Electricity Theft Detection and High Alert Techniques Using PLC

Prof. Saylee Begampure, Rutuja Gawade, Aditi Yevale, Sonali Bhor

Department of E&TC, RMD Sinhgad School of Engineering, Warje Pune, India

ABSTRACT: Electricity theft is a growing problem worldwide. India, like many other developing countries. Due to huge power theft, India is losing billion of rupees because of unbilled consumption and illegal power usages.Electrical power theft detection system is used to detect an unauthorized tapping on distribution lines. Electricity theft can be in the form of fraud (meter tampering), stealing (illegal connections), billing irregularities, and unpaid bills. Implementation area of this system is a distribution network of electrical power supply system it has always been a difficult task for the government of the day and the Electricity Company to achieve their aim due to power theft activities.This is a real time system which aims at eliminating all these difficulties by designing a simple device to send a message whenever there is a power theft activity at a certain cluster of an area. The distribution network will be protected from power theft done by tapping, meter tampering etc.

KEYWORDS: electronic meter, tampering technique, PLC,Modbus-RTU, GSM Technology, Wired Techniques.

I. INTRODUCTION

It is estimated that utility companies lose more than$25 billion every year due to energy theft around the world.With a technical view, Power Theft is a non ignorable crime and at the same time it directly affected the economy of a nation [3]. Electricity theft 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 consumers than earlier, in highly populatedcountry such as INDIA. There are two types oftechniques to deliver the information to the authorized agency to control the theft of the electricity.

Wiredtechniques | Wirelesstechniques

- Electricalcables • Zigbeetechnology

- Coaxialcable •WI-FI

- Optical fiber • InfraRed

II. CONTEXT

Electric power is lost while being transmitted and distributed when it passes through transformers and is distributed in small capacity lines. Systems with long transmission lines risk a higher amount of T&D loss than shorter line systems. Also, the quality of the lines and transformers can affect efficiency of transmission and distribution. Power systems that invest significantly in maintenance and in the advanced technology of transmission and distribution can reduce technical T&D losses[5].A Electro- mechanical Meter is usually installed at the residential consumer, outside the main

house inside a metallic shelter, protected from rain, and its display should be accessible for a local reader to show the accumulated value (total amount) of energy consumption. Usually power factor or instantaneous consumption samples can not be directly read from the meter. An electronic meter has a LED/LCD display on which the readings of the electricity consumption of the connected appliances[1].The readings are digital in the electronic meters in contrast to the electromechanical meters Some can also transmit readings to remote places.These are much more efficient than the electromechanical meters in the sense that they do register every small unit of electricityconsumed.

III. OBJECTIVES

☐   This system would provide a simple way to detect an electrical power theft without any humaninterface.
•   It would be time saving if distribution company personnel take reading by this wirelesstechnique.

•   It would provide a digital record in case of any judicialdispute.

•   To maximize the profit margin of power utilitycompany.

•   Troubleshooting through a PLC system is much more technician friendly and very easy to adapt andchange.

•   Development Time is less usingPLC.

•   The system can handle severe conditions such as dust, humidityetc.

IV. METHODOLOGY

The distribution network of the proposed system is divided into main station,distributive panel and substations.Current transformer is the heart of the system.Each electricity pole will have a current transformer mounted over it.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.Another important component is the PLC(Programmable Logic Controller).It is a digital computer used for the automation of typically industrial and electromechanical processes.The system uses PLC CX5020 of Beckhoff Automation Technologies with Internal main memory 1 GB DDR3 RAM and Power supply 24 V DC.The current transformer is compatible on the EL3403-0010 module which is a 3-phase power measurement terminal with 500VAC,5A.The system uses single phase power measurement.Now the current transformer measures power,cuurent and voltage values of both the transmitter and receiver side.These readings are given to the main station.as the main station and load station having some distance between them then there are some transmission losses in the conductor joining these stations so the at main station we compare the power transmitted through station and the summation of the powers at the load sides in comparison we have considered sometolerance due to the transmission losses. If by considering allowable tolerance the comparison is equal, then no theft has occurred. And if comparison is not equal, then theft has been occurred.So an alert message will send to the operator through the GSM or Buzzer and the alert message will shown on the visualization screen in the main station.Several modules in a network can also be used. The network is then connected to the GSM or buzzer using RS-485 cables, which provideuniversality.
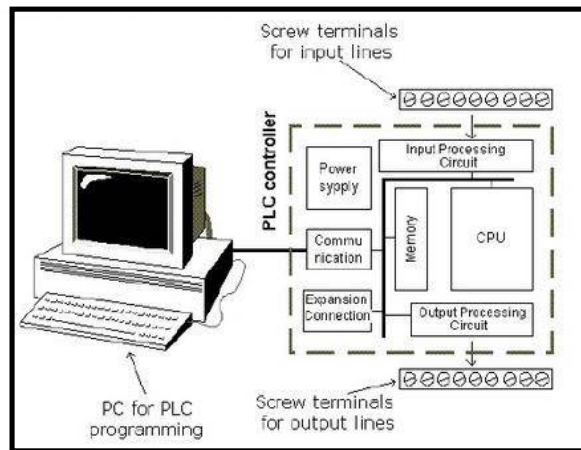
Fig.1.PC acts as a soft PLC

