

Design and Implementation of Service Line Power Theft Monitoring System Using GSM

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ABSTRACT

Electricity theft is one of the major contributors to non-technical losses in electrical distribution systems and results in considerable financial losses to power utilities. This paper presents the design and implementation of a service-line power-theft monitoring system using GSM communication. The proposed system monitors the current at the distribution side and consumer side using ACS712 current sensors. The measured quantities are processed by an Arduino Uno, and a difference between the two current measurements beyond a predefined tolerance is considered an indication of unauthorized power tapping. When power theft is detected, the controller activates the protection mechanism and the GSM modem transmits an alert message to the concerned lineman or authority. An LCD provides local indication of system status. In addition, voltage fluctuations are monitored, and an electromagnetic relay disconnects the load when an abnormal voltage condition is detected. The developed system provides a simple approach for real-time monitoring, theft detection, remote notification, and protection of connected electrical equipment.

Keywords— Power Theft, GSM, Arduino Uno, ACS712 Current Sensor, Service Line, Electricity Distribution, Relay, Power Monitoring.

INTRODUCTION

Electrical energy plays a fundamental role in domestic, commercial, agricultural, and industrial development. The generation, transmission, and distribution of electrical energy are associated with both technical and non-technical losses. Technical losses occur naturally because of losses in transmission lines, transformers, and other electrical equipment, whereas non-technical losses mainly arise from unauthorized electricity consumption, meter bypassing, and illegal tapping of distribution lines. Electricity theft therefore creates considerable revenue losses for utilities and affects the reliability and efficiency of electrical distribution systems.

Conventional identification of illegal electricity consumption often requires physical inspection of service lines and consumer installations. Such procedures can be labor-intensive and time-consuming, particularly when a distribution network covers a large geographical area. An automated monitoring arrangement capable of continuously observing electrical parameters and communicating abnormal conditions to the concerned personnel can improve the detection process.

The proposed system employs current sensors at the distributor output and consumer input to monitor the power flow through a service line. The current measurements are supplied to an Arduino Uno, which compares the measured values. When their difference exceeds the permitted tolerance, the condition is considered an indication of power theft. GSM communication is then employed to transmit an alert to the

concerned authority. The system also incorporates voltage-fluctuation protection in which an electromagnetic relay disconnects the load during abnormal supply-voltage conditions.

LITERATURE SURVEY

Christopher *et al.* [1] presented a distribution-line monitoring scheme for detecting power theft using power-line communication. Their approach injects a narrow-band carrier signal into a 230-V, 50-Hz distribution line and identifies unauthorized utilization by observing variations in the carrier-signal amplitude. Jokar *et al.* [2] proposed electricity-theft detection in Advanced Metering Infrastructure (AMI) using customer consumption patterns. Their technique employs transformer-meter information together with classification and clustering approaches to identify abnormal consumption patterns and shortlist consumers having a high probability of electricity theft.

Tariq and Poor [3] investigated electricity-theft detection and localization in grid-tied microgrids using a Stochastic Petri Net approach. The technique considers disturbances and smart-meter measurements to identify and localize theft while limiting unnecessary data transmission. Somasekhar and Puviarasi [4] proposed a GSM-based power-theft detection model simulated using Proteus to reduce manual monitoring requirements. Other studies have also investigated GSM-based electricity-theft detection [5], Arduino- and GSM-based theft identification [6], and GSM-enabled prepaid electricity systems incorporating theft detection [7]. These studies demonstrate the importance of automated monitoring and wireless communication for reducing non-technical losses. The present work applies this concept to service-line monitoring by comparing current measurements and transmitting GSM alerts when an abnormal difference is identified.

PROBLEM STATEMENT

Electricity theft through unauthorized tapping of service and distribution lines contributes significantly to non-technical losses and reduces the revenue of electricity utilities. Manual inspection is not always capable of locating illegal connections quickly, especially over widely distributed service areas. Therefore, an automatic system is required to continuously monitor electrical parameters, identify abnormal differences between distributor-side and consumer-side current, and immediately communicate suspected power-theft conditions to the responsible personnel.

OBJECTIVES

The main objectives of the proposed work are:

1. To develop a GSM-based system for continuously monitoring service lines and detecting unauthorized power consumption or power theft.
2. To automatically identify abnormal conditions and send an alert to the concerned authorities while providing protection against abnormal supply-voltage conditions.

