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# Vehicle Fuel Theft Detection System

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***Abstract* - Fuel theft from autos, particularly motorcycles and cars, is a prevalent problem that costs owners a lot of money and causes them great hardship. The research focuses on the design and implementation of a GSM-based vehicle fuel theft detection system to eliminate this issue. The suggested method makes use of a GSM modem to notify the owner via SMS in the event of theft and a level sensor to track the fuel level in the tank. At the central processing unit, the microcontroller integrates sensor inputs and controls the communication protocol. When the ignition key is withdrawn from the vehicle, the system is triggered, providing protection only when the vehicle is left alone. The objective of this solution is to improve vehicle security and reduce incidences of fuel theft.**

***Keywords — GSM(Global System for Mobile Communication) modem, Fuel theft detection, SMS(Short Messaging Service) alert, Vehicle security, Microcontroller, Real-time monitoring, Ignition key interface***

## I. INTRODUCTION

Fuel theft is still a major problem for car owners around the world, resulting in substantial financial loss and inconvenience. Traditional anti-theft devices are less effective as automobiles get more sophisticated and criminals' techniques change accordingly. To protect vehicle fuel, creative and dependable solutions must be developed in response to this continuous challenge.

Fuel theft affects commercial fleet operators as well as private car owners, leading to higher operating costs and logistical difficulties. The downtime related to refilling and handling the aftermath of the theft adds to the cost strain. Furthermore, it is impossible to ignore the psychological toll that frequent fuel theft instances take on car owners.

Traditional anti-theft devices, such as fuel tank locks and alarm systems, sometimes fall short of preventing fuel theft. Determined thieves can evade these security measures by adopting a variety of strategies to siphon fuel without triggering alarms or causing visible damage. As a result, there is an urgent need for a more comprehensive approach that includes real-time monitoring along with rapid alarms.

This study presents a GSM-based vehicle fuel theft detection system that addresses these problems. The device uses a level sensor to continuously monitor the fuel level in the tank. When the sensor detects a gasoline level drop below a predefined threshold, it alerts the microcontroller and the theft is detected. The microcontroller, which serves as the system's central processing unit, activates a buzzer to deter the thief while also sending an SMS notice to the vehicle owner via a GSM modem. This dual-action response provides both immediate local deterrence and remote notice.
The system's activation is timed to correspond with the removal of the car's ignition key, ensuring it only acts when the vehicle is unattended. This strategy reduces false alerts and guarantees that the system is only activated when necessary. The research proposes an anti-theft system for vehicles that utilizes GSM technology to send SMS alerts to the owner in case of fuel theft. The system combines GSM with an existing vehicle alarm and relies on an infrared sensor to detect fuel theft attempts. Additionally, it can measure fuel level to estimate travel distance. The paper highlights the importance of fuel security and aims to address the rising number of fuel theft cases. However, the effectiveness of the system depends on GSM network coverage in the vehicle's location.GSM-based technology is a cheap and easy to use solution that can send SMS to the vehicle owner and trigger an alarm in case of theft.[1]

Another paper proposes a new anti-theft system to combat the rising issue of stolen vehicles. Traditional methods often result in stolen cars being sold illegally, dismantled, or even destroyed, making recovery difficult. This system offers a multi-layered approach for improved security and recovery. It utilizes a microcontroller to manage various functionalities. Fingerprint scanner, RFID tag, or a password can be used for authorized access, replacing the traditional car key. To detect unauthorized entry attempts, a tilt sensor monitors for unusual movements or vibrations. If a breach is detected, the system sends an SMS alert to the owner's phone with the vehicle's location via GPS and sounds an alarm. Additionally, it can disable the fuel injector, preventing the engine from starting even if the thief bypasses other security measures. This system provides several advantages. Multi-factor authentication makes it harder to steal the car, and real-time GPS tracking allows for faster recovery. Engine immobilization offers another layer of security, this multi-layered anti-theft system with multi-factor authentication and tracking offers a significant improvement over traditional methods, enhancing vehicle security and recovery chances.[2]