V. THEFTPREVENTION

Current transformers are connected to the power measurement terminal EL3403-0010 module for measuring power of each station. The values of the main station and substation will be sent to the visualization screen to the operator. Considering some tolerance losses we can compare the transmitted and received power values and an alert message is displayed on Twin Cat Visualisation (Beckhoff software for PLC Programming).the buzzer will get on if the theft has occurred.In this way,an illegal load use can be identified and theft can be detected by comparison of the consumption values.

Another way of theft detection is to avoid the tampering of the meter.In the system,an inductive sensor is placed near the electricity meter. Inductive proximity sensors are used for non-contact detection of metallic objects.The sensor is EL2008 module and buzzer to the EL1008 module of the CX5020 controller.Alert message can be shown on visualisation screen if the theft is identified. The GSM module is used to send a sms when electricity theft or any line problem is generated in a transmission line or buzzer can be used.

VI. HARDWAREREQUIREMENTS

1.   EL3403-0010MODULE:

The 3-phase Power Measurement Terminal EL3403- xxxx enables the measurement of the electrical data of a three-phase supply network with 500VAC,5A :

☐   The voltage is measured via the connection of the network at the terminal points L1,L2, L3 andN.
☐   The current of the three phases is fed invia current transformers at the terminal points I_{L1}, I_{L2}, I_{L3} andI_N.
•   2. INDUCTIVE SENSOR:
☐   Rangingdistance:4mm
☐   Type:PNPNO

3. CURRENTTRANSFORMER:

•   Ratio:100/5A
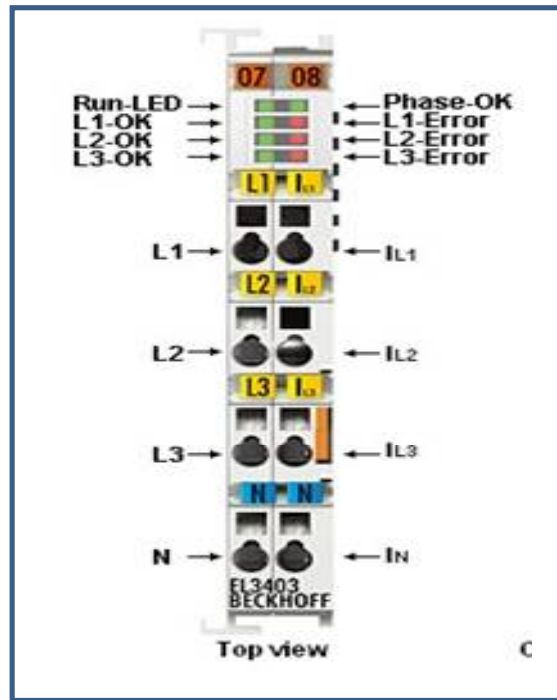•   Frequency:50Hz

Fig.3.Flowchart

VII. SOFTWARE REQUIREMENTS

- TWINCAT2.0/3.0
- Programming Languages: Strucured Text and LadderLogic

The BeckhoffTwinCAT software system turns any compatible PC into a real-time controller with a multi-PLC system. TwinCAT3 provides extended Automation Technology (XAT) and is integrated with Microsoft visual Studio 2010.

VIII. MATHEMATICALMODEL

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 theft ofenergy.

