

# GSM Based POWR Theft Detection & Over Load Protection in Power Lines

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**Abstract**— The electrical substation which supply the power to the consumers i.e. industries or domestic can have failures due to some faults like open or short circuit faults which can be temporary or permanent. These faults lead to substantial damage to the power system equipment. This project introduces hardware implementation to develop an automatic tripping mechanism for the single-phase supply system. The project output resets automatically after a brief interruption in the event temporary fault while it remains in tripped condition in case of permanent fault. Along with effective solutions for problems faced by India's electricity distribution system such as power theft, and transmission line fault with the help of software module also incorporates different data aggregation algorithms needed for the different pathways of the electricity distribution system. The proposed system will trip the load in the event of the input voltage falling below/above a set value. Two comparators are used as window comparator formed out of one quad comparator IC. This delivers an error output if the input voltage to them crosses the range beyond the voltage window. A relay is then operated to cut off the load for safety reasons. An alarm, which sounds when the tripping takes place. It can also be enhanced by interfacing with a GSM modem to convey alert message to the user via SMS to take appropriate action.

**Key words:** GSM, LED, PWM, OVP, SIM, A.C, D.C

## I. INTRODUCTION

Electrical energy is very imperative for ever day life and a spine for the industry. Electricity is indisciplined to our daily life with increasing need of electricity. The electrical substation which supply the power to the consumers i.e. industries or domestic can have failures due to some faults which can be temporary or permanent. These faults lead to substantial damage to the power system equipment. In India, it is common to observe the failures in supply system due to the faults that occur during the transmission or distribution. To overcome this problem a system is built, which can sense these faults and automatically disconnects the supply to avoid large scale damage to the control gears in the grid substations.

The power theft is also increasing power theft is a problem that continues to plague power sector across the whole country. In recent years, along with the rise of noble metal prices such as steel and copper wire in the international society, the conducting cables of Taiwan Power Corporation had now become the targets of theft group, therefore, theft situation became more and more serious, which not only caused the power supply quality of Taiwan Power Corporation, but also caused a great loss to it. In the past, passive prevention method was adopted by

Taiwan Power Corporation in preventing the theft, for example, recovery with coated aluminum wire, request of the police department to reinforce night checking, monitoring on recidivist and drug-using population, and irregular visit of the resource recycling companies to stop the channel of disposing the stolen objects, however, since the police cannot arrive the site on the first instance to catch the thief and to get the direct evidence of theft, the preventing result was limited.

The electricity is needed to be protected for efficient power delivery to the consumer because electricity is indispensable to domestic and industrial development activity [9]. There are two types of losses technical and Nontechnical losses. Every year the electricity companies fare the line losses at an average 20- 30% according to power ministry WAPDA Company's loss more than RS.125 billion.

T&D losses have been a concern for the Indian electricity sector. Since these have been very high when compared with other developed countries. The present T&D losses including unaccounted energy are about 30% and there is need to reduce these losses through efficient management the best operation and maintenance practice of the transmission and distribution.

### A. Modes of Theft

It has been seen that there are common modes of power theft as given below:

- Bogus seals and tampering of seals,
- Meter tampering,
- Meter tilting,
- Meter interface and
- Meter bypassing.

The above modes of power theft can specify Bogus seal and tampering seal describes that faulty meter can be utilized without proper check from electricity department [4].

Meter tampering describes that a permanent magnet fitted internally to disturb meter needle rotation which implies wrong notations of number of units utilized [5]. Meter tilting describes that the tilting that effects meter position which implies that wrong display.

Meter interface and bypassing describes that extra phase is added to the circuit which effects the magnetism provided to the disc again miss diverting the electricity board for less billing.

#### 1) Factors that influence illegal consumers are:

- Higher energy prices deject consumers from buying electricity. In light of this, 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.
- 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 electricity utilization.
- 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.

## 2) 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.

## 3) Over voltage Protection:

Overvoltage Protector (OVP) refers to a circuit that protects downstream circuitry from damage due to excessive voltage [1], [3]. Arduino UNO Board: The Arduino UNO board is the main microcontroller board in this project. All calculations and data collections will be done through this board.

The main idea of the project is to avoid the power theft that occurs in transmission lines by implementing the detection of power theft using Sensor and Relay. Sensors are placed on the transmission line. Whenever current flowing through the transmission line it exceeds the normal range then immediately sends signal to the preprogrammed microcontroller and the microcontroller there by operates the buzzer and then after it passes the same information to nearby substation by using GSM module. Also, the voltage in the transmission line exceeds certain limit then the relay immediately trips the circuit and protects the equipment from over voltage. Here we are using Variable Potentiometer to increase the voltage when it outmatches the normal rated voltage then the relay operates and trips the supply and protects the equipment from being damaged.

## II. PROBLEM SOLUTION

To overcome all the above disadvantages, we are going to design a new model which improves the quality of the in-Electricity theft detection. Here we are going to use Current Sensor in transmission line to detect whenever current theft occurs to reduce cost of the design as well as to reduce complexity of the circuit.

