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Automatic Electricity Theft Detection System

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Abstract: *Distribution companies today deal with a variety of issues, including energy theft, consumer disconnections, and billing errors. We are currently working to develop systems that will lessen energy theft and the effort needed to climb poles to disconnect. Several inventions are now being made to make these achievable. In order to address these issues, we are inventing and putting into practise a circuit that will detect energy theft and cut off the supply when it occurs. It is made simpler to bill. This makes energy theft impossible and simplifies the billing process. Interconnected circuits are used in this situation so that when a service interruption occurs, the supply is automatically cut off.*

Keywords: energy theft

I. INTRODUCTION

In this modern world, energy has become a basic necessity for national development; its availability in the required quantity enables reduced work hours, better agricultural yield, optimized industrial production, superior health conditions, more reliable transportation infrastructure/machines and even more nourishing diets. Different forms of energy exist but electrical energy is by far superior to other forms of energy due to its ease of conversion/control, lower cost, transmission efficiency and reduced pollution. Generally, development indicators tend to increase with improved electric power availability. Power theft is the menace of electric utilities from rural cooperatives to large investor-owned and municipal providers. Utility companies have been plagued with non-technical losses almost since their inception. As early as 1899, the Association of Edison Illuminating Companies addressed the problem of tampering with screws that adjusted meter damping magnets.

Over 36 years ago in 1984, the New York Times published an article citing ConEd and the potential of "1% of power customers of stealing services." As power generation and electric utility proliferation moved into developing countries, many more providers confronted new challenges and obstacles to combat non-technical losses and the issues it causes. No utility provider is immune to attempts to steal power. The financial losses, also known as non- technical losses, include metering inaccuracy, non-payment, billing, and rate class errors and simple to complex energy theft. The two dominant components of non-technical losses are non-payment and energy theft. Non-payment refers to customers who are unable or unwilling to pay for their electricity, which can lead to significant revenue loss if the utility fails to handle non payment situations quickly. However, electricity theft usually impacts a utility more than non-payment problems. Until recently, there were few effective solutions for this problem. Labor-intensive premise inspections and account auditing often costs more than the actual value of the losses, enforcement is always challenging, and previously Advanced Metering Infrastructure (AMI) was not cost effective in many countries.

Regulators typically do not require utilities to absorb the costs. Instead, electricity ratepayers subsidize the thievery. So non-technical losses are often hidden costs and have received little public attention, but they have enormous costs for utilities, customers and governments. The idea that energy theft is a victimless crime is clearly wrong. According to estimates, theft and fraud of electricity costs the industry as much as $96 billion 2 every year globally, with as much as $6 billion3 every year in the United States alone.

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Background :

Electricity theft is nothing new and can be a complex phenomenon with many facets. Theft of power is common in many countries and a considerable amount of energy is stolen every year from the electric low voltage grid. An electric utility low voltage grid can never be one hundred percent secure from theft and fraud due to the number of distributed end points which sit largely unmonitored in public accessible locations. The problem has socioeconomic, political, environmental and technical roots, but the solution is generally sought solely through technical measures. In many systems the amount of energy theft is relatively small (1–2%) in terms of the electricity generated. But, the financial loss is high due to the large amount of electricity being distributed. The financial losses are critical to many electric power utilities. Lost earnings can result in lack of profits, shortage of funds for investment in power system capacity and improvement, and a necessity to expand generating capacity to cope with the nontechnical losses. Some electric utility companies in the worst affected countries are near bankrupt from the impact of year over year losses. Many electric utilities are embarking on specific programs to reduce electric energy losses on their low voltage grids, both as a measure of energy conservation and as an alternative to adding generation capacities. One of the primary sales drivers for advanced AMI systems during the last few years has been the potential to reduce non-technical losses from a theft and fraud prospective. The upward industry trend seems to be that more and more utilities seek the ability for much more stringent practices in theft detection and ability to discover fraud.

