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Wireless Power Theft Detection

Vrushali V.Jadhav **Soniya S.Patil** **Rupali V.Rane** **Swati R.Wadje**

***Abstract*—while technology in on the raising slopes, we should also note the increasing immoral activities. With a technical view, Power Theft is a non –ignorable crime that is highly prevent, and at the same time it directly affected the economy of a nation.Electricity theft is a social evil, so it has to be completely eliminated. Power consumption and losses have to be closely monitored so that the generated power is utilized in a most efficient manner.**

The system prevents the illegal usage of electricity. 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 then earlier, in highly populated country such as INDIA.

***Key Words* – Wireless, Power, Automation, Theft Detection**

I. INTRODUCTION

Generation, transmission and distribution of electrical energy involve many operational losses. Whereas, losses implicated in generation can be technically defined, but T&D losses cannot be precisely quantified with the sending end information. This illustrates the involvement of non-technical parameters in T&D of electricity. Overall technical losses occur naturally and are caused because of power dissipation in transmission lines, transformers, and other power system components. Technical losses in T&D are computed with the information about total load and the total energy billed [1].NTL cannot be precisely computed, but can be estimated from the difference between the total energy supplied to the customers and the total energy billed.

NTL are caused by the factors external to the power system. In many developing countries, NTL are a serious concern for utility companies as they account to about 10 to 40% of their total generation capacity. Data regarding NTL is uncertain and it is very difficult to analyze theft in terms of actions that cause these losses. Electricity theft forms a major chunk of the NTL. Electricity theft includes bypassing, tampering with the energy meter and other physical methods to evade payment [2]. Illegal tapping of electricity from the feeder and tampering with the meter arethe most identified and accounted ways of theft. Electricitytheft can also be defined as, using electricity from the utilitycompany without a contract or valid obligation to alter its measurement is called electricity theft [3].

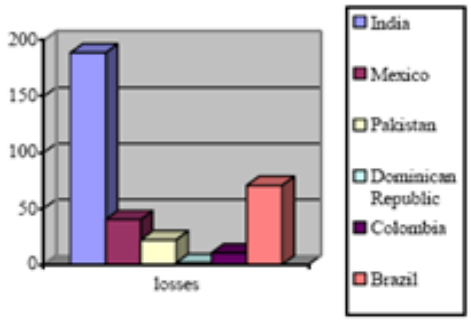

Fig 1: Over all T&D

II. WIRELESS AUTOMATION

Embedded systems - a combination of software, hardware and additionalmechanical parts that together forms a component of a larger system, to perform a specific function. It's a technology, characterized by high reliability, restricted memory footprint and real time operation associated with a narrowly defined group of functions. Automation has made the art of living comfortable and easy. "Technology have taken the world by storm performance ratings and exceptionally value for money prices" .Our paper throws light on automated monitoring of theft identification, which is an application of embedded controllers. '*Electricity theft'*as covered in this paper.Encompasses areas itemize known as'Illegal usesor by bypassing itcompletely.

III. 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 neighbor but not from the state or public owned utility company. In addition, other factors that influence illegal consumers are:

• Higher energy prices deject consumers from buyingelectricity. Table II illustrates energy prices in differentcountries. In light of this, rich and highly educated communities also steal electricity to escape from hugeutility bills.

• Growing unemployment rate show severe effect on thecustomer'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.

• Weak economic situation in many countries has implied its effect directly on common man.

• In view of socio economic conditions of the customer, electricity theft is proportional to the tariff of electricityutilization.

• Countries with weak enforcement of law againstelectricity theft have recorded high proportion of theft.

• Corrupt political leaders and employees of the utilitycompany are responsible for billing irregularities.

Table 1. Tariff charged for electricity consumption in Several countries.