Based on the rigorous analysis, comparing the voltage and current readings the amount of power to be theft

calculation is achieved and further action takes to reduce the theft loss further temporarily or permanently.

### A. Technical Solutions to Power Theft:

- Plastic meter encasements
- Pre-pay meters
- Electronic Tamper Detection Meters
- Automatic Meter Reading
- Automatic detection of Meter tamper, Meter Bypass, Meter disconnection
- Encasing meters
- Anti-theft cable
- Software (Analytics)
- End of line monitoring
- Smart Meters (AMI/AMR)

### B. Non-Technical Solutions for Energy Theft:

#### 1) Financial rewards:

Utility companies encourage consumers to report electricity theft.

#### 2) 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.

#### 3) Enforcement of law:

Fines should be imposed by the government for stealing electricity, Legal Measures, Stricter fines and jail time for offenders, Management, implementing inspection after a meter was disconnected and not reconnected.

Out of which some other methods to be considered as follows

#### a) Management

Immediate action to be taken for those persons tries to theft power illegally.

#### b) Public Outreach

The awareness of problems, dangers of power theft illegally will be provided to the public.

#### c) Legal regulatory

The awareness to be provided the punishment for illegal power theft causes imprison, penalty and removal the electricity supply for their usage thereby.

There are two types of techniques to deliver the information to the authorized agency to control the theft of the electricity.

#### 4) Wired Techniques

- Electrical cables
- Coaxial cable
- Optical fiber.

#### 5) Wireless techniques

- Zigbee technology
- GSM technique
- WI-FI
- Infra-Red
- Wi-max and Bluetooth

## III. PROPOSED SYSTEM

The system utilizes the technique named GSM because all the problems associated with the wired techniques. There are a lot of problems related with the wired techniques such as installation problem, complexity and cost also matters in

the case of long haul [2]. The main problem associated is about the rural areas where it's really very much difficult to install the wired system to convey the information. The GSM module provides an efficient way to convey this information to the authorized official. The other wireless techniques such as Bluetooth, infrared etc are having the limitations of range and also of the efficiency.

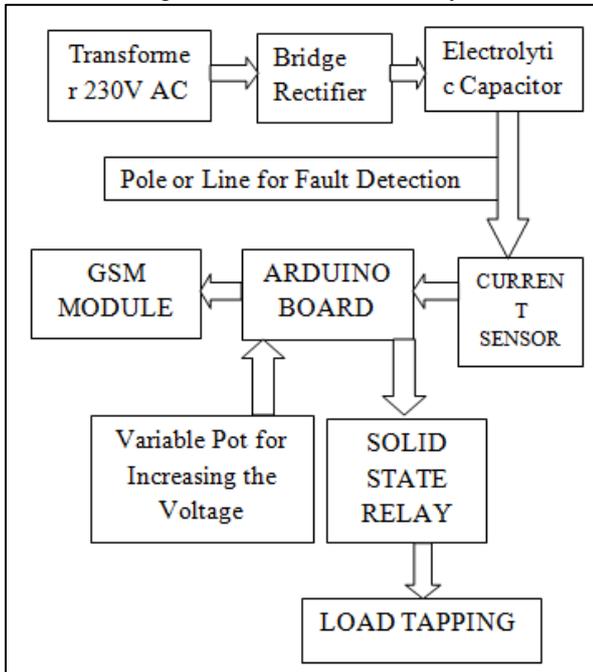


Fig. 1: Block Diagram

Figure 1 shows the basic block diagram of our work. Whenever 230v supply is given single phase step down transformer delivers 12V. But, the Arduino board driven supply is 5V DC which is achieved by Output of transformer is followed by a bridge rectifier that converts ac to dc. A capacitive type is used to smoothen the dc wave form. A microcontroller ATmega328 is used to provide a constant 5V dc irrespective of load fluctuations.

The main idea of the project is to avoid the power theft that occurs in transmission lines by implementing the detection of power theft using Sensor and Relay. Sensors are placed on the transmission line. Whenever current flowing through the transmission line it exceeds the normal range then immediately sends signal to the preprogrammed microcontroller and the microcontroller there by operates the buzzer and then after it passes the same information to nearby substation by using GSM module. Also the voltage in the transmission line exceeds certain limit then the relay immediately trips the circuit and protects the equipment from over voltage. Here we are using Variable Potentiometer to increase the voltage when it outmatches the normal rated voltage then the relay operates and trips the supply and protects the equipment from being damaged.

#### IV. RESULTS

##### A. Overall view of the Kit:

Figure 2 shows the overall view of the kit



Fig. 2: Overall view of the kit

##### B. Trips the Relay in Overload Condition:

Whenever voltage changes from normal condition to overload condition the load will be tripped by relay will be shown in figure 3 and 4.



