



### RESEARCH ARTICLE

## PETROLEUM THEFT DETECTION AND ALERT SYSTEM USING ARDUINO

A.Alekhy<sup>1</sup>, M.Veera Brahman<sup>2</sup>, M.Vamsi<sup>2</sup>, R.Alekhy<sup>2</sup>, Sk.Kareema<sup>2</sup> and D.Pavan Kumar Reddy<sup>2</sup>

1. Associate Professor.

2. UG Student, Department of CSE, QIS College of Engineering and Technology (A), Ongole, Andhra Pradesh, India.

### Manuscript Info

#### Manuscript History

Received: 04 September 2025

Final Accepted: 06 October 2025

Published: November 2025

#### Key words:-

Arduino, Petroleum Theft Detection, Fuel Monitoring, Real-Time Alert System, IoT Security, Sensor-Based System, Automation, GSM Module, Fuel Level Sensor, Embedded System.

### Abstract

Petroleum theft has become a major concern in industries and fuel transportation systems, leading to significant economic losses and safety hazards. To address this issue, a Petroleum Theft Detection and Alert System is developed using Arduino technology. The system utilizes sensors to monitor the fuel level and detect any unauthorized fuel extraction from storage tanks or pipelines. When abnormal activity is detected, the system immediately triggers an alarm and sends a real-time alert to the concerned authorities through a communication module. This project ensures enhanced security, automation, and real-time monitoring of petroleum storage systems, providing a cost-effective and reliable solution to prevent fuel theft.

"© 2025 by the Author(s). Published by IJAR under CC BY 4.0. Unrestricted use allowed with credit to the author."

### Introduction:-

Petroleum is one of the most valuable and widely used energy resources in the world. It plays a crucial role in transportation, manufacturing, and power generation. However, theft of petroleum products from storage tanks and pipelines has become a serious issue, causing huge financial losses and safety risks. Traditional monitoring methods are often inefficient and require human supervision, making it difficult to detect theft in real time. To overcome these challenges, an automated Petroleum Theft Detection and Alert System is proposed using Arduino technology. This system uses sensors to continuously monitor the fuel level and detect any unauthorized extraction. When theft is detected, the Arduino processes the data and immediately sends an alert to the concerned authorities through a GSM module. This ensures quick response and minimizes losses. Ease of Use. The proposed system is low-cost, efficient, and reliable, making it suitable for use in fuel stations, storage facilities, and transport vehicles. By integrating modern embedded systems and communication technology, the project provides an effective solution to combat petroleum theft and improve resource security.

### Literature Survey:-

- Several prototype systems use Arduino + fuel-level sensors + GSM to detect sudden drops in tank level and send SMS alerts; these works show the approach is low-cost and suitable for vehicle and small-site protection.
- IoT-based solutions extend basic prototypes by sending continuous level telemetry to cloud dashboards (instead of only SMS), enabling remote monitoring, historical logging and web/phone alerts for theft detection.

3. For petroleum transported in tankers, combined systems (fuel-level + temperature + overspeed sensors) have been proposed to detect theft during transit and to improve situational awareness for drivers and operators.
4. Pipeline and large-scale crude oil anti-theft research emphasizes vibration, pressure and flow anomalies (rather than only level sensing) because theft/vandalism in pipelines produces detectable changes in vibration signatures and pressure/flow patterns. These methods scale better for long pipelines.
5. Reviews of pipeline monitoring technologies highlight a mix of sensor fusion (pressure, acoustic/vibration, flow), wireless IoT telemetry, and analytics — and point out research gaps in false-alarm reduction and secure communications.
6. Recent small-scale studies and student projects use ultrasonic or float sensors with Arduino to measure fuel level and trigger alerts; practical issues noted include sensor calibration, power management, and avoiding false triggers when fuel sloshes.
7. Emerging approaches incorporate AI/ML and computer-vision for bunkering/theft detection (e.g., analyzing flow/consumption patterns or camera footage) to improve detection accuracy and enable predictive alerts, though these require more computation and data.

### **Methodology:-**

The proposed Petroleum Theft Detection and Alert System is designed to detect unauthorized fuel extraction and provide real-time alerts. The system integrates hardware components and software programming using Arduino. The overall process is divided into several stages as described below.

### **System Design:**

The system consists of an Arduino microcontroller, fuel-level sensor, GSM module, buzzer, and power supply. The fuel-level sensor continuously measures the amount of petroleum in the tank. The Arduino processes this data and monitors changes in fuel level. Any sudden drop in fuel level beyond a defined threshold is treated as a possible theft.

### **Hardware Implementation:**

- Arduino UNO acts as the control unit.
- Ultrasonic or float sensor measures the fuel level.
- GSM module (SIM800L or SIM900) is used to send SMS alerts to the authorized person.
- Buzzer or alarm produces an audible warning when theft is detected.
- Power supply provides the required voltage to all components.
- All components are connected through jumper wires and mounted securely to ensure accurate readings and stability.