Σ Psent = ΣPconsumed + Tolerance … NO THEFT

Σ Psent $\neq$ ΣPconsumed + Tolerance …THEFT OCURRED

Here; Psent = Power measured by pole side energy meter Pconsumed = Power measured by load side energy meter.
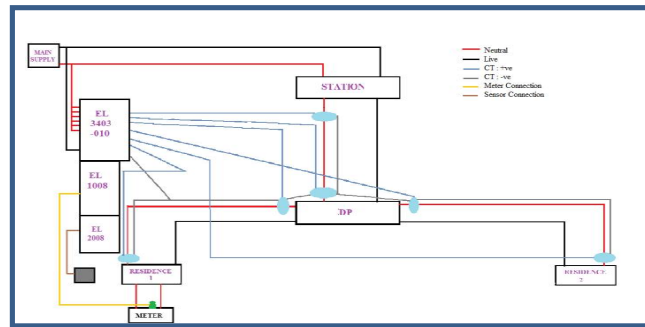
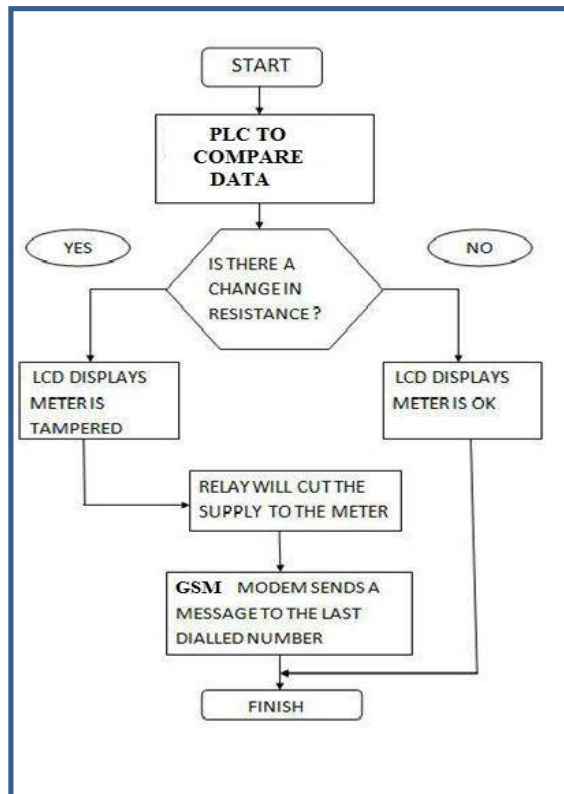Fig.4 Block Diagram

IX. FLOWCHART

Fig.5 Flowchart

X. FUTURE SCOPE

In future, this project can be implemented and validated in remote areas. Future enhancements can be incorporated to suit the system for three phase electric distribution system in India. Along with all this new architectural components can be incorporated, so that the system can be completely used for optimizing the energy consumption. This method will reduce the energy wastage and save a lot of energy for future use.We can also use Advanced Metering

Infrastructure(AMI)in Smart Grid Networks[4].The unique characteristics of AMI, such as complex network structure, resource- constrained smart meter, and privacy-sensitive data make itefficient.

XI. CONCLUSION

Frauds on electricity measurement systems are not limited to underdeveloped countries. The concern is not the unlawful act but the increasing number of committed crimes with advanced technologies and sophisticated methods. This system is aimed at reducing the heavy power and revenue losses that occur due to power theft by the customers. By this design it can be concluded that power theft can be effectively curbed by detecting where the power theft occurs and informing the authorities. Also an automatic circuit breaker may be integrated to the unit so as to remotely cut off the power supply to the house or consumer who tries to indulge in power theft.

ACKNOWLEDGEMENT

REFERENCES

[1] M.A.O liveira and C.C. Barioni, "Technical loss calculation by distribution system segment with corrections from measurements", Proc.20th international Conference and Exhibition on Electricity Distribution, Prague, Czech Republic, June 2009

[2] C. J. Bandim, E. R. Alves ., A. V. Pinto, F. C. Souza, M. R. B. Loureiro, C. A. Magalhges and F. Galvez-Durand, "Identification of Energy Theft and Tampered Meters Using a Central Observer Meter: A Mathematical Transmission and distribution conference and exposition" 2003 IEEE PES, vol. 1, pp. 163-168,2003.

[3] VirendraPandey (EC, final year), Simrat Singh Gill(Assistant Professor), Amit Sharma (Assistant Professor) MIT,MORADABAD.

[4] "Wireless Electricity Theft Detection System Using Zigbee Technology" P.Kadurek, Student member, IEEE, J. Blom, J. F. G. Cobben, W.L. Kling, Member, IEEE1 "Theft detection and smart metering practices and expectations in the Netherlands"

[5] Frank VAN DEN BERGH "Electricity Theft Localization Based On Smart Metering" A.I. Abdullateef, M.J.E. Salami, M.A. Musse, A.M. Aibinu, and M.A.Onasanya "Electricity Theft Prediction on Low Voltage Distribution System Using Autoregressive Technique" SagarPatil, GopalPawaskar, KirtikumarPatil" "Electrical Power Theft Detection and Wireless Meter Reading".

[6] Donald G, Wayne H.Beaty, "Standard Handbook for Electrical Engineers" 11th Edition, McGraw Hill, 2003, New York Croft, Terrell, Summers, Wilford I, "American Electricians' Handbook" 11th Edition, McGraw Hill,2008 New York.