



GSM Based Energy Meter Monitoring and Controlling with Power Theft Detection

Sarvesh Temgar¹, Pranav Magdum², Vinod Burute³, Pranav Nikam⁴, Prathamesh Bhause⁵, Guide Mr. S.M. More⁶

Department of Electrical Engineering Rajaram Bapu Institute Technology [Rit], Islampur

ABSTRACT :

In This project, stole of electricity detection in residential, commercial and in industrial is presented for various types of power thefts. Electricity theft is a major problem that leads to huge financial losses for power companies and honest consumers. To tackle this issue, we've designed a smart energy meter system that not only tracks electricity usage in real-time but also detects and prevents power theft—all while giving users control through their mobile phones.

Our system uses a GSM module (SIM800L) to send electricity consumption data via SMS, allowing users to monitor their usage remotely. It also includes a current sensor (ACS712) and a voltage divider to detect discrepancies between actual power flow and meter readings—a clear sign of tampering or theft. The Whole system is monitored or controlled by an **Arduino Microcontroller** with an energy meter. If any cheating is detected (in energy meter), the system instantly alerts the concerned authorities(user) and can even cut off power remotely via a relay.(automatically)

Key benefits of this system:

- Instant theft detection—unusual power usage triggers an alert(A alert message)
- Remote control—authorized users can turn the power on/off via SMS.
- Cost-effective & scalable—works with existing meters, reducing implementation costs.

This solution helps electricity providers reduce losses while giving consumers transparency and control over their usage.

Introduction

Electricity is a vital resource in modern life, yet power theft remains a major challenge for utility providers and consumers. Unauthorized tapping, meter tampering, and bypassing result in significant financial losses, inefficient power distribution, and increased costs for honest consumers. Traditional energy meters lack real-time monitoring and theft detection, making manual inspections inefficient and time-consuming.

How It Works

The system uses a simple GSM module (like a SIM card in a phone) to send electricity usage data to the user and the electricity company. A current sensor and a voltage divider keep checking if the actual power flow matches the meter reading. If someone tries to steal electricity (by tampering with the meter or using illegal connections), the system immediately sends an alert and can even cut off the power remotely to stop the theft. The whole system is controlled a Arduino Microcontroller.

Why This System is Useful

- **✓ No more manual meter reading** – Usage data is sent automatically
- **✓ Catches thieves instantly** – Detects meter tampering or illegal connections
- **✓ Saves money** – Reduces losses for electricity companies, which can lead to lower bills
- **✓ Easy to use** – Control and monitor electricity from anywhere via SMS

This system is a simple, low-cost solution to fight electricity theft and improve power management for everyone.

Literature review

Detection of power theft in every house and in industry for different methods of theft. A system is designed which will try to reduce the unlawful use of electricity and also lessen the probabilities of theft. Detect the theft and try to acquire theft manipulate [1].

Because of electric powered electricity theft, about 30-35 percent of the earnings earned through the electric board is going waste. Previous attempt to monitor the power theft has not resulted in well-ordered manner because of the unlawful practices of some of the employs and consumers. This studies goals at reducing all these difficulties by fabricating a simple system to send a message whenever there is a power theft activity at a certain location [2].

The electricity theft detection using microcontroller has been proposed. This system reduces the cost of man power for providing information regarding theft by consumers [3].

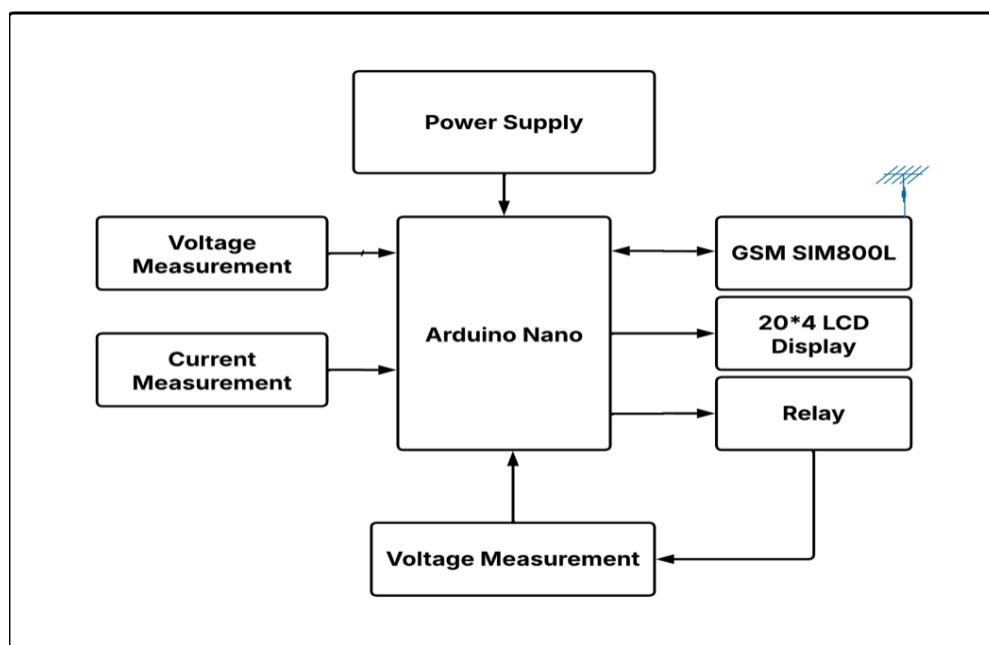
This paper considers a model to reduce the power theft. Use of GSM in this system provides a various advantage of wireless system. The government saves money by the manipulation of theft in energy meter and also more beneficial for customer side and the government side [4].