II. LITERATURE REVIEW

Mrs. Surekha S.Bhalshankar & Mr.C.S. Thorat "Smart Grid Advanced Metering Infrastructure and Drone Operated Technology for Controlling Theft by Direct Hooking" IEEE WiSPNET 2017, 978-1-5090-4442-9/17. The method of power theft detection for meter tampering and direct hooking of overhead conductors. The developed system is ManPower less, simple, easy to operate and cost effective. It saves time as well as revenue losses for the utility company. We have investigated the system model for both methods. Finally, we discuss the challenging issues in energy theft detection and provide some research directions. In the future, the smart grid requires more accurate and efficient energy theft detection designed.

Mr. Jaco Engelbrecht, Mr.Gerhard P.Hancke & Mr.Martins O.Osifeko "Design and Implementation of an Electrical Tamper Detection System" IEEE 2019,978-1-7281-4878-
6/19. The detection device is able to classify a user as either clean or fraudulent according to their energy consumption behavior. The test bench was implemented in such a way that the load profile which is measured matches that of a typical household. The test bench is controlled with simple commands and the parameters of the pseudo-randomly generated load profile that can be easily adjusted. The detection device functioned as expected. This work proves that an SVM model can be used to classify a consumer as either a clean or fraudulent user by comparing past energy consumption patterns to real-time energy consumption measurements. The accuracy and precision of the energy metering system are good enough to be classified as a class 2 energy meting system, the current sensor proved to be accurate for near rated values and an accurate representation of the load profile can be generated using only purely resistive loads.

Mr. Mohd. Uvais "Controller Based Power Theft Location Detection System" IEEE 2020, 978-1-7281-5846-4/20. the proposed system is having capability to resolve the most prevalent issue of Power theft. It uses the wireless network for data communication which will increase the reliability and effectiveness of the system. The system is based on real time detection and the location of power theft can be easily determined with the help of received data i.e. current and voltage readings.

Mr.Sitao Li & Mr. Haibo Yu, Helong Li China"An anti-power theft method for secondary circuit of energy meter current transformer" ICSAI 2017, 978-1-5386-1107-4/17.Transient
anti power theft method based on the secondary circuit of the energy meter current transformer. At AC signal zero-crossing moment of the secondary circuit of the energy meter current transformer, the circuits are orderly applied two adverse test pulses.

According to the variation and the transient values of the current in the circuit at the two different moments, the values of equivalent resistance and equivalent inductance of the circuit are obtained by rigorous mathematical derivation.

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Compared with the original values of equivalent resistance and equivalent inductance of the circuit, power theft methods can be detected, including open circuit, series diode, parallel shunt resistance, short circuit and other stealing methods. The range of anti-power theft is larger than other methods.

