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Power Theft Identification Using Smart Grid Technology

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***Abstract*—**Paper deals with identification of online theft that prevails on distribution line. Here used smart grid technology to identify theft online. Smart grid means an effective two-way communication between sending and receiving end. Here used microcontroller based system to detect power theft .Taking consideration grid & resident designing intelligent program which is main concept of paper.

***Keywords*:** Smart grid, Microcontroller

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I. INTRODUCTION

The demand for electrical energy is ever increasing. Today over 20% power losses as transmission loss is 4-6% and distribution loss (overload or theft) is 15-18%. The electrical power deficit is 18%.Clearly reduction in distribution losses can reduce this deficit significantly. It is possible to bring down overload losses up-to 6-8%.With the help of newer technology option including information technology in electrical power distribution sector which will enable better monitor and control.

When power consumed becomes more than sanctioned limit, then use is increased. The distribution system cannot identify reason behind increase in consumption, that whether it is due to increase in consumption or power is being theft. If power theft is online on pole create problems to distribution line and at last distribution station.

Smart grids are an integrated communication and power system infrastructure which allows for robust to a communication, advance sensor and distributed computers to improve the efficiency, reliability and safety of power delivery and use. Smart grid technology can represented an opportunity for developing countries to leapfrog in growth of their power sector. Smart grid in energy transmission means use of feedback from the consumption end.

Electrical power systems vary in configuration from country to country depending on the state of the respective power sources and loads. The practice of using medium-voltage (11- to-33kV) and low-voltage (100-to-400V) power distribution lines as high-speed PLC communication means and optical networks as backbone networks is commonplace.

Electric utilities lose large amounts of money each year due to power theft by electricity consumers. Electricity power theft can be defined as a dishonest or illegal use of electricity equipment or service with the intention to avoid billing charge. It is difficult to distinguish between honest and fraudulent customers. Realistically, electric utilities will never be able to eliminate fraud. It is possible, however, to take measures to detect, prevent and reduce fraud [1]. Investigations are undertaken by electric utilities to assess the impact of technical losses in generation, transmission and distribution networks [2-3].

In [4] by ZHOU Wei, electricity-stealing prevention became a big problem to the electricity board. Based on the kind of electricity-stealing and actual demand of prevention of stealing electricity, realizes the behavior of electricity-stealing with remote monitoring. In [5] Amin S. Mahmoud deals with automatic meter reading and theft control system in energy meter. This model reduces the manual manipulation work and theft control.

John chambers, CEO of communication Giant Cisco, had identified smart grids to be a bigger opportunity than the internet itself! Not surprisingly considering that smart grid will pervade the whole world. It is possible to see a world where every significant energy consuming device will have an IP address.

TATA BP SOLAR Company is the one who has initiated the use of smart grid concept for energy transmission in India. A TATA BP SOLAR spokesman presenting an introduction to smart grids at recent IEEE conference in Mysore rightly called it a digital upgrade to current power distribution and long distance transmission system.

II. SYSTEM MODEL

The power theft monitoring is an important research in electric power system and electricity stealing prevention became a big problem to the electricity.

Electricity stealing is a long term problem; however each power supply department has huge investments of manpower and material, the phenomenon of defending stealing electricity has increased and not abated and the method of electricity stealing is continuously improved.

The behavior of electricity stealing not only makes the power industry suffering huge financial losses but also threatens the main power supply security and reliability.

Proposed system designed considering two conditions as follows:

Condition I- When actual load is more than sanctioned load distribution system recognize that power is theft or overload exists.

Condition II- When actual load is less and at that time if power is theft then it is difficult to distribution system to recognize power theft.

Hence here system is implemented which find out power theft in under load and overload condition.

Block Diagram

Fig.1 represent block diagram of current power distribution system. In fig.1 distribution pole transmits power using transmission line to the house. Power being theft from transmission line situated between distribution pole and house.

The metering of electric energy meter is mainly according to the relationship with voltage, electric current and power factor angle.

According to the analysis, there are many electricity stealing trick about electric energy meter, the methods could be approximately divided into under voltage, under current, phase shifted and difference expansion to their principle.

Some common tricks:

- Un-hooking technology will electricity stealing. Secretly destroy the lead sealing of electric energy meter, open voltage hook of terminal in junction box and make no electric current through all using quantity of electricity steal.
- One fire-one ground technology. Take the ground. Wire as naught line, generally take the water pipe or cal duct as ground wire, the risk is bigger (most dangerous).

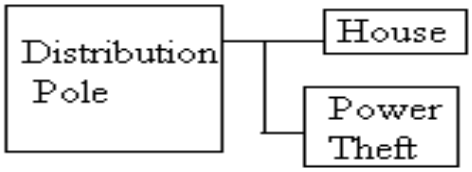

Fig.1 Current Distribution System

- Violated wire connection.
- Loop of short electric current, which makes the electric energy meter shift slow.
- Cross meter to connect wire, added bypass to reel across electric energy meter, which makes no or less electric current through, stall or rear measurement.
- Exchange fire wire and zero wire.
- Reverse the in and out of fire.
- Make electric meter reverse by using external supply. Adopt hand generator with voltage and current output or inverter power supply to join into the electric meter, make the electric energy meter reverse rapidly (rarely used technique and dangerous)

Fig. 2 is block diagram of power theft identifier using smart grid. Home side consists of digital reading of energy transmission. In this the pulses are converted into units. 10 pulses are considered as 1 unit, ie. When 10 pulses are counted it is assume as 1 unit. This data is send to grid, as basic theory of smart grid is two-way communication between all the residences to grid for accurate calculation and to reduce losses like power theft.

