# MINIPROJECT REPORT

*On*

**REMOTE FUEL LEVEL MONITORING SYSTEM**

*Submitted in partial fulfilment for the award of degree*
*Of*
***Bachelor of Technology***

*In*

***Computer Science & Engineering***

*By*


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**MANGALAM COLLEGE OF ENGINEERING, ETTUMANOOR**

*(Affiliated to APJ Abdul Kalam Technological University*

**MAY 2024**

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# ***CERTIFICATE***

*This is to certify that the Miniproject titled **“Remote fuel level monitoring system”** is the bonafide record of the work done by, **JOEL ABE THOMAS (MLM21CS062), JOEL JOHNSON KOCHUKOIKKAL (MLM21CS063)**,* **JOSEPH BABU (MLM21CS064) and** ***PATRIC JOE AJI (MLM21CS085)****of B.Tech in Computer Science and Engineering towards the partial fulfilment of the requirement for the award of the* ***DEGREE OF BACHELOR OF TECHNOLOGY by APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY****, during theacademic year 2023-24.*

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# ABSTRACT

Fuel theft and leakage pose serious risks when transporting and storing fuel, from economic losses to environmental damage and safety hazards. To address these concerns, we are designing and implementing an innovative fuel level monitoring system utilizing an ARM/Arduino microcontroller. The collected data is seamlessly transmitted to the user's mobile phone via a GSM module, ensuring immediate access to critical information anytime, anywhere. A key feature of this system is the alert SMS notification. Programmed to activate in response to significant or sudden drops in fuel levels, these alerts enable users to promptly identify potential theft or leakage incidents. The user-friendly interface of the monitoring system makes it easy to track fuel levels, receive alerts, and interpret data. This simplicity ensures that operators of all technical proficiency levels can effectively utilize the system.

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# LIST OF ABBREVIATIONS

| ABBREVIATION | | FULL FORM |
|---|---|---|
| MC | - | Micro Controller |
| GUI | - | Graphical User Interface |
| DFD | - | Data Flow Diagram |
| IoT | - | Internet of things |
| GIF | - | Graphics Interchange Format |

# CHAPTER 1
# INTRODUCTION

## 1.1 Background

In an increasingly interconnected world, efficient management of fuel resources plays a pivotal role across various industries. Whether it's transportation, agriculture, or power generation, monitoring fuel levels remotely has become essential to ensure uninterrupted operations, prevent losses, and promote sustainability. The Remote Fuel Level Monitoring System leverages cutting-edge technology to address this critical need, providing real-time insights that empower organizations to optimize their fuel management practices.

By enabling remote, real-time monitoring, this system allows companies to track fuel levels from anywhere, at any time. This capability is particularly valuable for organizations with multiple storage locations or limited on-site staff. The Remote Fuel Level Monitoring System streamlines operations by eliminating the need for manual, in-person tank checks, reducing labor costs and increasing efficiency.

Beyond the convenience of remote monitoring, the system's real-time alerts are a key feature in preventing fuel theft and leakage. By immediately notifying operators of sudden or significant drops in fuel levels, the system enables swift response and minimizes potential losses. This proactive approach is invaluable in safeguarding fuel supplies and reducing both economic and environmental risks.

The versatility of the Remote Fuel Level Monitoring System makes it an ideal solution for a diverse range of industries and applications. From diesel generators and heavy equipment to emergency backup systems and bulk storage tanks, the system can be customized to meet the unique needs of various organizations. Its adaptability, combined with its user-friendly interface and reliable performance, position it as a leading solution for fuel level monitoring in today's interconnected world.

As the global demand for efficient fuel management continues to grow, the Remote Fuel Level Monitoring System is at the forefront of innovation. By harnessing the power of technology, the system delivers unparalleled insights, enabling organizations to make data-driven decisions that enhance operational efficiency, reduce costs, and promote environmental stewardship. In an era where fuel resources are more critical than ever, the Remote Fuel Level Monitoring System stands as a pivotal tool for organizations seeking to navigate the challenges and opportunities of the future.

## 1.2 Preamble

The Remote Fuel Level Monitoring System is designed to provide accurate and real-time data on fuel levels, giving organizations unparalleled visibility into their fuel resources. By leveraging advanced sensors and Internet of Things (IoT) technology, users can remotely track fuel consumption, prevent theft, and optimize resource allocation like never before. This innovative system addresses a critical need in fuel management, enabling companies to make data-driven decisions that enhance efficiency, reduce costs, and minimize risks. Let's delve deeper into the system's components and benefits to understand its transformative potential.