Another paper which help as it tackles three major theft concerns: siphoning fuel, tampering with the ignition, and stealing the entire vehicle. By utilizing the phone's built-in GPS and GSM capabilities, the system can track the vehicle's location in real-time and send SMS alerts to the owner. This clever repurposing keeps costs down and reduces environmental impact compared to buying new hardware. To detect tampering attempts, the system uses a vibration sensor. An onboard microcontroller (MCU) monitors this sensor and the vehicle's fuel level sensor. If the MCU detects any suspicious activity, it triggers an alarm and can even cut off the engine using relays. The system's functionality is further enhanced by two Android applications. One app runs on the repurposed smartphone inside the vehicle. It communicates with the MCU, sending SMS alerts and updates to a cloud database whenever theft is suspected. The other app is for the user's phone, allowing them to lock/unlock the vehicle and see its location on demand. For secure data storage, the system utilizes a Google Firebase database. This allows the user to access past theft reports and provides a central location for information. Additionally, the system includes a user forum. Here, victims of theft attempts can share reports from the database and connect with other users for support or to share valuable information.[3]

This GSM-based fuel theft detection system provides a comprehensive solution to an ongoing issue by combining real-time monitoring, local alarms, and remote messages. Implementing such a system has the potential to drastically minimize fuel theft incidences, giving vehicle owners and operators peace of mind while also saving them money. The research describes the suggested system's design, development, and testing, demonstrating its effectiveness in real-world circumstances.

## II. Literature Review

Networked Tethered Flying Platforms (NTFPs) are a new technology gaining interest for their potential to revolutionize communication networks. Unlike free-flying drones, NTFPs are tethered to ground stations, providing constant power and data. This unique feature gives them key advantages: they can stay operational for much longer durations, cover broader areas, and transmit data through a reliable, high-capacity connection.

This survey delves deep into the world of NTFPs. It explores the different types of these platforms, their functionalities, and the various benefits they offer, including cost-efficiency and ease of deployment. To ensure successful implementation, the survey acknowledges the economic considerations of deploying NTFPs. It also recognizes the challenges and areas that require further research before widespread adoption. Overall, this survey provides a comprehensive overview of Networked Tethered Flying Platforms and their potential to shape the future of communication technology.[4] This paper addresses a major issue in Indonesia - illegal fuel hoarding by oil tanker truck drivers during transport. Despite Pertamina, the national oil company, implementing various technologies to prevent this theft, the problem persists.

To address this challenge, the authors propose a new automatic alarm system specifically designed for oil tank trucks. The system relies on a microcontroller as its central processing unit, along with a GSM module for mobile network communication, GPS for real-time tracking, and ultrasonic sensors to detect unauthorized access to the fuel tank. The system's intelligence comes from an algorithm created based on observations of how these drivers steal fuel. Experiments show that the system can effectively safeguard oil throughout its journey, from terminals to gas stations and back. This is expected to significantly reduce illegal hoarding, leading to benefits for both Perta-mina and gas station owners by minimizing fuel theft losses. While the paper demonstrates the system's success in identifying basic theft attempts, it doesn't detail how the system reacts upon detecting such an incident (e.g., alerting authorities, stopping fuel flow). Nevertheless, this automatic alarm system presents a promising new approach to combating fuel theft in oil transportation, offering improved security and reduced financial losses.[5]

Also, a new research work proposes a smartphone application to combat the increasing vehicle theft rates in Indonesia. The problem is particularly severe, with Aceh Province recording over 1,600 stolen vehicles in 2016 alone. The proposed solution is an Android application designed for vehicle monitoring and tracking. The app utilizes GPS and Google Maps to pinpoint the user's vehicle location. If the vehicle moves from its parked location, the app not only alerts the owner but also tracks the movement in real-time. The application's development followed the Agile software development methodology, emphasizing flexibility and rapid adaptation. To ensure functionality and accuracy, the app underwent three tests. The first test confirmed the app works reliably in various locations, including crowded areas. The second test focused on distance accuracy, and the results showed that incorporating altitude data significantly improves accuracy, both indoors and outdoors. Finally, a test measured the response time between the app and the Firebase web service it interacts with. The average response time of 2.15 seconds indicates good performance for a smartphone application. In essence, this paper presents a promising solution for curbing vehicle theft in Indonesia. The Android application's real-time tracking and location features, coupled with its accuracy and responsiveness, position it as a valuable tool for improving vehicle security.[6]

A new paper proposes a cost-effective and eco-conscious theft detection system designed specifically for two-wheeled vehicles. The system addresses three main theft concerns: siphoning fuel, tampering with the ignition, and stealing the entire vehicle itself. What makes this system unique is its reliance on a repurposed smartphone. By utilizing an old or unused Android device, the system leverages the phone's built-in GPS and GSM capabilities to track the vehicle's location in real-time and send SMS alerts to the owner. This clever reuse of existing hardware keeps costs down and reduces environmental impact compared to buying new parts.