Block Diagram:-

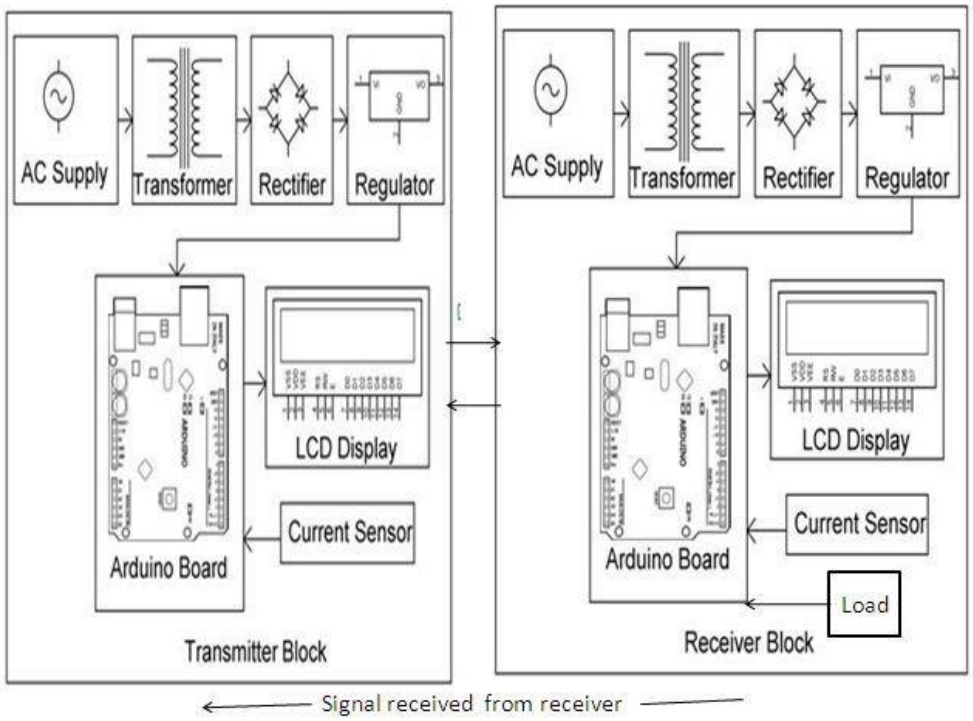

Figure no.1

III. OPERATION

It is Automatic Electricity Theft Detection and circuit design. Energy theft metering system consists of two parts one is pole unit and another is consumer unit. The Energy Meter Theft Detection System mainly works for detecting theft based on the monitoring the CT parameter data from pole unit and consumer unit. It compares pole unit CT data and consumer unit data if found the deviation between them then system will automatically trip the load and send GSM message to MSEB distribution Centre. For this we will use Arduino based microcontroller for taking above decision actions. The same time our system will generates the auto bill at the end of month and send the consumed unit data to distribution Centre as well as consumer mobile number. If the consumer unable to pay the bill amount within the limit, then electricity of the consumer load trips through the MSEB Centre which is done automatically. So, the auto disconnection and reconnection of electricity will be done through this system, it is very useful to MSEB for those consumers not pay the bill amount within time. In our system GSM is used for sending and reception of message purpose only, also the protection system of consumer load we will consider the voltage. i.e., if MSEB voltage increase beyond the above limit then system will automatically isolated consumer load from MSEB line so that protects the equipment's from over voltage. Using this functionality user will able to pay in advance and use the exact amount of energy. When the external or internal theft occurs in system, the system immediately inform authority. The system is made up of AVR Microcontroller, current sensors, GSM modem, LCD display, energy meter and loads.

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IV. RESULT TABLE

Sr. No	condition	voltage	Current per pole	Current at consumer unit	supply
1	Normal	250	0.15	0.15	on
2	Thift Occor	250	0.15	0.35	off