At the heart of the Remote Fuel Level Monitoring System are highly accurate fuel level sensors. These sensors continuously monitor the fuel levels within tanks or storage containers, capturing even slight changes in real-time. The sensors' precision ensures that users have an exact understanding of their fuel supplies at all times, eliminating the guesswork often associated with manual tank checks.

The sensor data is then transmitted to the cloud via IoT connectivity, enabling remote access to fuel level information from anywhere, at any time. This web-based platform provides a user-friendly interface for viewing real-time fuel levels, tracking historical consumption trends, and setting custom alerts and notifications. Regardless of the number of storage locations or tanks, the platform offers a centralized solution for monitoring fuel resources across an entire operation.

One of the system's most valuable features is its ability to prevent fuel theft and leakage. By establishing baseline consumption trends, the system can identify unusual or sudden drops in fuel levels, indicating potential theft or leakage. Instant SMS or email alerts are then sent to designated operators, enabling them to investigate and address the issue promptly. This proactive approach minimizes losses and reduces both the economic and environmental impacts of fuel theft and leakage.

Beyond theft prevention, the Remote Fuel Level Monitoring System offers numerous benefits for optimizing fuel resource allocation. With real-time visibility into fuel levels, organizations can ensure tanks are replenished at the optimal time, preventing stock outs that could disrupt operations. Conversely, the system helps avoid over ordering fuel, reducing waste and saving costs. By analyzing historical consumption trends, companies can also identify opportunities to improve operational efficiency and reduce fuel consumption.

The Remote Fuel Level Monitoring System is a highly customizable solution, adaptable to various types and sizes of fuel storage containers. Whether it's diesel, gasoline, or other fluid management, the system can be tailored to meet the unique needs of different industries and applications. Its versatility, combined with its ease of use and robust features, make it an ideal solution for organizations seeking to transform their fuel management practices.

In conclusion, the Remote Fuel Level Monitoring System represents a cutting-edge solution for accurate, real-time fuel level monitoring. By leveraging IoT technology and advanced sensors, the system provides unparalleled insights into fuel resources, enabling organizations to make data-driven decisions that enhance efficiency, reduce costs, and minimize risks. As fuel management continues to evolve in our increasingly interconnected world, the Remote Fuel Level Monitoring System stands at the forefront of innovation, empowering organizations to navigate the challenges and opportunities of the future.

## 1.3 Problem Statement

Traditional manual methods of checking fuel levels are time-consuming, prone to errors, and often lead to unexpected fuel shortages that can disrupt critical operations. These outdated practices require personnel to physically visit each tank or storage location, climbing stairs or ladders to read gauges, and then manually record levels. Additionally, fuel theft remains a significant challenge, impacting businesses' bottom lines and posing environmental risks. According to the National Insurance Crime Bureau, fuel theft costs companies millions annually, with stolen fuel often being sold on the black market or used by thieves themselves. The Remote Fuel Level Monitoring System aims to address these pressing issues by automating fuel level measurements and significantly enhancing security.

By automating fuel level monitoring, the system eliminates the need for manual tank gauging, freeing up staff to focus on more valuable tasks. Real-time fuel level data is captured by precision sensors and transmitted to the cloud, providing an accurate, up-to-the-minute picture of fuel inventories. This ensures that operators can proactively manage fuel supplies, scheduling deliveries and preventing stock outs that could halt operations. The system's real-time monitoring capability is particularly beneficial for organizations with multiple storage locations or limited on-site personnel, enabling centralized fuel management from a single platform.

Beyond improving operational efficiency, the Remote Fuel Level Monitoring System offers robust features to deter fuel theft and quickly identify potential losses. Programmable alerts can be set to notify operators of sudden or unusual drops in fuel levels, indicating possible theft or leakage. These instant notifications enable companies to respond swiftly, investigating the issue and taking appropriate action to minimize losses. By providing an added layer of security, the system helps safeguard fuel inventories and protect businesses' valuable assets.

The Remote Fuel Level Monitoring System is designed with versatility in mind, accommodating various types and sizes of fuel storage containers. From small generators to large bulk storage tanks, the system can be customized to meet the unique needs of different industries and applications. Its adaptability, combined with an intuitive user interface and reliable performance, make it an ideal solution for organizations seeking to modernize their fuel management practices.