In this system the data collection and manipulation task become fast and easier. Also, it can be easily installed before for consumer energy meter for checking the consumer status [5]

Proposed Methodology

The proposed system uses an Arduino Nano microcontroller connected to voltage and current sensors for accurate power measurement. A GSM module (SIM800L) enables real-time data transmission via SMS, allowing both monitoring and remote-control functions. The system continuously compares actual sensor readings with expected meter values - when discrepancies exceed a predefined threshold, it automatically triggers a power theft alert. This alert is immediately sent via SMS to authorized personnel, who can then remotely disconnect power through SMS commands using the relay module. Simultaneously, all power consumption data is displayed locally on a 20x4 LCD screen. The system operates on a dual verification principle: first through hardware sensor validation and second via secure GSM authentication, ensuring reliable theft detection while maintaining user control over power supply. This integrated approach provides a cost-effective solution for modern energy monitoring needs while effectively combating electricity theft.

Block Diagram



Fig(1)

Circuit Diagram

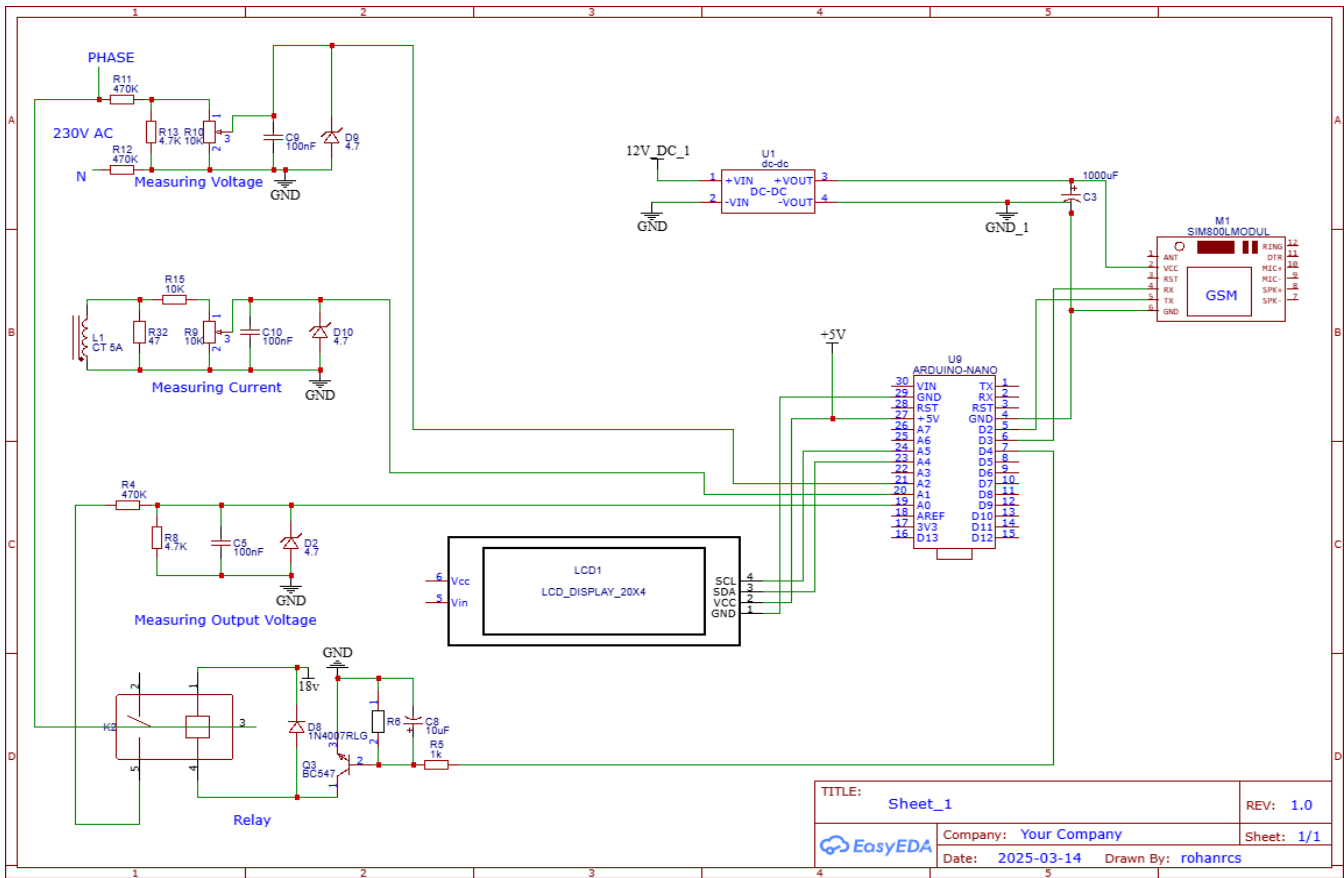


Fig (2)

As fig (1) shows the components and working is shown below:

The system consists of several key components working together to monitor and control electricity usage while detecting power theft. At its core is an Arduino Nano microcontroller that processes all the data and coordinates the other components. For power measurement, a voltage measurement circuit and current sensor (typically ACS712) continuously track the electrical parameters, allowing the Arduino to calculate real-time power consumption by multiplying voltage and current values. A 20x4 LCD display shows these live measurements including voltage, current and power usage for local monitoring.

Communication is handled by a GSM SIM800L module which enables SMS functionality - it sends regular usage updates to authorized users and can receive control commands. A relay module serves as the switching mechanism that can remotely disconnect power when needed. The entire system is powered by a stable power supply unit that provides electricity to all components.

The system operates by constantly comparing actual current flow measured by the sensor with the expected values. When discrepancies are detected that suggest meter tampering or unauthorized usage, the GSM module immediately sends theft alert notifications via SMS. Authorized personnel can then respond by sending SMS commands to control the relay, either cutting off power to prevent further theft or restoring supply when the issue is resolved. This combination of real-time monitoring, automated theft detection and remote-control capability makes the system an effective solution for modern energy management challenges while combating electricity theft. The data flows from the power supply through measurement sensors to the Arduino, which then shares information with both the display and GSM module while controlling the relay's operation.

Below shows the working of Fig (2):

This electricity monitoring system has several important parts that work together to measure and control power usage. The main brain of the system is the Arduino Nano, a small computer that makes all the decisions. It connects to different parts that help it do its job.

First, there's the power supply that gives electricity to all the components. Then there are measurement parts - one checks the voltage (how strong the electricity is) and another checks the current (how much electricity is flowing). These measurements help calculate how much power is being used.