Country	Tariff in US $ per 1 kWh	Information as of year
Australia	7.11 [14]	2006-07
Canada	6.18 [14]	2006-07
Denmark	42.89 [14]	2006-07
Finland	6.95 [14]	2006-07
Germany	30.66 [15]	2009
Italy	37.23 [15]	2009
Malaysia	7.42 [16]	2007
South Africa	10.15 [17]	2008-09
Sweden	27.34 [15]	2009
UK	18.59 [15]	2009
USA	9.28 [14]	2007

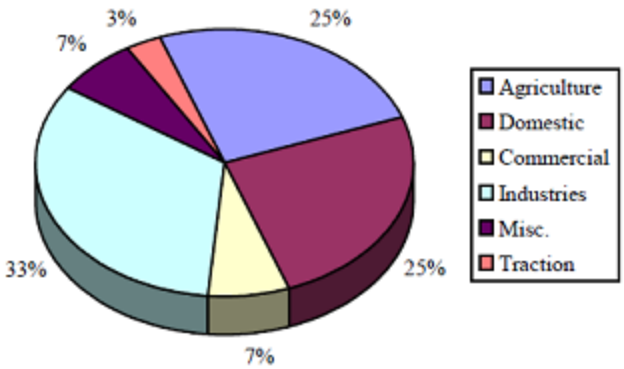

Fig 2.Electricity consumption in different sectors in India

IV. Effects Of Electricity Theft

Negative effects of electricity theft are severe and dangerous. Primarily, electricity theft affects the utility company and then its customers. In addition, electricity theft overloads the generation unit. In energy market, utility companies expect their money back from the customers for the electricity supplied, most of which is lost by them due to the NTL (Non technical losses).Electricity theft is a serious concern for utility companies as they are under threat of survival because of these incurring economic losses. It is evident that some utility companies in developing countries are losing about 10 to 30 percent of their total revenue, which shows that they could not invest on measures to reduce the electricity theft. These economic losses affect the utility company's interest in development of the devices in view of improving the quality of supply or for electrification process.

V.Methods Of Theft

Methods used to commit theft fall into the Following broad categories:

A. Connection of supply without a meter
Connection of supply without a meter following disconnection for nonpayment or by "squatters" occupying empty properties.

B. Bypassing the meter with a cable
It coveted into the supply side of the metering installation (i.e. the meter terminals, the metering cables, the cut-out or the service cable).

C. Interfering with the meter to slow or stop
The disc, including use of electrical devices which stop the meter or cause it to reverse (so-called 'black boxes).

D. Interfering with the timing control

Equipment used for two rate tariffs to obtain a cheaper rate. Methods (C) and (D) usually involve removal of official (certification) seals and/or company seals.

VI.Identification Of Theft

A. Financial Rewards
Utility companies encourage consumers to report electricity theft, sometimes offering big rewards for information leading to conviction of anyone stealing electricity. Unfortunately, most cases are never identified in the apartment industry due to lack of timely information.

B. Periodic Checks
Electricity theft frequently takes place after service has been disconnected. Some utility companies periodically check disconnected meters if the customer has not contacted them to reconnect service. This labor-intensive, manual process has little chance of success given that the apartment industry averages 70% turnover of tenants annually.

C. Meter Readers
Utility meter readers typically suspect that electricity theft is taking place when they find a broken meter tag or other signs of tampering. But as more utility companies outsource the meter reading function to third parties, training meter readers to detect theft is becoming more difficult and less efficient. In addition, third party meter readers do not read disconnected meters.

VII.Analysis of Losses in Power Systems

Losses incurred in electrical power systems have two components:

• Technical losses and

• Non-technical losses (Commercial losses)

Technical Losses-Technical losses will always arise as the physics of electricity transport means that, no power systemcan be perfect in its delivery of energy to the end customer. The instantaneous power loss. Ploss (t) in a transmission line can be expressed as:

P (t)P (t) P (t) loss source load = − 1

Where Psource (t) is the instantaneous power that the source injects into the transmission line and Pload (t) is the instantaneous power consumed by theLoad at the other end of the Non-Technical Losses (Commercial Losses)-Losses incurred by equipment breakdown are quite rare. These include losses from equipment struck by lightning, equipment damaged by time and neglect. Most power companies do not allow equipment to breakdown in such a way and virtually all companies maintain some form of maintenance policies. Other probable causes of commercial losses are:

- Non-payment of bills by customers
- Errors in technical losses computation
- Errors in accounting and record keeping that distort technical information.
- Inaccurate or missing inventories of data on customers.

VIII. Previous Power Theft Detection Dork

Bandim C.J. et al. proposed utilization of a central observer meter at secondary terminals of distribution transformer. Vigilant energy metering system (VEMS) is an advanced energy metering system that can fight against electricity theft

Nagi J. et al. proposed a novel approach of using geneticalgorithm- support vector machines (GA-SVM) in detecting electricity theft.