To detect tampering attempts, the system uses a vibration sensor. The system's brains are an onboard microcontroller (MCU) that monitors this sensor and the vehicle's fuel level sensor. If the MCU detects any suspicious activity, it can sound an alarm and even cut off the engine using relays.

The system's functionality is further enhanced by two Android applications. One app runs on the repurposed smartphone inside the vehicle, communicating with the MCU. It triggers SMS alerts and updates a cloud database whenever theft is suspected. The other app is for the user's phone, allowing them to lock/unlock the vehicle and see its location on demand.

For secure data storage, the system utilizes a Google Firebase database. This allows the user to access past theft reports and provides a central location for information sharing. Additionally, the system boasts a user forum. Here, victims of theft attempts can share reports from the database and connect with other users for support or to share valuable information.

In essence, this paper offers a promising and affordable solution for two-wheeler theft. By reusing existing hardware and leveraging cloud technology, the system provides cost-effective and eco-friendly theft detection with real-time tracking and a user-friendly interface. The unique user forum fosters a sense of community and support among users.[7]

Car accidents are a growing problem, caused by increased traffic and driver distractions from technology. This paper proposes a new in-car system to improve response times and outcomes in these situations. The system uses multiple sensors to detect accidents. A vibration sensor picks up on sudden movements that might indicate a collision. An unspecified "inaudible detector" might identify sounds or signals related to an accident.

If an accident is detected, the device springs into action. It uses a GSM module to send an emergency message to a central location, like a police station or rescue team. This message also includes the vehicle's location data from a GPS module. The response team receives the message and can see the location on Google Maps. If the situation seems serious, they can immediately dispatch help. If it appears to be a minor incident, the driver can cancel the alert to avoid wasting emergency resources.

This system offers several benefits. Faster emergency response times can save lives in critical situations. The GPS data ensures rescuers can find the accident scene quickly. It also helps to reduce false alarms by allowing drivers to cancel unnecessary alerts. The data collected by the system could even be useful for police investigations. The paper also proposes a potential future advancement: integrating a portable digital camera to capture images of the accident scene. Overall, this paper describes a promising use of technology to improve car accident response. By enabling faster and more effective help, this system has the potential to save lives and minimize property damage.[8] Just like our bodies need food for energy, the modern world relies on fuel to function. It powers our transportation and industries, and without it, our way of life wouldn't be possible. Stealing fuel, or "fuel burglary" as the paper calls it, is a major problem. This paper proposes a solution: a fuel level monitoring system for vehicles. This system keeps a close eye on fuel levels and provides real-time alerts to the driver. It uses a combination of sensors: An ultrasonic sensor constantly monitors the fuel level. A flow sensor detects any leaks that might occur. A vibration sensor helps identify potential theft attempts. The system also includes a GPS module to track the vehicle's location. All this data is collected by an ESP32 WIFI module, which acts as the brain of the system.

When the system detects a problem, it springs into action. An API-based messaging system can send alerts if fuel theft or leaks are suspected. Additionally, a built-in sound alert system immediately notifies the driver of any leaks. The system even helps with planning. When fuel levels get low, it uses the Haversine formula to calculate the distance to the nearest gas station. The driver then receives a recommendation for the closest place to fill up. In summary, this paper describes a comprehensive system for monitoring fuel levels, preventing theft, and even helping drivers find gas stations when running low.[9]

Parking lots, especially those without security cameras or guards, are vulnerable to fuel theft. This paper proposes a new Fuel Monitoring System to address this problem. The system utilizes embedded system technology to keep a close eye on fuel levels in real-time. This proactive approach allows for early detection of potential theft. If the system suspects fuel theft is happening, it immediately sends a text message notification to the vehicle owner through its embedded Global Communications Technology (GSM).