V. FINAL HARDWARE

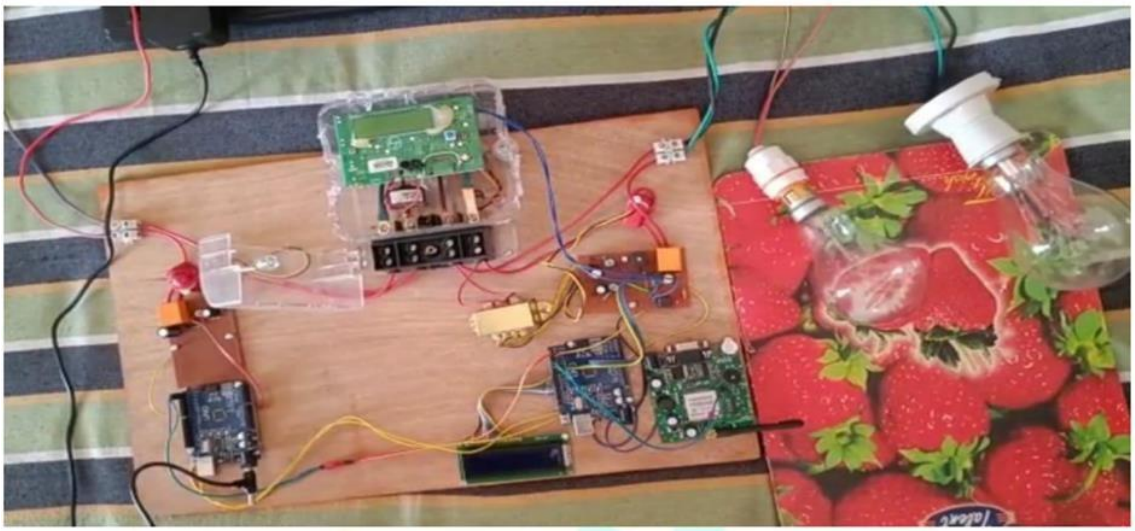

Figure No-2

VI. FUTURE SCOPE

The unit can be made small as possible.
Wireless Communication.
Addition of Direct Hooking Theft Detection.

HARDWARE REQUIREMENTS :

- Arduino UNO
- Power supply
- Transformer
- Bridge rectifier
- Voltage Regulator
- Current transformer
- LCD display
- Resistors
- Capacitors
- Transistor
- Diodes
- LEDs
- Switches
- Buzzer
- Holder

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HARDWARE DESCRIPTION :

Arduino UNO microcontroller:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive project. Arduino board senses the environment by receiving inputs from many sensors, and affects its surroundings by controlling lights, motors, and other actuators. Arduino software, you can tell your Arduino what to do by writing code in the Arduino programming language and using the Arduino development environment [8]

Atmega328: An Arduino board consist of Atmega328 IC. In this Atmega328 IC we can implement our program [11].

Voltage Sensor:

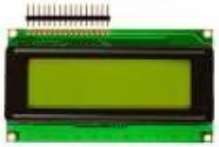
This module is based on resistance points pressure principle, and it can make the input voltage of red terminal reduce 5 times of original voltage. The max Arduino analog input voltage is 5 V, so the input voltage of this module should be not more than 5 V x 5 = 25 V. Because the Arduino chip have 10 bit AD, so this module simulation resolution is 0.00489 V (5V/1023), and the input voltage of this module should be more than 0.00489 V x 5 = 0.02445 V[10].

ACS 712 module current sensor:

The ACS 712consists of a a precise, low-offset, linear Hall sensor circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. Device accuracy is optimized through the close proximity of the magnetic signal to the Hall transducer. A precise, proportional voltage is provided by the low-offset, chopperstabilized BiCMOS Hall IC, which is programmed for accuracy after packaging [12].

Liquid Crystal displays (20 x4):

LCD (Liquid Crystal Display) screen is an electronic display module. It is a flat panel display, electronic visual display. In this paper there is an interfacing of two 20x4 LCDs With Arduino. A 20x4 LCD means it can display 20 Columns and 4 Rows.



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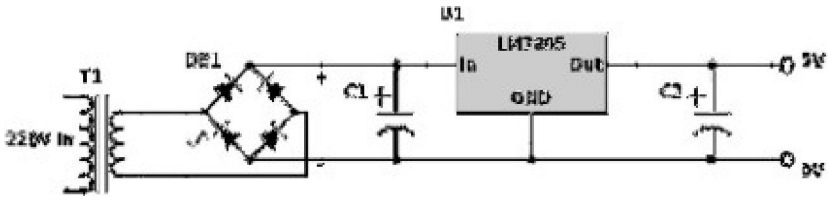
Power Supply There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage source.



VII. CONCLUSION

By using Automatic Electricity theft detection Security Metering System, we can overcome the problems we observed in the system. Main advantage is energy losses are reduced and due to paperless billing, we save the money and environment.

The so-called Smart Grid (SG) has captivated researchers' attention for that it is seen by many to be the key for a sustainable grid future. Smart grid is a terminology that indicates a whole new use of technology applied on the current traditional grid, plus the addition of modern components to the grid for sufficient grid functionality. The paper has considered a number of points: Addition intelligent components to the power grid to be smart.

Reduction of excessive power usage for residential consumer and prevention of power theft could be done using a wire control system. So, GECOL can adjust the electricity that comes into all homes and enforce the user to use a limited amount of electricity depending on the value set by GECOL and wrote in consumer's contract. GECOL can cutoff the electricity from the illegal user.

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