A. Modern detecting tools

There are many modern tools that assist in power theft identification. Some of them are:-

- Tamper proof seals and labels.
- Meter leaders.
- Tamper resistant screws / locks. AC Check meter and remote meter readers.
- Tamper alarms and sensors.

This paper undertakes the Check meter and remote meter readers for power theft identification. In our case, the consumption recurred by the checkmeter is compared with the revenue meters consumption. If there is a difference, then it indicates either there is a theft or revenue meter malfunction. The check meter can also be used to monitor the energy used on the secondary of a distribution transformer serving several customers and compared to the sum of all the meter usage. Besides spotting out the line where power theft is suspected to occur, it also detects the amount of energy stolen. Compact size, lightweight for quick and high accuracy make the system more effective. Power theft identification, in this paper, is done by converting the disc revolutions of each consumer's energy meter and distribution transformer into pulses. These pulses are frequency division multiplexed and transmitted through power line. These signals are individually picked and counted at the receiver end. If the difference of the sum of the consumer's readings and that of distribution transformer exceeds the preset value, which is set by considering transmission loss, the power theft is said to occur.

B. Detection and estimation of theft

Researchers have proposed and developed several techniques for detection and estimation of electricity theft. Of which, a few methods are illustrated in this section. Total phase currents at all the distribution transformers and feeder lines over a period of time are collected. These two values of the current are compared to estimate the total electricity being lost by the utility company in the form of theft. Bandim C.J. et al. proposed utilization of a central observer meter at secondary terminals of distribution transformer. Value of energy read by the central observer meter is compared with the sum of energy consumption values read by all energy meters in range. These two values of the current are compared to estimate the total electricity that is being consumed illegally. Vigilant energy metering system (VEMS) is an advanced energy metering system that can fight against electricity theft. It has the ability to collect, transfer and process data between other energy meters, local station and base station. It also identifies probable locations of theft and helps the utility companies to control theft. A remote billing system can also be developed modifying this model.

Illegal consumption of electricity can be detected using a remote check meter based on the amount of losses and the time stamp of the check meter. This method is implementedbefore inspecting the illegal consumers personally by the vigilance officials, based on the data at proper frequency of the consumer measurements.

IX.IMPLEMENTATION OF SYSTEM

We can detect power theft wirelessly.Illegal usage of electricity can be solved electronically without any human control, using Radio frequency (RF) Technology.Electric Power is transforming from transmitter to the receiver at that time if load is apply in between transmission of power and if difference is find between the transforming and receiving power then there is stealing of power from unauthorized person. i.e. Whenever energy is passing from supplier to the receiver at that time if the total amount of power is not received by the receiver then there is possibility of thefting of energy.

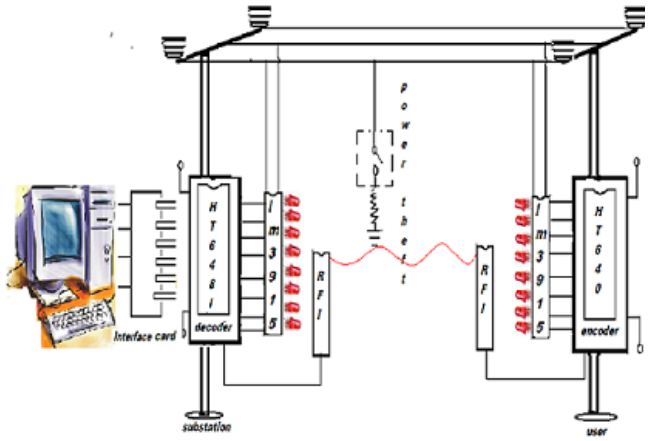

Fig 3: Block diagram of power theft detection system

A.Encoder

A digital circuit that produces a binary output code depending on which of its input is activated [2].The HT640 includes the following features: Scan, quick access channels, Battery life

Indicator Large LCD with back light.

