on the overall economic growth of the country. Generation, transmission and distribution of electrical energy involve many operational losses. Total distribution system losses equals technical losses plus non-technical losses. The term “distribution losses” refers to the difference between the amount of energy delivered to the distribution system and the amount of energy customers is billed. The reasons cited for such high losses are; lack of adequate T & D capacity, too many transformation stages, improper load distribution and extensive rural electrification etc. Simply Losses could be defined as the difference between the metered units of electricity entering the distribution network and those leaving the network paid for through electricity accounts, whether estimated or metered, in a well defined period of time.

Technical losses are regarded as the electrical system losses which are caused by network impedance, current flows and auxiliary supplies. The sources of technical losses may be directly driven by network investment or by network operation. Non-technical losses arise from several areas including theft, un-billed accounts, and estimated customer accounts, errors due to the approximation of consumption by un-metered supplies and metering errors. In a recent study carried by SBI capital markets, the Transmission and Distribution losses have been estimated as 58%.The Transmission and Distribution losses in the advanced Countries of the world ranging from 4-12%.

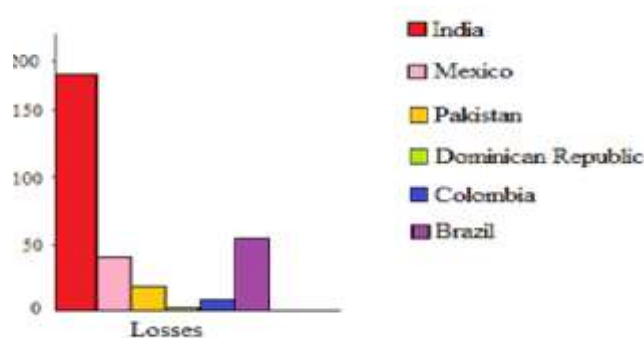


Fig :1 Overall transmission and distribution losses

The Transmission and Distribution losses in India are not comparable with advanced countries as the system operating conditions are different in different countries[5]. Figure (1) shows the overall transmission and distribution losses.

A).Analysis of losses in power system

Technical Losses: Technical losses in power system are caused by the physical properties of the components of the power system. The most obvious example is the power dissipated in transmission lines and transformers due to internal electrical resistance. Technical losses are naturally occurring losses and consist mainly of power dissipation in electrical system component such as transmission lines, power transformers, measurement system, etc. Technical losses are possible to compute and control, provided the power system in question consists of known quantities of loads[3]. Technical losses occur during transmission and distribution and involve substation, transformer, and line related losses. These include resistive losses of the primary feeders, the distribution transformer losses, resistive losses in secondary network, resistive losses in service drops and losses in kWh meter. Losses are inherent to the distribution of electricity and cannot be eliminated.

B).Non-Technical Losses: Non-Technical losses are caused by actions external to the power system or they are caused by loads and condition that the technical losses computation failed to take into account. Non- Technical losses are more difficult to measure because these losses are often unaccounted for by the system operators and thus have no recorded information. Non -technical losses (NTL), on the other hand, occur as a result of theft, metering inaccuracies and unmetered energy. NTLs, by contrast, relate mainly to power theft in one form or another. Theft of power is energy delivered to customers that is not measured by the energy meter for the customer. This can happen as a result of meter tampering or by bypassing the meter. Losses due to metering inaccuracies are defined as the difference between the amount of energy actually delivered through the meters and the amount registered by the meters.



Fig:2 Illegally Tapping into the Power Line

The most visible indication of energy theft occurs when users illegally tap into the public supply as shown in figure(2). Power theft is defined as power is sent out but not paid for and it can also be defined as, using electricity from the utility company without a contract or valid obligation to

alter its measurement[4]. Power theft is neither a known and noticeable problem. power use is metered down to the individual household. Throughout the less developed world, users without access to electricity tap illegally into existing lines. Unsanctioned connections to the grid are probably the numerically most frequent way that electricity is stolen.

Power theft is the largest source of energy loss. This instead stems from the meter fraud and unmetered use. One way that meter fraud occurs is when the public utility meter reader is bribed to report an inaccurate number, thereby effectively providing unpaid power to a consumer. Meter tampering is a second type of meter fraud that allows users more power than is paid for. Standard electro-mechanical meters use a slowly spinning disk to record the amount of power that is being drawn. The rotation of the disks can be slowed using magnets or by impeding the disk mechanism with foreign objects. Disk rotation can be stopped completely by inserting small rocks, gum, or other obstructions.