The design prioritizes affordability and simplicity, making it a cost-effective solution. However, it doesn't compromise on effectiveness. By integrating a microcontroller, the system transforms into a user-friendly and advanced security solution that can be implemented in various parking environments. In summary, this paper presents a cost-effective and user-friendly Fuel Monitoring System specifically designed for parking lots with limited security. By offering real-time monitoring and instant theft alerts, the system provides valuable security for vehicle owners.[10]

While modern cars use digital displays to show fuel level, the exact amount remaining can be inaccurate. This research paper proposes a more precise fuel measurement system. The proposed system utilizes two sensors to improve accuracy:

Ultrasonic sensor: This sensor works like sonar, sending sound waves and measuring the time it takes for them to echo back from the fuel surface. By calculating this distance, the sensor estimates the fuel level.

Flow sensor: This sensor monitors the rate of fuel entering or exiting the tank. By tracking the total flow, it can estimate the remaining fuel. An Arduino board acts as the brain of the system, collecting data from both sensors and calculating the fuel level. The results are then displayed on a Liquid Crystal Display (LCD) for easy viewing. This system offers several advantages. Not only can it be used in cars for more accurate fuel level readings, but it's adaptable for measuring other liquids like milk or water. Additionally, it can track fuel consumption more precisely, allowing for better monitoring of fuel efficiency.[11]

Modern cars are packed with technology, but this paper proposes a new system that takes things a step further. It's a comprehensive driver assistance system designed to improve safety, security, and fuel efficiency. This system isn't just about navigation. It acts like a guardian for both the driver and the car. It constantly monitors the car's health, keeping the driver informed about any potential issues. It also adds extra security layers to deter theft. Safety is a major focus. The system can prevent the car from starting if it detects the driver has been drinking alcohol. In case of an accident, it automatically sends out an emergency alert, potentially saving lives. Another interesting feature is a highly accurate method for calculating fuel levels. This helps drivers plan their trips more effectively and avoid running out of gas unexpectedly.

The system is designed to be affordable. It uses a combination of Raspberry Pi and Arduino, which are powerful but cost-effective options.[12] Overall, this paper presents a promising vision for the future of in-car technology. This system prioritizes safety, offers security against theft, and provides valuable information for a more informed and efficient driving experience.

## III. Proposed Methodology & Experimental Prototype

*3.1 Block Diagram:*

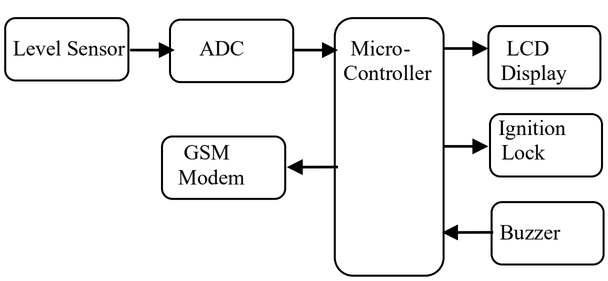


Fig. 1. Block Representation of Vehicle Fuel Theft Detection System

*3.2 System design and implementation:*

*3.2.1Hardware Development:*

The hardware architecture of the GSM-based car fuel theft detection system includes many important components that work together to monitor gasoline levels and notify the vehicle owner in the event of theft. The main components are a level sensor, microcontroller, GSM modem, buzzer, ignition key interface, and an LCD display.

*A. Level sensor*

The level sensor continuously monitors the fuel level in the vehicle's tank. A capacitive fuel level sensor is employed in this project because of its great accuracy and reliability. The sensor is positioned within the gasoline tank and generates an analog signal that is proportional to the fuel level. This signal is subsequently passed into the microcontroller for processing.

Fig. 2. Level sensor

*B. Arduino uno*

The central processing unit is a microcontroller called the Arduino Uno. This decision is based on the Arduino Uno's ease of use and enough input/output functionality. The microprocessor evaluates the level sensor's analog signal and uses specified criteria to determine whether a fuel theft condition occurs. When the microcontroller detects a theft condition, it activates a piezoelectric buzzer and a GSM modem.