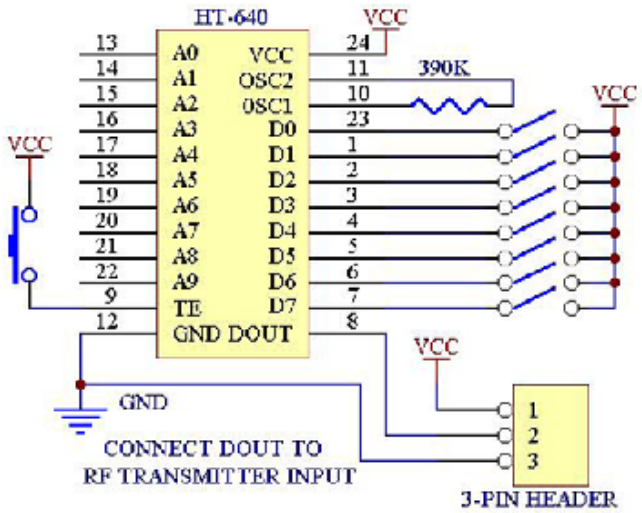

Fig 4: Circuit diagram of encoder HT640

B .Decoder

A digital circuit that converts an input binary code into a single numeric out-put.[3]Decoder HT648l decodes the incoming signals from encoder and send it to theserver for comparing the outgoing and incoming signal for identifying power theft. Power Theft Detection Using RF

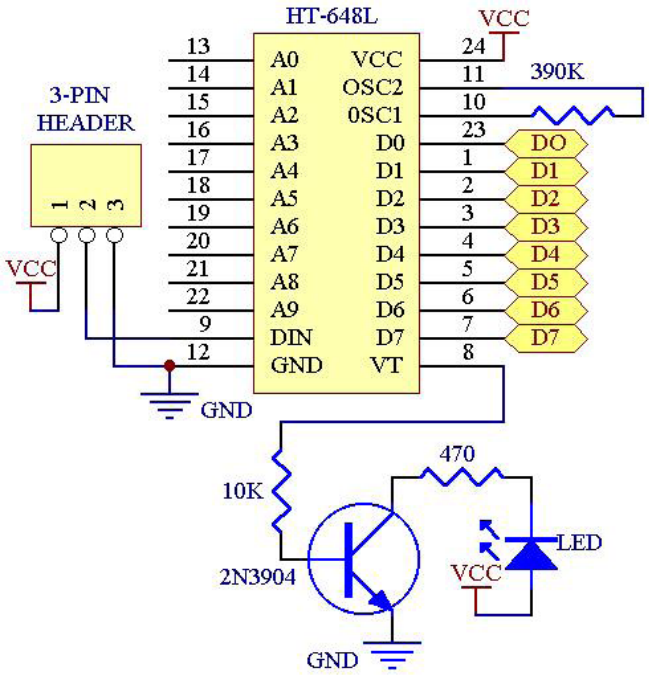

Fig 5: Circuit diagram of decoder HT648l

C.LM3915

The LM3915 is a monolithic integrated circuit that senses analog voltage levels and drives ten LEDs, LCDs or vacuum fluorescent displays. One pin changes the display from a bar graph toa moving dot display. LED current drive is regulated and programmable, eliminating the need for current limiting resistors. The whole display system can operate from a singlesupply as low as 3V or as high as 25V.The IC contains an adjustable voltage reference and an accurate ten-step voltage divider. The high-impedance input buffer accepts signals down to ground and up to within 1.5V of the positive supply. Further, it needs no protection against inputs of ±35V. The LM3915's 3 dB/step display is suited for signals withwide dynamic range, such as audio level, power, light intensity or vibration. Audio applications include average or speak level indicators, power meters and RF signal strengthmeters. Replacing conventional meters with an LED bargraph results in a faster responding, more rugged displaywith high visibility that retains the ease of interpretation of ananalog display. The LM3915 is extremely easy to apply. LED brightness is easily controlled with a single pot. The LM3915 is very versatile. The outputs can drive LCDs, vacuum fluorescents and incandescent bulbs as well as LEDs of any color. Multiple devices can be cascaded for a dot or bar mode display with a range of 60 or 90 dB.LM3915s can also be cascaded with LM3914s for a linear/log display or with LM3916s for an extended-range VU meter.