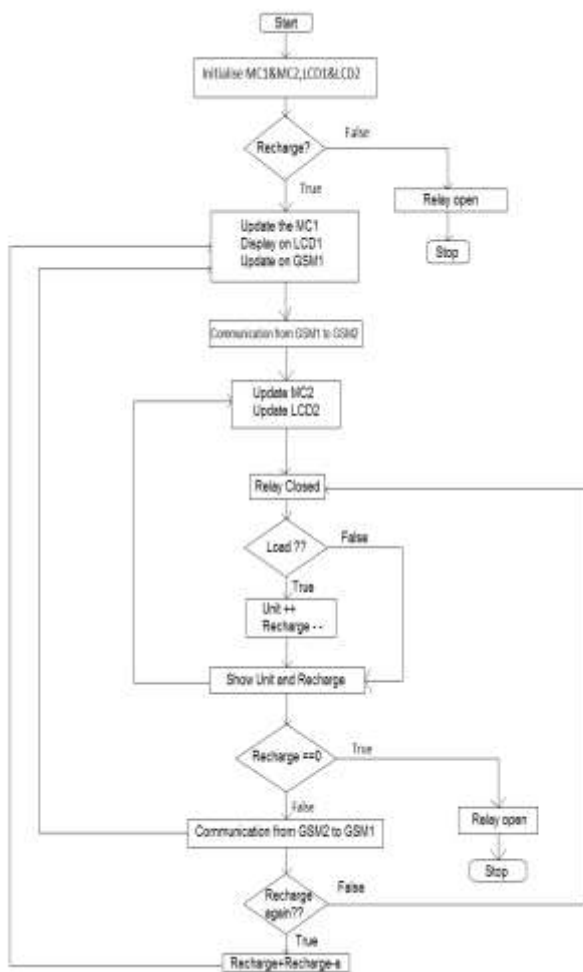
In unpaid bills some consumer do not pay what they owe for electricity. Some analysts may not regard non-payment as “theft”. However, when it becomes institutionalized and people and Organizations expect that they can get away with it, unpaid bills should fall into the “theft” category. power theft can also be done by grounding the neutral wire, Hitting the meter to damage the rotating coil, interchanging input output connection. Power theft occurs mainly during election time due to criminal status of state legislators.

C).Factors that influence illegal consumers

There are many factors that encourage people to steal electricity. Of which socio-economic factors influences people to a great extent in stealing electricity. A common notion in many people is that, it is dishonest to steal something from their neighbour but not from the state or public owned utility company. In addition, other factors that influence illegal consumers are[5]:

- Higher energy prices deject consumers from buying electricity. Rich and highly educated communities also steal electricity to escape from huge utility bills.
- Growing unemployment rate show severe effect on the customer’s economic situation.
- Lower illiteracy rate in under developed communities has greater impact on illegal consumers, as they might not be aware of the issues, laws and offenses related to the theft.
- Countries with weak enforcement of law against electricity theft have recorded high proportion of theft.
- Corrupt political leaders and employees of the Utility company are responsible for billing irregularities.

D). Flow chart of efficient energy distribution



V.RESULT



Fig3: Substation and Consumer Unit

Fig(3) shows substation unit and consumer unit for efficient energy distribution with power loss detection



Fig4 :SMS Message Read

Fig(4) shows SMS Message read, CMGR: Read SMS Message ,this command is used to send mobile number of recipient to the GSM Modem.



Fig5: Number of unit Recharged in Substation Unit

Fig(5) shows number of units recharged in substation unit Whenever consumer wants to use power they need to recharge their prepaid energy meter. Recharge amount will be given to microcontroller via keypad in substation unit, which is displayed on 16x2 LCD display as in figure. The format to recharge is R1<space>unit to be recharged.



Fig 6:Recharged amount received in Customer Unit

Fig(6) shows recharge amount received in the customer unit will be displayed on 16x2 LCD display present in customer unit



Fig 7:Relay closed and consumer gets power

Fig(7) shows relay closed , after recharge the relay present in the consumer unit will be closed and power will be provided to customer.



Fig 10:Display of power theft after consuming certain units

Fig(10) shows power theft ,energy consumed by customer will be sum up and will be compared with energy delivered by the substation unit. Any difference found between both the values(Substation unit will be having some particular value (6) if the difference exceeds 6) theft is detected .



Fig 8:Number of unit left in Consumer Unit

Fig(8) shows number of unit left in consumer unit, according to the consumption of power recharge unit will be decremented and will be displayed on LCD



Fig 11:Display of power theft from particular distribution unit

Fig(11)shows ,power theft on particular distribution unit will be displayed on LCD present in substation unit.