Fig. 3. Arduino uno

*C.GSM modem*

The GSM modem, specifically the SIM900 module, was chosen for its compatibility with the Arduino and consistent performance when delivering SMS messages. The modem connects to the mobile network via a SIM card and sends programmed alarm messages to the owner's phone when a theft condition is identified.

Fig. 4. SIM900 module

*D.Buzzer*

A piezoelectric buzzer provides an aural deterrent by emitting a loud sound that deters the burglar and alerts nearby individuals. The microcontroller activates the buzzer when the fuel level falls below a certain threshold.

Fig. 5. Buzzer

*E.LCD display*

Furthermore, a liquid crystal display is integrated to offer instantaneous feedback regarding the status of the device. The status of system activation, the current fuel level, and any alerts are displayed on the 16x2 character LCD display. The I2C standard is used to interface this display with the Arduino Uno, making the wiring and coding procedure simpler.


Fig. 6.2*16 LCD display

*F.Ignition key*

An ignition key interface is used to guarantee that the system only operates when the car is left unattended. An easy-to-use mechanical switch that is linked to the ignition lock is used in this interface. The switch closes when the ignition key is removed, telling the microcontroller to turn on the system.

Fig. 7. Ignition key

*3.2.2.Software Design*

The software design includes the microcontroller firmware and the SMS alert system. The firmware is written in C++ and uploaded to the Arduino Uno. It is responsible for monitoring the fuel level, processing sensor data, and triggering appropriate actions based on predefined conditions.

*1.Microcontroller Firmware*

The firmware on the microcontroller initializes the hardware and keeps an eye on the fuel level all the time. It receives the analog input from the level sensor, translates it into a digital fuel level value, and then compares that value to a preset threshold. The firmware uses the GSM modem to send an SMS alert and activates the buzzer in the event that the fuel level falls below this threshold.

*2. SMS Notification System*

At instructions are used to operate the GSM modem in the SMS alert system. The firmware notifies the vehicle owner via SMS on their phone when it detects a theft condition. "Alert: Fuel theft detected in your vehicle," is shown. "Immediate action required" guarantees that any suspicious behavior is reported to the owner as soon as possible, enabling fast intervention.

*3. System Activation and Operation*

When the vehicle's ignition key is withdrawn, the system is supposed to turn on. This event is detected by the ignition key interface, which then instructs the microcontroller to begin monitoring the fuel level. The firmware continuously checks the fuel level and sounds the buzzer and sends an SMS alert if it detects a dip below the threshold. The alert is sent, and then the system resets to keep watching.

### *3.3 Algorithm*

1. Import Libraries and Initialize Components

Inputs: None
Outputs: Initialized hardware components

Steps:

1. Import necessary libraries for microcontroller programming (e.g., Arduino IDE).
2. Initialize microcontroller peripherals (e.g., LCD display, buzzer, GSM modem).
3. Set up communication protocols for GSM modem (e.g., UART).

2. Monitor Fuel Level and System Activation

Inputs: Analog signal from the level sensor, ignition key status
Outputs: System activation status, fuel level reading

Steps:

1. Read analog signal from the fuel level sensor.
2. Check ignition key status:
   I. key is removed:
   II.Activate the system for monitoring.
   III.f key is inserted:
   IV.Deactivate the system.

3. Continuous Monitoring and Alert Triggering

Inputs: Fuel level reading, predefined threshold value
Outputs: Activation of buzzer and SMS alert system

Steps:

1. Continuously monitor the fuel level.
2. If fuel level drops below predefined threshold:
   I.Activate the buzzer to deter the thief.
   II.Trigger the SMS alert system to notify the owner.

4. Send SMS Alert

Inputs: Theft detected flag, GSM modem configured for SMSOutputs: SMS alert sent to owner's mobile phone

Steps:

1. Check if theft condition is detected:
   I.If yes, proceed to next step.
   II.If no, continue monitoring fuel level.

2. Initialize GSM modem for SMS communication.
3. Compose and send predefined alert message to owner's mobile phone.
4. Wait for acknowledgment or retry mechanism.