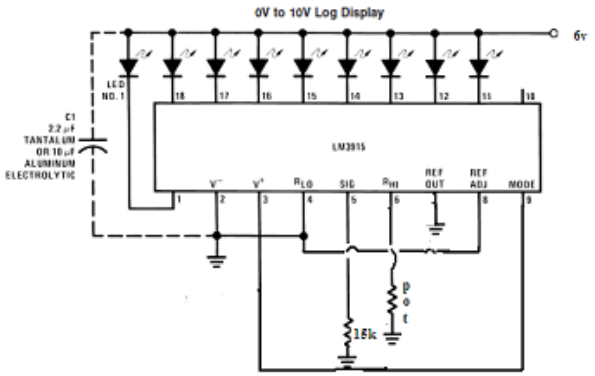

Fig 6: Circuit diagram of LM3915

Features

- 3 dB/step, 30 dB range
- Drives LEDs, LCDs, or vacuum fluorescents
- Bar or dot display mode externally selectable by user
- Expandable to displays of 90 dB
- Internal voltage reference from 1.2V to 12V
- Operates with single supply of 3V to 25V
- Inputs operate down to ground
- Input withstands ±35V without damage or false outputs
- Directly drives TTL or CMOS
- The internal 10-step divider is floating and can be
- Referenced to a wide range of voltages
- LM3915N-1 is available in an 18-lead molded DIP
- Package.

D.RF Module

RF modules are normally divided into three groups, RF transmitter module, RF receiver module and RF transceiver module. In system RF Transmitter transmit the signal from encoder to decoder.

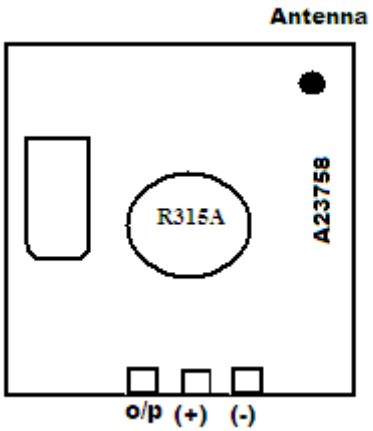

Fig 7. RF Transmitter Module.

Its range on open ground is 80m.Transmit Frequency is 315/433MHz.At decoder side RF Receiver is present for receiving the signal, and gives it to decoder, for decoding.

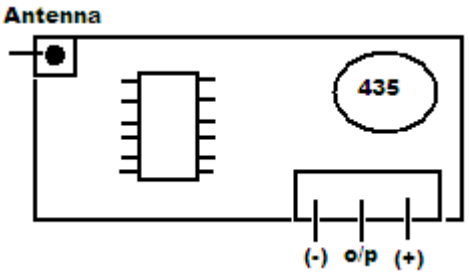

Fig 8. Receiver Module.

Receive frequency is 315/433MHz.

E.Server

Server accepts the radio waves through LPT port. Then compare the input power and out power of the power line. If comparison result is not positive then it detects the power theft and it ringing alarm. Server maintains the history about when power theft occurs previously.

F.I/O Driver

I/O Drivers enable powerful data connections to your devices for control, data acquisition, and visualization fueling innovative software solutions for a sustainable competitive advantage

G.LPT

Parallel port is a simple and inexpensive tool for building computer controlled devices and projects. The simplicity and ease of programming makes parallel port popular in electronics hobbyist world. The parallel port is often used in computer controlled robots, Atmel/PIC programmers, home automation.

X.MATHEMATICAL MODEL

Whenever input power is passing from supplier to the receiver at that time if the total amount of power is not received by the receiver then there is possibility of thefting of energy.

$$O = \begin{cases} \sum Pin = \sum Pout & \text{...NO THEFT} \\ \sum Pin \neq \sum Pout & \text{....THEFT OCCURE} \end{cases}$$

Here, O = Final output of system,
Pin = Input to the system from substation,

CONCLUSION

This paper defines electricity theft in social, economical, regional, political, infrastructural, literacy, criminal and corruption points of view. This paper 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 paper illustrates the effect of NTL on quality of supply, burden on the generating station and tariff imposed on genuine customer.

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AUTHOR'S PROFILE

Vrushali V.Jadhav
B.E. Computer (Appear), SITRC, Nashik.

Soniya S.Patil
B.E. Computer(Appear), SITRC, Nashik.

Rupali V.Rane
B.E. Computer(Appear), SITRC, Nashik.

Swati R.Wadje
B.E. Computer (Appear), SITRC, Nashik.