Fig. 3: Normal Condition

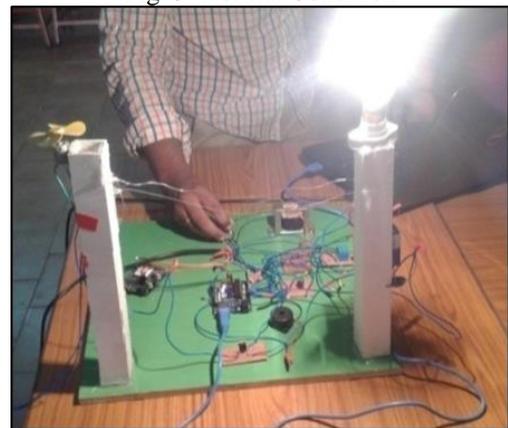


Fig. 4: Over load condition

Here, potential divider is manually operated to vary the voltage from normal condition to abnormal condition. The sensors sense the change in voltage or current for abnormal condition [1]. This sends signals arduino board. The arduino board operates relay then the relay trip the circuit for protection of load against over voltages. Again, potential divider is manually operated to vary the voltage from abnormal condition to normal condition. For action, the load gets supply by the relay closes it circuit.

C. Power Theft Occurring Message:

When power theft occurs between two poles then GSM will be activated and it will send message to the number specified by the user. Figure 5 shows the power thefting message.

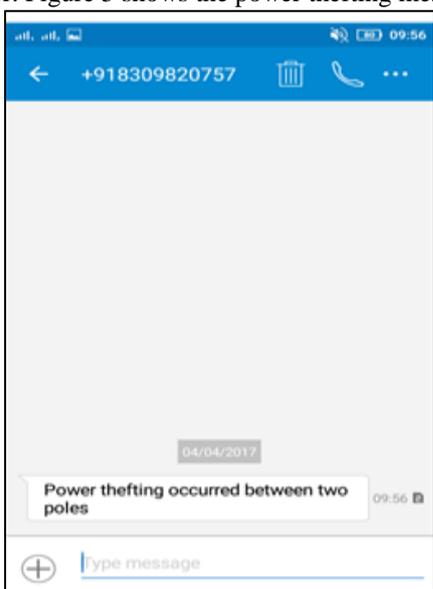


Fig. 5: Power theft occurring message

1) Serial Monitoring of Power Theft:

Figure 6 shows the serial monitoring of power theft occurred in the system. The following output is shown in the monitor as:

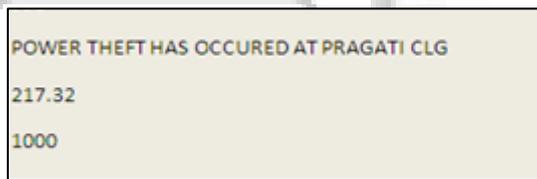


Fig. 6: Serial Monitoring of Power Theft

2) Overload Indication through Message:

Whenever voltage exceeds the normal rating then over voltage occurs, GSM module will send message to the specified number in the module. Figure 7 shows the over load indication through message.

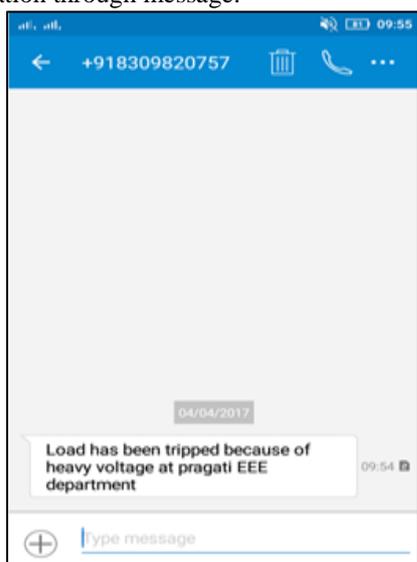


Fig. 7: Over load indication through message

3) Serial Monitoring of Over Voltage:

Figure 8 shows the serial monitoring of over voltage occurred in the system. The following output is shown in the monitor as:

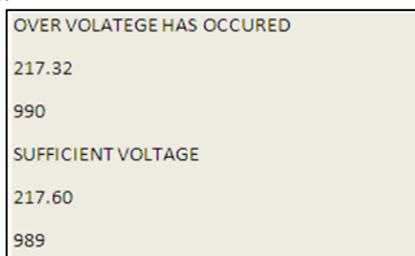


Fig. 8: Serial Monitoring of Over Voltage

V. CONCLUSION

In developing countries electricity theft is a common practice especially in remote areas, as they do not pay utility bills to a government company in case of electricity and gas as well. To solve these problem governments must think of an idea to provide help in terms of subsidy to manage this issue. With this system, the service provider can collect the bill any time with a single message. The data collection and manipulation task becomes fast and easier. Any modification can be made to the code in less time. Changes in rate or unit calculation can be done very effectively.

This project 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 removed 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. The ability of the proposed system to inform or send data digitally to a remote station using wireless radio link adds a large amount of possibilities to the way the power supply is controlled by the electricity board. The system design mainly concentrates on single phase electric distribution system, especially. The proposed system provides the solution for some of the main problems faced by the existing Indian grid system, such as wastage of energy, power theft, and transmission line fault.

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