5. User Interface Interaction

Inputs: None
Outputs: GUI for user interaction and testing

Steps:

1. Develop GUI using Tkinter for user-friendly interaction.
2. Allow users to draw numerals on canvas using mouse input.
3. Implement real-time recognition by trained CNN for drawn digits.
4. Display recognition results and system status on the GUI.

6. System Reset and Continuous Operation

Inputs: None
Outputs: Continuous monitoring and operation

Steps:

1. After sending alert and/or deterring theft, reset the system.
2. Resume continuous monitoring of fuel level and system activation.
3. Implement error handling and recovery mechanisms for robust operation.
4. Ensure system remains operational until key is reinserted or manual intervention.

### A. Flowchart

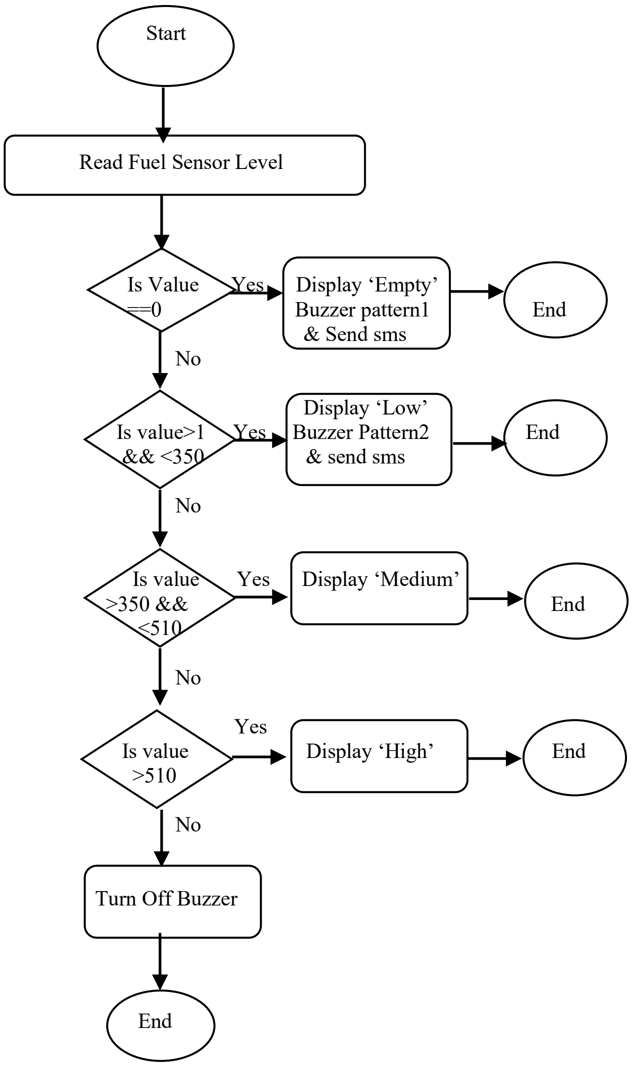


Fig. 2. Flowchart Representation of Vehicle Fuel Theft Detection System

## IV. FUTURE PLAN

A prototype system with a fuel tank mock-up, a calibrated level sensor, an Arduino Uno microcontroller, a SIM900 GSM modem, and a buzzer made up the experimental setup. The gasoline level sensor was meticulously calibrated to identify notable decreases in fuel, which may be signs of possible fuel theft. In a controlled setting, tests were carried out to mimic several gasoline theft scenarios that car owners frequently deal with.

The GSM-based Vehicle Fuel Theft Detection System's efficacy was demonstrated by the positive outcomes of the experimental tests. The alert mechanism was activated when the system successfully identified notable decreases in the fuel level. The technology provided real-time notifications by sending SMS alerts to the car owner's mobile phone as soon as it detected a possible theft occurrence. Furthermore, the buzzer was engaged as an auditory deterrent, increasing the system's efficiency in discouraging potential robbers. Overall, the trial results proved the system's functioning and reliability, emphasizing its potential to alleviate fuel theft worries for car owners.

The GSM-based fuel theft detection system demonstrated in this project is a practical and efficient way to tackling fuel theft concerns in cars. Its real-time alarm system and deterrent measures greatly improve security. Future developments, such as adding GPS for exact location monitoring and fine-tuning sensor accuracy, would broaden its capabilities, giving it a more comprehensive and robust option for car owners looking to improve fuel theft security.