PROPOSED SYSTEM

The proposed service-line power-theft monitoring system is designed around an Arduino Uno microcontroller. Two ACS712 current sensors are installed at different points in the service line: one at the distributor output and another at the consumer input. These sensors measure the respective current values and provide corresponding analog voltage signals to the controller. The Arduino continuously processes and compares the two measurements. Under normal operating conditions, the difference remains within the predefined tolerance. An abnormal difference above the tolerance is interpreted as unauthorized current consumption between the two measurement locations.

When a theft condition is identified, the controller initiates an alert through the GSM modem and provides the corresponding indication on the LCD. The relay section enables the controller to disconnect the output when required. The project additionally incorporates supply-voltage monitoring. During an abnormal voltage condition, the electromagnetic relay trips the circuit to protect connected electrical equipment, while information regarding the condition can be communicated to the lineman.

BLOCK DIAGRAM

As shown in Fig. 1, the system consists of an AC–DC converter, regulated 5-V supply, Arduino Uno, distributor- and consumer-side ACS712 current sensors, voltage-monitoring input, GSM modem, LCD, relay driver, and electromagnetic relay. The Arduino compares the sensor measurements and controls the GSM communication, display, and relay according to the detected operating condition.

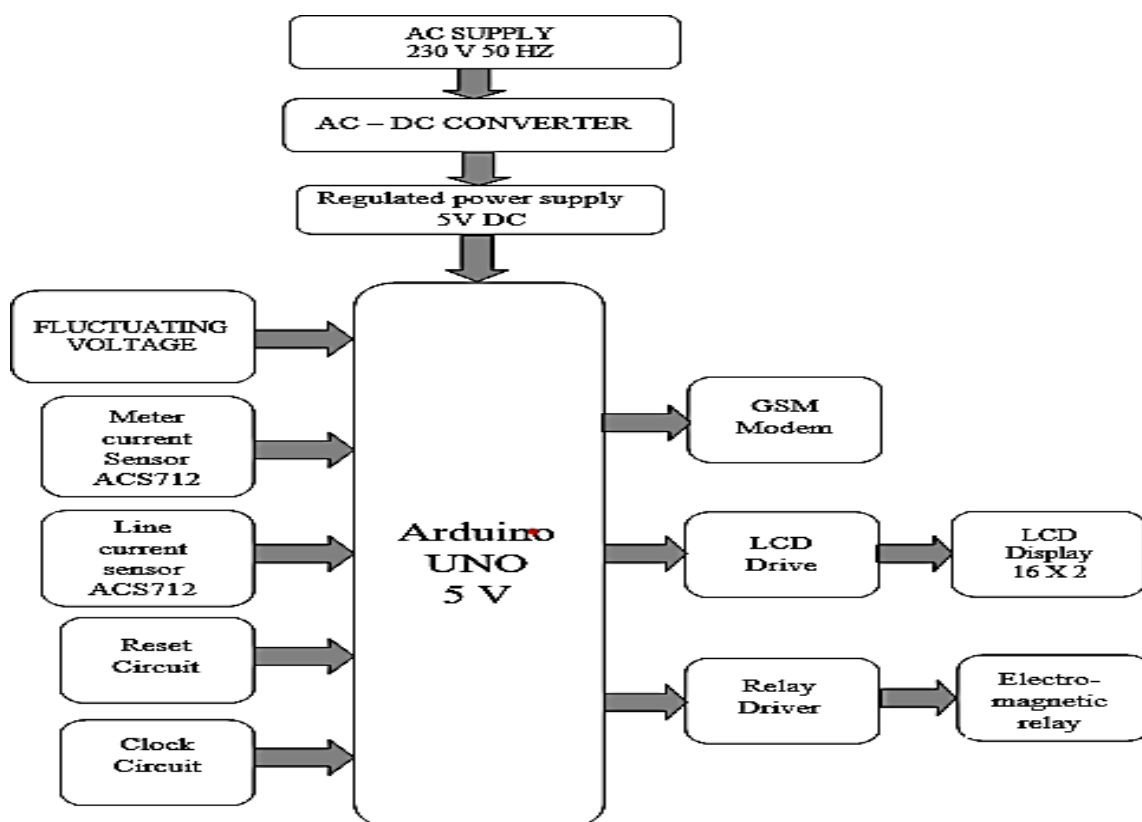


Fig. 1. Block diagram of the proposed service-line power-theft monitoring system.