First get data of resident say it is consuming 8 units, this data is stored at smart hardware microcontroller, now if any power is theft, smart grid side input reading is increased say 12, but resident reading is 8, so 4 unit is being theft, this is possible to know using two-way communication which is basic of smart grid technology. In fig.2 Alarm kit is used to specify condition has elapsed. The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications.

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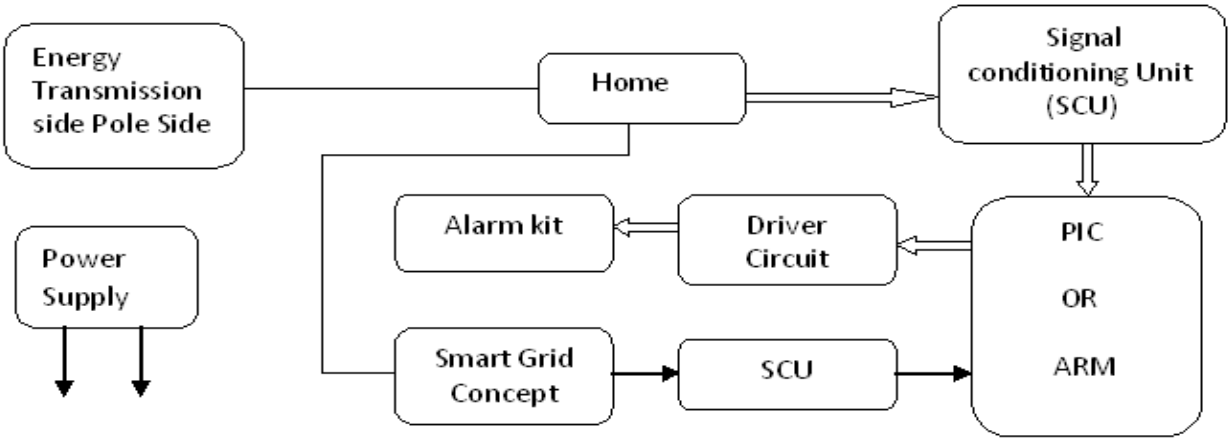

Fig. 2: Block diagram of Power theft identifier using smart grid

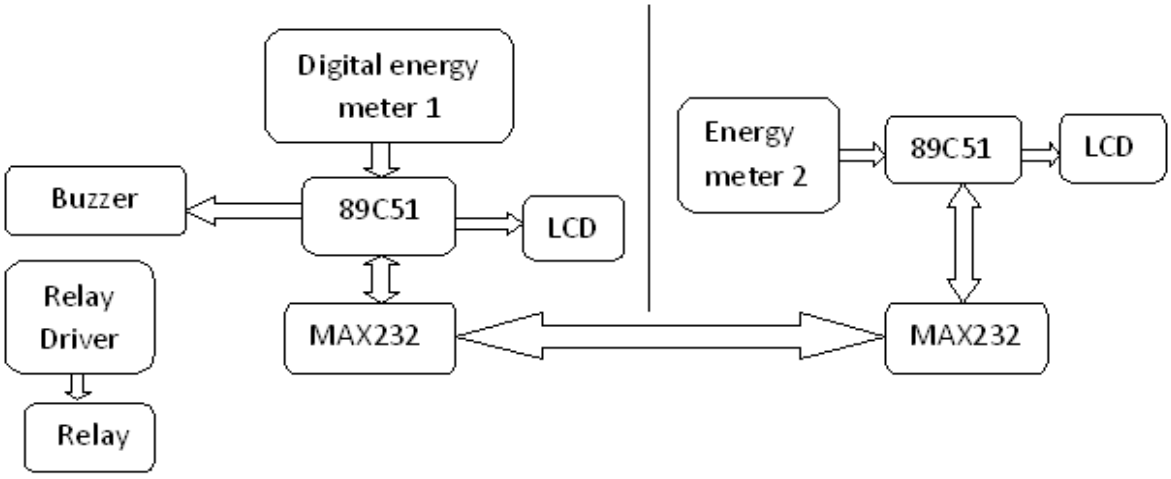

Fig 3: Actual working diagram of Power theft identification.

Fig.3 shows actual working diagram of power theft identification. Calculate energy send by distribution system on digital energy meter 1 & display the on top of display. Now on second side on residential side calculate consume energy and display on LCD of side 2, send this data to side 1 microcontroller through smart grid technology and display energy at address on side 1. Differentiate energy by subtracting side1 – side 2 energies & if it is greater than zero o/p relay & buzzer must be activated on side 1 i.e on pole side. If difference is zero then no activation is taken.