## V. CONCLUSION

The GSM-based Vehicle Fuel Theft Detection System provides a strong and practical defence against vehicle fuel theft. The technology improves car owners' security by means of deterrent devices, timely alarms, and real-time monitoring. Its capabilities will likely be significantly enhanced by future developments in GPS integration, machine learning algorithms, and user interface enhancements. With scalability, energy efficiency, and regulatory compliance as top priorities, the system is set up to become a market-leading solution that not only stops fuel theft but also elevates vehicle security standards in a variety of industries. However, there are limitations that should be acknowledged. The accuracy of the sensors is compromised due to vibrations and external noise. It additionally requires steady power and stable connectivity, which can be compromised by low network coverage or Electro-Magnetic Induction (EMI). These limitations can be mitigated with further research.

## REFERENCES

[1] Saini, Manoj, and Shagufta Khan. "GSM Based Fuel Theft Detection." In 2021 1st International Conference on Power Electronics and Energy (ICPEE), pp. 1-6. IEEE, 2021.
[2] Noman, A. T., Hossain, S., Islam, S., Islam, M. E., Ahmed, N., & Chowdhury, M. M. (2018, September). Design and implementation of microcontroller based anti-theft vehicle security system using GPS, GSM and RFID. In 2018 4th International Conference on Electrical Engineering and Information & Communication Technology (iCEEiCT) (pp. 97-101). IEEE.
[3] Mukherjee, K. (2014, December). Anti-theft vehicle tracking and immobilization system. In 2014 International Conference on Power, Control and Embedded Systems (ICPCES) (pp. 1-4). IEEE.
[4] Belmekki, B. E. Y., & Alouini, M. S. (2022). Unleashing the potential of networked tethered flying platforms: Prospects, challenges, and applications. IEEE Open Journal of Vehicular Technology, 3, 278-320.
[5] Fadjrimiratno, M. F., Wicaksono, A., Prayogo, R. C., & Sidabutar, H. A. Y. (2015, November). Automatic oil tank truck alarm system from illegal fuel hoarding with microcontroller and GSM module based system. In TENCON 2015-2015 IEEE Region 10 Conference (pp. 1-6). IEEE.

[6] Mutiawani, V., Rahmany, S., & Abidin, T. F. (2018, September). Anti-theft vehicle monitoring and tracking android application using firebase as web service. In 2018 International Conference on Electrical Engineering and Informatics (ICELTICs) (pp. 72-77). IEEE.

[7] Krishnaprasad, C., Joseph, C. A., Sarath, I. S., & Manohar, O. R. (2021, May). A Novel Low-Cost Theft Detection System for Two Wheelers with Minimum Carbon Foot Print. In 2021 2nd International Conference for Emerging Technology (INCET) IEEE.

[8] Vijayalakshmi, N., Shrinithi, R., Sanjana, V., & Sowmiya, T. (2021, March). Vehicle Tracking and Locking System Based on GSM and GPS. In 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS) (Vol. 1, pp. 758-761). IEEE.

[9] Prabhu, S. B., Deepa, K., & Nithya, M. (2022, October). IoT enabled fuel level monitoring and automatic fuel theft detection system. In 2022 13th International Conference on Computing Communication and Networking Technologies (ICCCNT) (pp. 1-7). IEEE.

[10] Madhavan, A., & Sheela, A. (2024, February). Detecting Fuel Theft with Arduino. In 2024 Second International Conference on Emerging Trends in Information Technology and Engineering (ICETITE) (pp. 1-6). IEEE.

[11] Ramprasad, P., Reddy, C. V., & Prasad, B. S. (2021, August). Digital Fuel Monitoring System For Automobiles. In 2021 Second International Conference on Electronics and Sustainable Communication Systems (ICESC) (pp. 6-10). IEEE.

[12] Jabeen, F., Rupanagudi, S. R., & Bhat, V. G. (2019, December). IoT based smart vehicle ignition and monitoring system. In 2019 International Conference on Advances in Computing, Communication and Control (ICAC3) (pp. 1-7). IEEE.