In conclusion, the Remote Fuel Level Monitoring System represents a powerful solution for automating fuel level measurements and enhancing fuel security. By leveraging advanced sensors and cloud technology, the system provides real-time visibility into fuel inventories, enabling proactive management and theft prevention. As companies navigate the challenges of fuel management in today's fast-paced world, the Remote Fuel Level Monitoring System stands as a transformative tool for optimizing efficiency, reducing costs, and protecting valuable resources.

## 1.4 Motivation

The motivation behind implementing the Remote Fuel Level Monitoring System lies in several key factors:

### 1.4.1 Efficiency:

Real-time monitoring allows organizations to proactively manage fuel levels, reducing downtime due to fuel shortages. With the system's automated monitoring, operators can receive instant notifications when fuel levels reach predetermined thresholds, triggering timely orders and preventing stock outs. This proactive approach minimizes disruptions, ensuring that critical operations can continue uninterrupted. For organizations reliant on fuel-powered equipment, such as generators or heavy machinery, avoiding downtime is paramount for maintaining productivity and meeting business objectives.

### 1.4.2 Cost Savings:

By optimizing fuel usage, businesses can minimize operational costs and improve overall efficiency. The system's real-time data and historical reporting provide valuable insights into fuel consumption trends, helping organizations identify opportunities to reduce waste and lower fuel expenditures. For example, businesses may discover that certain pieces of equipment are less fuel-efficient than others, prompting upgrades to more economical models. Additionally, the system helps avoid over ordering fuel, reducing the costs associated with excess inventory storage and handling.

### 1.4.3 Security:

Preventing fuel theft ensures uninterrupted operations and protects valuable resources. Fuel theft is a significant concern, with stolen fuel often being resold or used by criminals. The Remote Fuel Level Monitoring System's instant alerts for unusual fuel level drops enable swift response to potential theft, minimizing losses and the environmental damage that can accompany fuel spills. By deterring theft and facilitating rapid response, the system plays a critical role in safeguarding fuel inventories and supporting business continuity.

Beyond these primary motivations, the Remote Fuel Level Monitoring System offers additional benefits that further enhance its value. Its remote monitoring capability reduces the need for personnel to physically visit storage locations, improving safety by minimizing the risk of accidents when accessing tanks. Additionally, the system's data-driven insights support more informed decision-making, helping organizations optimize their fuel management strategies over time.

In conclusion, the Remote Fuel Level Monitoring System is a powerful solution driven by the need for greater efficiency, cost savings, and security in fuel management. By providing real-time monitoring, data-driven insights, and robust security features, the system enables organizations to transform their approach to fuel management. As businesses continue to seek innovative ways to optimize operations and protect valuable resources, the Remote Fuel Level Monitoring System stands as a leading solution for fuel management in the modern era.

## 1.5 Scope

The scope of the Remote Fuel Level Monitoring System extends to various sectors, including:

### 1.5.1 Transportation:

Fleet managers can remotely monitor fuel levels in trucks, buses, and other vehicles. This real-time visibility enables proactive scheduling of refueling stops, minimizing downtime and ensuring that vehicles remain operational. For logistics and delivery companies, the system helps optimize routes and reduce delays, improving overall fleet efficiency.

### 1.5.2 Mining:

Heavy machinery relies on fuel; accurate monitoring prevents unexpected downtime. In mining operations, equipment failure can halt entire productions lines, incurring substantial costs and delays. The Remote Fuel Level Monitoring System's real-time alerts ensure that fuel levels are maintained, preventing unexpected shutdowns and keeping operations running smoothly.

### 1.5.3 Agriculture:

Farm equipment benefits from real-time fuel level data for efficient planning. During peak seasons, farmers cannot afford for tractors, combines, or other critical equipment to run out of fuel. The system's automated monitoring and alerts enable farmers to plan refueling during breaks in operations, minimizing disruptions and ensuring that work can be completed efficiently.

### 1.5.4 Power Generation:

Diesel generators require a consistent fuel supply; remote monitoring ensures reliability. For data centers, hospitals, and other facilities reliant on backup generators, uninterrupted power supply is paramount. The Remote Fuel Level Monitoring System provides real-time fuel level data, enabling facilities to schedule refueling during maintenance windows and prevent unexpected generator shutdowns. This proactive approach safeguards against power outages that could have catastrophic consequences.