CITCUIT DIAGRAM

As shown in Fig. 2, the sensing and communication units are interfaced with the controller along with the LCD and relay-driver circuitry. The circuit enables continuous acquisition of electrical quantities, comparison of the distributor and consumer currents, local status indication, GSM-based alert transmission, and relay operation during abnormal conditions.

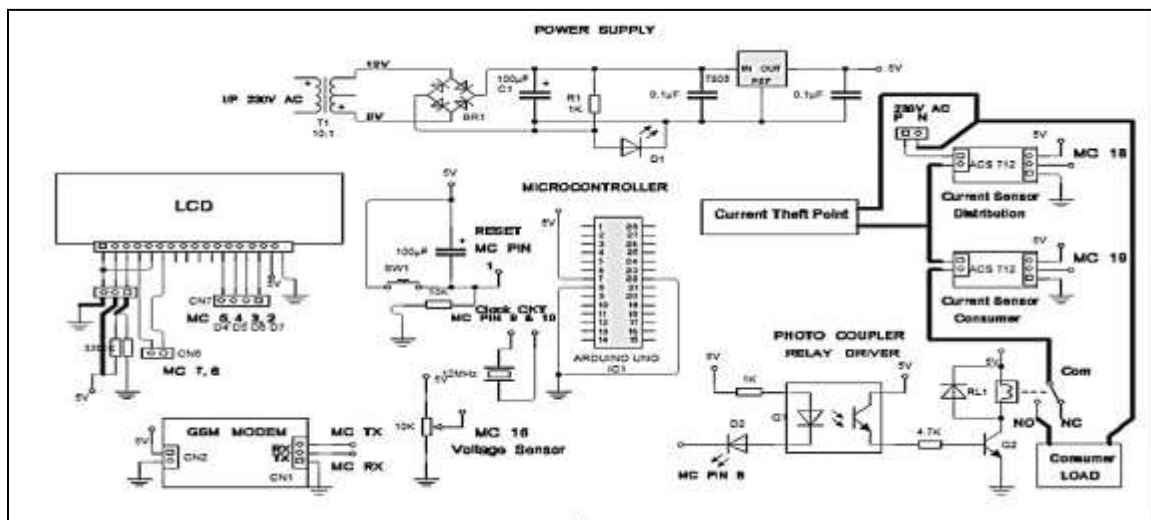


Fig 2:Circuit Diagram

METHODOLOGY

The methodology begins with the conversion and regulation of the input power required for the control circuitry. The 230-V, 50-Hz AC supply is converted to DC and regulated to provide the 5-V supply required by the Arduino and associated electronics. The distributor-side and consumer-side ACS712 sensors continuously measure current. Since the ACS712 provides an output voltage proportional to the measured current, the Arduino processes these analog signals to determine the current values at both locations.

The controller repeatedly compares the two current measurements. If the difference is within the permissible range, the system treats the service line as operating normally and continues monitoring. When the difference exceeds the programmed tolerance, a power-theft condition is detected. The GSM module is subsequently activated to send an SMS alert to the concerned authority or lineman, and the condition is displayed locally through the LCD. The software is implemented using Embedded C through the Arduino development environment. The methodology therefore combines sensing, processing, decision-making, local display, protective switching, and wireless notification into a single monitoring arrangement.

RESULTS AND DISCUSSION

The developed project prototype shown in Fig.3 integrates current sensing, Arduino-based processing, LCD display, GSM communication, and electromagnetic relay control for effective service-line monitoring. The system compares the distributor-side and consumer-side current values to identify unauthorized power

consumption. If the difference exceeds the predefined tolerance limit, the controller detects power theft and activates the alert mechanism.

The implemented GSM communication provides remote notification to the lineman when a power-theft condition is detected. The project prototype and the message received by the lineman demonstrate the intended monitoring and communication process. The use of GSM reduces dependence on continuous manual inspection and enables utility personnel to receive information about abnormal service-line conditions remotely.