Fig 9:Unit consumed updated in Substation Unit

Fig.(9) shows unit consumed in substation unit, after consumption of one unit customer unit sends a message to the substation unit and it also get updated and LCD displays the unit consumed. For each unit consumed consumer unit updates that in substation unit



Fig 12:If recharged again

Fig(12) shows recharged unit, if we recharge again in the middle the recharged unit will be get added to the balance unit.

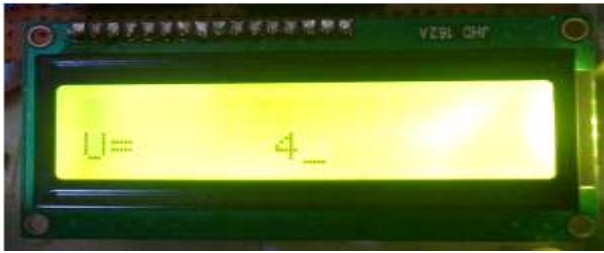


Fig 13: Number of units available in consumer unit

Fig(13) shows available unit, the added value will get displayed in the LCD of the consumer unit.



Fig 14: Recharged amount becomes zero

Fig(14) shows when recharge unit becomes zero LCD display the message in customer unit.



Fig 15: When recharged amount becomes zero

Fig(15) shows when recharged unit becomes zero the power supply will be disconnected and it is displayed on the LCD in consumer unit.



Fig 16: Relay open and no power to consumer detect illegal electricity consumption, by GSM based

Fig(16) shows when recharge unit becomes zero the relay gets open and power will be disconnected.

VI. ADVANTAGES

After implementing this distribution system it will have some advantages over the present distribution system. Some of them are given below.

- **Eliminate Chances of Meter Tampering:** This system uses GSM based energy meter which removes any chance of mechanical tampering.
- **Decrease Meter Reading Costs:** Since the load of travelling to read the energy meter reading are removed by using GSM technology, the costs are considerably reduced.
- **Quick Determination of Account Queries:** As there can be no meter reading record errors, consumer objections will be less. On-line determination of account queries will be available to resolve consumer complaints.
- **Enhanced Consumer Care Facilities:** The consumer can get full details of his energy consumption as a database for every consumer is being conserved.
- **Better Energy Management:** Since the load arrangement of a particular area and consumers will be available through the Database, it will accelerate load shedding in the case of the energy shortfall. The system will enable relaxed energy audits.
- **Decrease in Power Theft:** Because of the actual time theft detection system, power thefts can be extremely decreased or removed.
- **In this proposed system all power information can be collected at a centralized single point.** Using the same transmitter permits the line voltage, line current and other measurements at various points to be examined by the centralized station. This data can be used in load shedding and fault analysis. The fault position can easily find out using this type of arrangement and fault clearance time can be considerably reduced, thereby increasing system reliability.

VII. CONCLUSION

This system defines electricity theft in social, economical, regional, political, infrastructural, literacy, criminal and corruption points of view. This illustrates various cases, issues and setbacks in the design, development, deployment, operation, and maintenance of electricity theft controlling devices. In addition, various factors that influence people to steal electricity are discussed. This also illustrates the effect of NTL on quality of supply, burden on the generating station and tariff imposed on genuine customer. The meter reading job can be completed at the management department of residence area by using this system. Meantime, the energy resources Management divisions can monitor the utilization of power in order to advance the utility of power. All possibilities of electricity theft will be eliminated.

In this project an attempt is made to develop a system, in which energy meter works as a prepaid energy meter and detect illegal electricity consumption, by GSM based

energy meter. At this point of technological development the problem of illegal usage of electricity can be solved electronically without any human control. The consumers and the suppliers can be benefited by using this system and it is of great advantage for the electricity department as this unit can be utilized effectively for preventing power theft, non-payment of electricity bills etc. The whole process of billing can be centralized, Cost of manpower for billing / collection is reduced

VIII.FUTURE WORK

In future the recharging system can be improved by online recharging over the internet online recharging have following advantages:-

- There are multiple options available for online recharge over the internet. Consumers can select any mode of payment (Net banking/Credit Card/Debit Card) as per their convenience.
- Customer can enjoy the benefit of doing anytime and anywhere online recharge.
- Online recharge facility offer complete freedom to consumer to do instant recharge of any desire amount as per their convenience.
- Online recharge enables stress free ,user friendly and convenient option of refilling of prepaid account for doing online recharge over the internet.

This can also be enhanced by using GPRS in place of GSM . In order to remedy the shortcomings of GSM, we can use GPRS or General Packet Radio Service. GPRS is only an extension to the older GSM technology, it is more cost effective. GPRS also gave mobile phones the ability to surf the internet at dial-up speeds through WAP enabled sites. It allowed subscribers to send videos, pictures, or sound clips to each other just like text messages.

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