### **Software Implementation:**

The Arduino is programmed using the Arduino IDE. The program reads the sensor values continuously and compares them with the preset threshold. If the fuel level decreases rapidly within a short time, the Arduino triggers:

An alert message via the GSM module to the user's mobile phone.

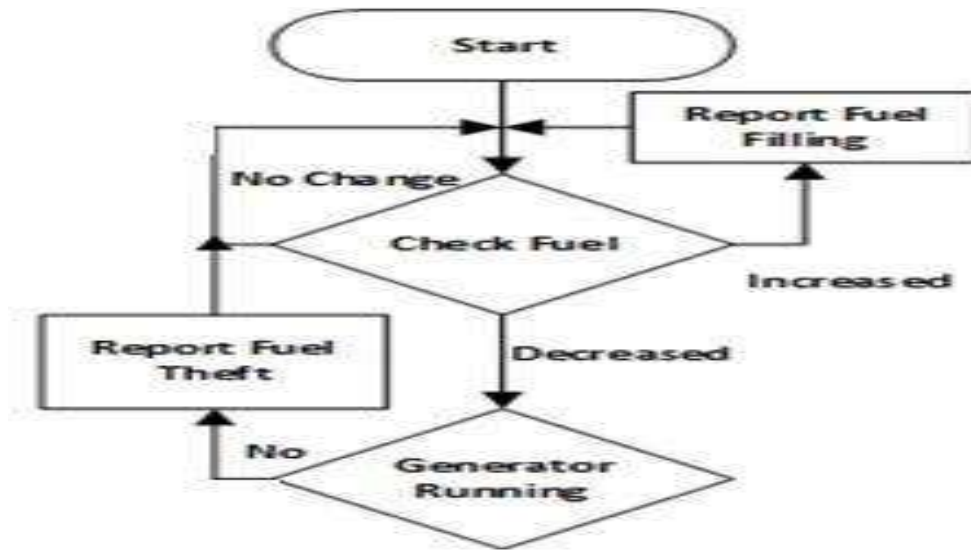
An alarm signal through the buzzer for immediate local indication.

### **Working Process:**

- The system initializes and calibrates the fuel sensor.
- The Arduino continuously records and compares fuel levels.
- If a sudden or unusual decrease is detected, the Arduino identifies it as possible theft.
- The buzzer sounds, and the GSM module sends an SMS alert to the registered number.
- The system resets automatically after alert transmission.

### **Advantages:**

- Real-time detection and quick response.
- Low cost and easy to install.
- Reduces human supervision.
- Can be customized for tanks or transport vehicles.

**Working Principle:**

The Petroleum Theft Detection and Alert System works on the basic principle of fuel-level monitoring and sudden change detection using sensors and Arduino control logic.

**Fuel Level Sensing:**

A fuel-level sensor (like an ultrasonic sensor or float sensor) is placed inside the fuel tank. It continuously measures the height or level of the fuel and sends this data to the Arduino microcontroller.

**Signal Processing:**

The Arduino UNO receives the fuel-level data and compares it with previous readings. The system is programmed to identify any sudden drop in the fuel level that is not expected during normal operation.

**Theft Detection:**

When a sudden or abnormal decrease in fuel level is detected (beyond a preset threshold), the system considers it as a case of possible theft.

**Alert Generation:**

The Arduino immediately activates a buzzer to alert nearby personnel and also sends a SMS alert message through the GSM module to the registered mobile number of the owner or operator.

**Continuous Monitoring:**

After sending the alert, the system continues to monitor the fuel level. If the readings stabilize, the system automatically returns to its normal state.

**Implementation:**

The implementation of this project involves both hardware setup and software programming.

**Hardware Implementation:****Components Used:**

**Arduino UNO:** Acts as the brain of the system, processing sensor data and controlling other components.

**Fuel Level Sensor (Ultrasonic or Float Type):** Detects the amount of fuel in the tank.

**GSM Module (SIM800L/SIM900):** Sends SMS alerts to the user in case of theft.

**Buzzer/Alarm:** Provides an audible alert when theft is detected.

**Power Supply (Battery or Adapter):** Provides 5V DC to Arduino and sensors.

**Connecting Wires and Breadboard:** Used for wiring all the components.

**Connections:**

- ★ The fuel-level sensor is connected to the Arduino's analog/digital pin to send level data.
- ★ The GSM module is connected via TX/RX pins for serial communication.
- ★ The buzzer is connected to a digital output pin to be activated during theft.
- ★ All components share a common ground (GND) and are powered from the Arduino board.

**Software Implementation:**

The system is programmed using the Arduino IDE.