The system also provides an additional protective function through voltage-fluctuation monitoring. During low- or high-voltage conditions, the electromagnetic relay can trip the circuit, thereby isolating the connected equipment from the abnormal supply. Consequently, the developed system combines theft monitoring with electrical protection and remote communication. Its intended benefits include reduced energy losses, improved monitoring efficiency, remote accessibility, improved security, and faster response to unauthorized service-line tapping.

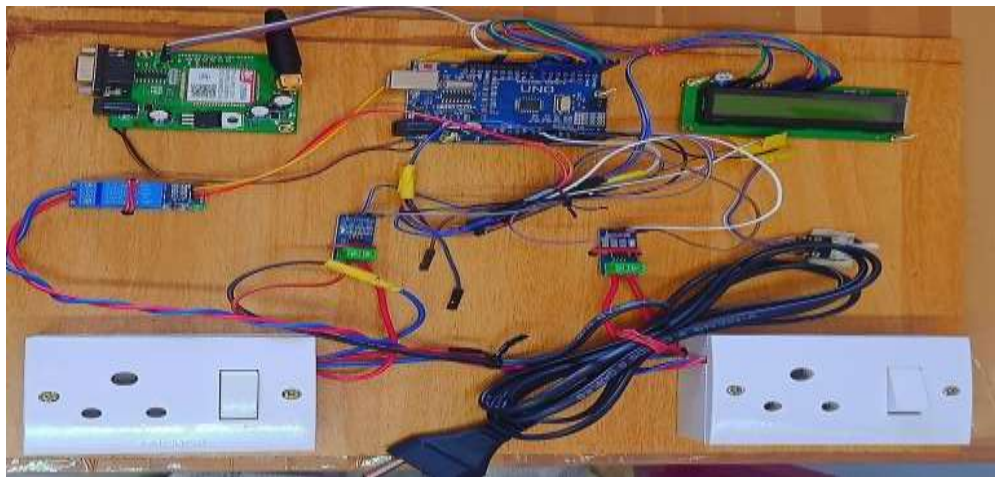


Fig 3 :Project Kit Prototype

CONCLUSION

A service-line power-theft monitoring system using GSM technology has been designed and implemented to provide automatic detection and notification of unauthorized electricity consumption. The system uses current sensors to monitor the electrical current at the distributor and consumer sides and employs an Arduino-based controller to identify abnormal differences. When power theft is detected, the GSM modem transmits an alert message to the concerned lineman, enabling timely investigation and corrective action.

The system provides an economical and practical approach for improving the monitoring of electrical distribution service lines. In addition to theft detection, the electromagnetic relay provides protection by disconnecting the circuit during abnormal voltage fluctuations. Thus, the proposed system combines automatic monitoring, wireless communication, local indication, and protective switching to reduce power theft and improve the security and reliability of electricity distribution.

REFERENCES

- [1] A. V. Christopher, G. Swaminathan, M. Subramanian, and P. Thangaraj, "Distribution line monitoring system for the detection of power theft using power line communication," in *Proc. IEEE Conference on Energy Conversion (CENCON)*, 2014.
- [2] P. Jokar and N. Arianpoo, "Electricity theft detection in AMI using customers' consumption patterns," *IEEE Transactions on Smart Grid*, 2015.
- [3] M. Tariq and H. V. Poor, "Electricity theft detection and localization in grid-tied microgrids," *IEEE Transactions on Smart Grid*, 2016.
- [4] V. Somasekhar and R. Puviarasi, "Simulation of GSM based power theft detection using Proteus," in *International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB)*, Feb. 2018.
- [5] G. Balder, N. Bhandure, A. Bhadane, and M. K. Sangole, "Electricity theft detection using GSM," *International Journal for Scientific Research and Development (IJSRD)*, vol. 5, no. 2, pp. 472–475, May 2017.
- [6] L. Hinduja, M. Nivedha, and B. Priyavadhana, "GSM based electricity theft detection using Arduino," *International Journal of Electronics, Electrical and Computational System*, vol. 7, no. 3, pp. 472–475, Mar. 2017.
- [7] M. Saad, M. F. Tariq, A. Nawaz, and M. Y. Jamal, "Theft detection-based GSM prepaid electricity system," in *Proc. 3rd IEEE International Conference on Control Science and Systems Engineering (ICCSSE)*, 2017.