Fig. 4 shows home side connection of energy meter. In this section, the disk revolution of the rotating non magnetic Disk of electromagnetic energy meter sensed by optocoupler slot sensor. This slot sensor employed an infrared light source and photo detector. For each revolution of disc sensing unit has to produce pulse which are shaped and given as control signal to analog CMOS switch. The analog switch employed in circuit is IC 4066 which is quad bilateral switch indented for transmission of analog or digital signal. It offers a very low on state resistance & bypass carrier wave generated by phase
locked loop to the next part of circuit .here PLL acts as carrier signal generator , which produce carrier signal of high frequency of band 300khz .the IC 567, which has an internal voltage controlled oscillator, is used. The output carrier signal is passed on to CMOS switch. From there, the modulated high frequency carrier signal is passed through a buffer circuit in order to have sufficient drive current and for isolation purpose.

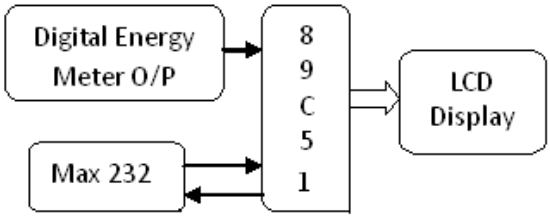

Fig 4: Home side connection of energy Meter (transmitter)

Fig. 5 shows pole side connection of energy meter. The FM signals that are transmitted from the transmitter section travel through the power line and reaches the receiving section, where these signals are tapped individually. The basic component intermediate frequency transformer, clipper, Phase locked loop.

The IFT used in this section is of the same type as that of transmitter. The frequency range is between 100 to 300 KHz as that used in radios. The IFT is externally tuned to same value as that of transmitter. So that only signals of tuned value enter into receiver circuit. The signal is sent to simple diode clipper which clips off it value of about 0.7v. Two diodes are connected back to back so that clipping is done at both positive and negative levels. This clipped signal is then given us and input signal of PLL which is a closed loop feedback system. Its function is to lock the output frequency and phase to the frequency and face of an input signal and it acts as tone detector.

The output of PLL is low whenever it goes into locked state. This low state will open circuit a transistor where by a pulse of +8 V is obtained as its output. Three conditions together form the basic operation of project. There are transmission and distribution losses while transmitting power, so three units are allowed for transmission losses. After evicting the allowance made for losses the following three conditions are executed.

CONDITION 1:

When there is no theft, energy consumed at residential point should be equal to energy transmitted from the pole end. Since both the energies are equal no theft is recognized and the buzzer dose not beeps. Under this condition the normal operation can be observed and it continues until there is theft at resident or line.

CONDITION 2:

When there is consumption at resident and theft is online, that is the power is being theft from the transmission line, The buzzer beeps indicating theft. In this condition power sent gradually increases as the theft power increases. After receiving the consumed unit at the resident the pole side controller starts its computation. As the send units are more than the units consumed the difference between the two units is the theft power. After noticing the difference the relay is actuated which turns on the buzzer. Hence theft can identify.

CONDITION 3:

When there is no consumption at the resident and theft is online at that time the residential consumption notified will be zero units, but send unit will be positive because of the online theft this difference will actuate the relay and buzzer to indicate theft. Besides the above three mentioned reasons, if there is a theft at the resident by tampering the meters and employing techniques which counts less readings, such illegal activities can also detected easily. At present 10 or there about connections are provided from a single distribution pole and every distribution pole has a typical code provided by Distribution Company. For implementation of smart grid technology every residential digital meter should be provided with code as an address. A small micro computer is to be installed at every distribution pole. The micro computer keeps the track of the sent and consumed units of each and every house. As here using MAX232 for communication, 89C51 is able to record and compute the consumptions of many meters at a time. Hence it is succeeds in keeping the track of units sent to and consumed by every house. If the number of connections increased from a pole then replace MAX232 by MAX245for greater speed and accuracy. Whenever theft is identified relay is actuated. Here used GSM model for communication purpose. Through GSM technology the distribution code is sent to substation. The operator can immediately attend the pole and through the micro-computer one can get meter code from where the power has been theft. Doing so the theft can immediately stopped and person responsible for theft can be caught for guilty.

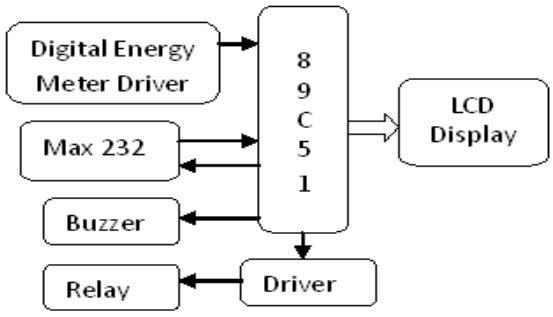

Fig 5: Pole side connection of energy meter (Receiver)

III. CONCLUSION

The proposed system can determine illegal power theft via distribution line. In financial year 2009-10 about 45000 corer losses occur due to power theft. Results proved that if smart grid system is used illegal power theft might be detected. Once this proposed detection systems are tried in real power lines, the distribution losses in India can be reduced effectively.

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