The system shows all this information on a screen (the 20x4 LCD display) so you

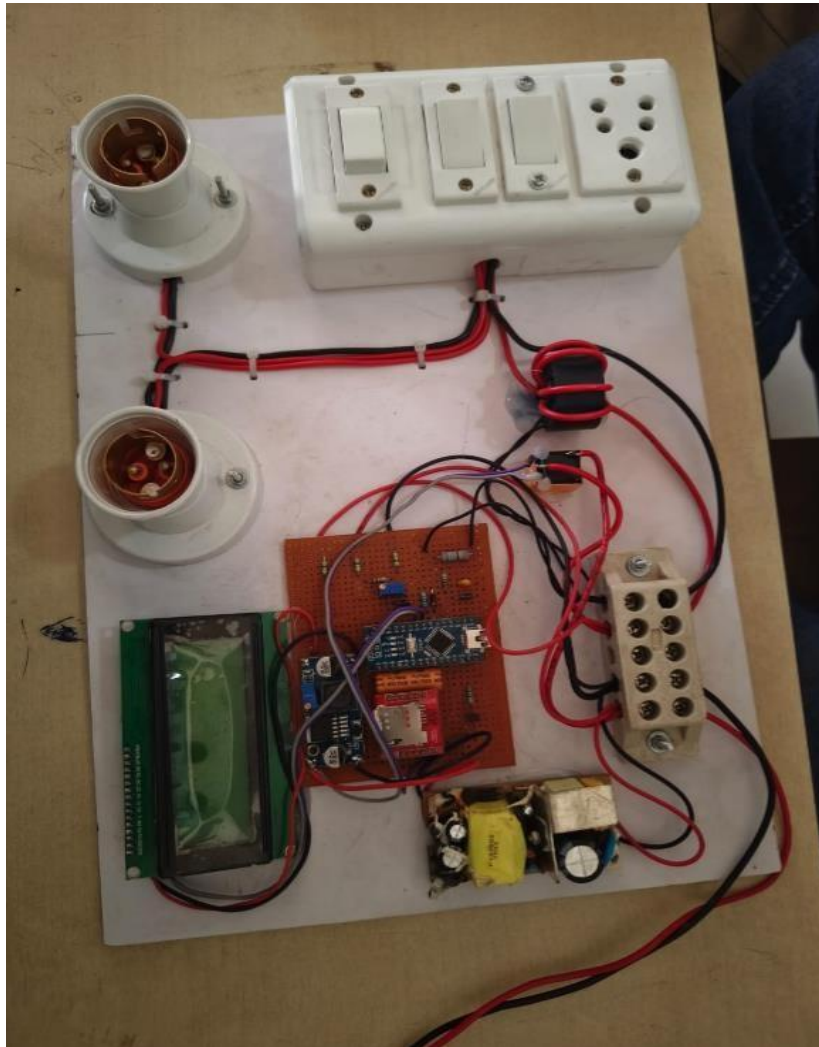
can see the numbers. It also has a GSM module (SIM800L) that can send text messages. If something unusual happens, like someone trying to steal electricity, it can send an alert message to your phone.

There's also a relay, which is like an automatic switch. The Arduino can tell the relay to turn the power off if it detects someone tampering with the system or stealing electricity. This helps stop power theft immediately.

The system constantly checks the electricity measurements to make sure everything is working normally. If the numbers don't match what they should be, it knows something is wrong and can take action. All these parts work together to create a smart system that watches over your electricity usage, can warn you about problems, and can even fix some problems automatically by turning power on or off when needed

Results

The real-time Controlling and Monitoring requires Voltage divider and Current Sensor is used, and relay is used to cut off power supply.



It includes all components said in the above working, circuit diagram and block diagram.

Notification

ALERT: Power Theft
Detected! Check
Energy Meter.

6:59 pm

Friday, 21 March

ALERT: Power Theft
Detected! Check
Energy Meter.

10:19 am

ALERT: Power Theft
Detected! Check
Energy Meter.

ALERT: Power Theft
Detected! Check
Energy Meter.

10:20 am

The Alert messages that come through the Arduino Nano.

When this message comes the relay will automatically cut off the Power Supply and the supply will shut down.

Conclusion

This GSM-based smart energy meter provides real-time power monitoring, detects theft by comparing sensor readings, and allows remote control via SMS. It helps prevent electricity theft, ensures accurate billing, and improves energy management with instant alerts and automated disconnection. A cost-effective solution for modern power distribution.

Future scope

The GSM-based smart energy meter with power theft detection has significant potential for future enhancements to improve functionality, efficiency, and user experience. One promising direction involves integrating IoT technology to enable cloud-based monitoring through mobile apps and web dashboards, providing more detailed analytics and historical consumption patterns. Artificial intelligence and machine learning algorithms could be implemented to analyze usage trends and detect more sophisticated forms of power theft through pattern recognition. The system could be upgraded with blockchain technology to create tamper-proof records of energy transactions, ensuring complete transparency in billing.

Additional sensors could be integrated to monitor power quality parameters like harmonics and voltage fluctuations. The system could also evolve to include predictive maintenance features by analyzing meter health data, and could be scaled up for industrial applications with higher voltage/current capacity. These advancements would transform the basic monitoring system into a comprehensive energy management platform while maintaining its core anti-theft functionality.

The GSM-based smart energy meter with power theft detection also has significant potential for future enhancements to improve safety and energy conservation for the user if any power theft occurs in energy meter. It involves a addition of GPS Tracker in the system. If any power theft occurs in the system, the GPS will send the location of the energy meter where power theft is going on. With the help of GPS Tracker, we are able to prevent the power loss and save electricity from loss.

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