# **ABSTRACT**

Petrol adulteration poses a significant threat to engine performance, environmental health, and consumer safety. This paper presents a GSM-based petrol adulteration detection system utilizing the MQ2 and MQ4 gas sensors interfaced with an Arduino Nano microcontroller. The system is designed to detect the presence of adulterants such as kerosene and other volatile substances in petrol by analyzing variations in gas concentration levels. The MQ2 sensor is sensitive to LPG, smoke, alcohol, and methane, while the MQ4 sensor primarily detects methane and natural gas, providing a reliable dual-sensor mechanism for improved detection accuracy. When abnormal gas concentration thresholds are detected, the system processes the data using the Arduino Nano and immediately transmits an alert via GSM to a designated mobile number, ensuring real-time monitoring and remote notification. The proposed system is low-cost, portable, and efficient, making it suitable for implementation at fuel stations, checkpoints, or within vehicles. Experimental results demonstrate the system's effectiveness in distinguishing between pure petrol and adulterated samples, offering a practical solution to curb fuel adulteration practices.

**INTRODUCTION**

Petroleum, as a crucial global energy source, plays a pivotal role in powering industries, transportation, and households. However, the purity and quality of petroleum products can be compromised through a practice known as petroleum adulteration. This illicit activity involves the intentional introduction of impurities or cheaper substances into petroleum products, leading to a range of economic, environmental, and health consequences.

Petroleum adulteration poses a severe threat to the economic stability of nations and industries. Adulterated fuels can disrupt the functioning of engines and machinery, leading to increased maintenance costs and reduced efficiency. Industries reliant on transportation and machinery, such as agriculture, manufacturing, and logistics, can experience significant financial losses due to the adverse effects on equipment performance.

Moreover, the economic impact extends to consumers who may unknowingly purchase adulterated fuels. This not only affects their vehicles' performance but can also lead to increased fuel consumption, placing an additional financial burden on individuals and households.

The adulteration of petroleum products contributes to environmental pollution and degradation. Impurities introduced during adulteration can release harmful emissions into the atmosphere when burned, contributing to air pollution and climate change. Additionally, the discharge of contaminated fuels into water bodies can harm aquatic ecosystems, affecting marine life and water quality.

The environmental repercussions are not only local but can have global implications, as the combustion of adulterated fuels contributes to the overall carbon footprint and exacerbates environmental challenges.

Adulterated petroleum products pose significant health risks to individuals and communities. The emissions resulting from the combustion of contaminated fuels contain pollutants such as particulate matter, sulfur compounds, and other toxic substances. Prolonged exposure to these pollutants can lead to respiratory diseases, cardiovascular problems, and other health issues.

Vulnerable populations, such as children, the elderly, and those with pre-existing health conditions, are particularly at risk. The widespread use of adulterated fuels in densely populated urban areas exacerbates the health impact, making it a critical public health concern.

This project is dedicated to advancing the detection methodology essential for identifying and preventing petroleum adulteration and addressing its effects and costs.

### 1.2 Problem Statement

Petrol adulteration, the illegal mixing of inferior or unauthorized substances such as kerosene into petrol, is a widespread issue that negatively impacts engine performance, increases harmful emissions, and leads to economic and environmental losses. Traditional methods of detecting fuel adulteration are often manual, time-consuming, expensive, and lack real-time monitoring capabilities. Moreover, there is limited access to portable and automated systems that can promptly identify and report adulteration at the point of sale or usage. Therefore, there is a critical need for a low-cost, automated, and real-time system that can accurately detect petrol adulteration and notify relevant authorities or users immediately to prevent damage and enforce fuel quality standards. This project aims to address this problem by developing a GSM-based petrol adulteration detection system using MQ2 and MQ4 gas sensors integrated with an Arduino Nano microcontroller.

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### **1.3 Aim and Objectives**

Aim:

To design and develop a low-cost, GSM-enabled petrol adulteration detection system using MQ2 and MQ4 gas sensors interfaced with an Arduino Nano, capable of detecting adulterants in petrol and providing real-time alerts to users or authorities.

Objectives:

i. To study the impact of fuel adulteration and the limitations of existing detection methods.

ii. To integrate MQ2 and MQ4 gas sensors for accurate detection of adulterants like kerosene and other volatile substances in petrol.

iii. To program an Arduino Nano microcontroller to process sensor data and identify fuel adulteration based on predefined threshold values.

iv. To incorporate a GSM module for sending real-time SMS alerts when adulteration is detected.

v. To develop a portable, user-friendly prototype suitable for use at petrol stations, checkpoints, or within vehicles.

vi. To test and validate the system’s effectiveness in differentiating between pure and adulterated petrol samples.

vii. To ensure the system is cost-effective, reliable, and scalable for widespread adoption.