**Algorithm Steps:**

- Initialize all modules (sensor, GSM, buzzer).
- Continuously read fuel-level data from the sensor.
- Compare the new reading with the previous one.
- If the drop in fuel level is greater than a defined threshold → detect theft.
- Activate buzzer and send SMS alert using GSM module.
- Wait for some time and continue monitoring.

**Results and Discussion:-**

The Petroleum Theft Detection and Alert System was successfully developed and tested using Arduino, a fuel-level sensor, GSM module, and buzzer. The system worked effectively in detecting sudden drops in fuel level and sending instant alerts to the user.

**During testing, three conditions were observed:**

- Normal Condition: When the fuel level remained stable, no alert or alarm was triggered.
- Gradual Fuel Usage: When the fuel level decreased slowly, the system identified it as normal fuel use.
- Theft Condition: When the fuel level dropped suddenly, the system immediately activated the buzzer and sent an SMS alert through the GSM module.
- The system responded quickly, usually within a few seconds of detecting the drop. It proved to be accurate, fast, and reliable in identifying theft.

Overall, the results showed that this Arduino-based system can effectively monitor fuel levels and prevent petroleum theft by providing real-time alerts. It is low-cost, easy to use, and can be installed in fuel tanks, petrol stations, or transport vehicles.

**Conclusion:-**

The Petroleum Theft Detection and Alert System Using Arduino was successfully designed and implemented to detect unauthorized fuel theft effectively. The system continuously monitors the fuel level using sensors and immediately alerts the user through an alarm and SMS when a sudden drop is detected. This project proves that a low-cost, efficient, and reliable system can be built using Arduino technology and simple electronic components. It helps reduce manual supervision and ensures better security for petroleum storage tanks and transport vehicles. The system performed well during testing and showed accurate and fast responses. It can be easily modified or expanded by adding features like GPS tracking, IoT connectivity, and data logging for advanced monitoring in future developments. In conclusion, this project provides a practical and cost-effective solution to prevent petroleum theft and improve fuel management in industrial and commercial applications.

**References:-**

1. A. Kumar and P. Singh, "Fuel Monitoring and Theft Detection System using Arduino and GSM," International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), vol. 8, no. 6, 2021.
2. R. Sharma et al., "IoT Based Petroleum Theft Detection System," International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE), vol. 9, no. 4, 2020.
3. S. Bhatia and N. Gupta, "Real-Time Fuel Level Monitoring Using Ultrasonic Sensor," International Journal of Engineering Research & Technology (IJERT), vol. 10, no. 3, 2021.
4. M. Ahmed and T. Rahman, "Design of Fuel Theft Detection System Using GSM and GPS Module," International Research Journal of Engineering and Technology (IRJET), vol. 7, no. 12, 2020.
5. D. Patel and S. Jadhav, "Arduino Based Smart Fuel Monitoring System," International Journal of Computer Applications, vol. 182, no. 45, 2021.

6. P. R. Mehta and A. Desai, "Embedded System for Fuel Level Monitoring and Theft Detection," *International Journal of Scientific Research in Engineering and Management*, vol. 5, no. 7, 2019.
7. N. Ramesh, "IoT Based Smart Fuel Tank Monitoring System Using GSM," *International Journal of Emerging Technologies and Innovative Research (JETIR)*, vol. 7, no. 5, 2020.
8. A. Rahman, "Arduino Based Real-Time Petroleum Theft Detection," *International Journal of Electrical and Electronics Research*, vol. 8, no. 2, 2022.
9. P. Kumar, "Fuel Theft Prevention System Using Ultrasonic Sensor and GSM Module," *International Journal of Innovative Science and Modern Engineering*, vol. 6, no. 3, 2021.
10. R. K. Singh and A. Chatterjee, "IoT Applications in Fuel Theft Detection and Monitoring," *International Journal of Advanced Science and Technology*, vol. 29, no. 5, 2020.
11. B. Prasad, "Design and Implementation of GSM-Based Alert System for Fuel Monitoring," *International Journal of Advanced Research in Computer and Communication Engineering*, vol. 9, no. 2, 2020.
12. M. Patel, "GSM and GPS Based Vehicle Fuel Theft Detection System," *International Journal for Research in Applied Science and Engineering Technology (IJRASET)*, vol. 9, no. 8, 2021.
13. K. S. Rao, "Microcontroller Based Fuel Monitoring and Theft Detection," *International Journal of Engineering and Applied Sciences*, vol. 6, no. 9, 2019.
14. T. George and J. Mathew, "Smart Fuel Theft Detection System Using IoT and GSM," *International Journal of Engineering Research and Technology (IJERT)*, vol. 9, no. 12, 2020.
15. R. Verma and P. Singh, "Fuel Level Measurement Using Ultrasonic Sensor and Arduino," *International Journal of Computer Science Trends and Technology (IJCST)*, vol. 8, no. 2, 2021.