Beyond these sectors, the Remote Fuel Level Monitoring System can be applied in various other industries where fuel plays a critical role. From construction and manufacturing to marine and emergency services, the system's versatility and customization options make it a valuable solution for fuel management. By providing real-time visibility, data-driven insights, and enhanced security, the system helps organizations across diverse sectors optimize their fuel resources and maintain operational continuity.

# CHAPTER 2
# LITERATURE REVIEW

## 2.1 A micro-controller based system for monitoring of a fuel cell stack [Volume3,17-19 May 2005]

The paper describes the development of a comprehensive monitoring and management system for a Proton Exchange Membrane (PEM) fuel cell stack. This self-contained unit integrates two microcontrollers, specialized hardware and sensing circuits, an LCD display, and a numeric keypad. The system is designed to provide real-time monitoring and control of the fuel cell stack's key operational parameters, enhancing its overall efficiency, reliability, and lifespan.

The proposed system acquires the most critical gas parameters, including mass flow rate, pressure, and temperature. Accurate, real-time monitoring of these parameters is vital for optimizing fuel cell performance, preventing damage, and ensuring safe operation. By providing operators with a continuous stream of data, the system enables proactive adjustments to operating conditions, such as fuel and oxidant flow rates, to achieve optimal power output and efficiency.

The system's microcontrollers play a central role in data acquisition, processing, and control. One microcontroller focuses on acquiring data from the various sensors, while the other handles user input via the keypad, processes complex algorithms, and controls the overall system operation. This distributed architecture ensures efficient processing and reliable control of the fuel cell stack.

The LCD display provides operators with a clear, real-time view of the fuel cell stack's operational status. Key parameters such as voltage, current, power output, temperature, and gas flow rates are displayed prominently, allowing operators to monitor performance at a glance. Alarm conditions, such as excessive temperature or low fuel pressure, are highlighted on the display to prompt immediate attention and prevent potential damage**.**

The numeric keypad enables operators to input setpoints, adjust operating parameters, and navigate through intuitive menus. Operators can set target values for voltage, current, and power output, and the system will automatically adjust fuel and oxidant flow rates to achieve these setpoints. This user-friendly interface simplifies operation and minimizes the risk of operator error.

For more in-depth information on the system's design, implementation, and testing, readers are encouraged to review the base paper. The paper provides detailed schematics, technical specifications, and experimental results that demonstrate the system's effectiveness in enhancing PEM fuel cell stack performance and reliability. As fuel cell technology continues to advance, the development of sophisticated monitoring and management systems like this will be crucial for realizing their full potential in various applications.

## 2.2 Fuel Monitoring and Vehicle Tracking [Volume 1, Issue 3, March 2012]

The paper addresses the pressing need for digital approaches to measure fuel quantity accurately and securely. Currently, most gasoline meters are analog, providing imprecise readings and lacking modern security features. The authors propose digitizing these meters to display fuel values digitally, such as 1 litre, 1.5 litres, 2 litres, etc., offering greater precision and clarity for users. This digital approach enables real-time monitoring of fuel levels, allowing vehicle owners to track consumption trends, plan refuelling, and prevent unexpected fuel shortages.

Fuel theft is a significant issue worldwide, resulting in substantial economic losses and inconvenience for vehicle owners. To combat this problem, the proposed system includes advanced security features. In the event of fuel theft, the system alerts the bike owner via text message and activates a buzzer alarm. These instant notifications enable owners to take swift action, reporting the theft to authorities and minimizing potential losses. By providing real-time alerts and deterring theft, the system offers enhanced fuel security and peace of mind for vehicle owners.

Beyond fuel monitoring, the paper discusses the importance of engine oil inventory management for cost-effective fleet maintenance. Regular oil changes are crucial for the longevity and performance of vehicles, but tracking oil levels can be a manual, error-prone process. The authors propose digitally displaying the oil level in an oil tank, such as 1 litre, 1.5 litres, 2 litres, etc., as part of the vehicle system. This real-time monitoring enables fleet managers to schedule oil changes based on actual usage rather than fixed intervals, reducing waste and optimizing maintenance costs.

Motorcycles, being economical and prevalent in many regions, are a primary focus for this digital fuel and oil management technology. For motorcycle owners and fleets, the ability to accurately monitor fuel and oil levels can improve operational efficiency, reduce costs, and enhance overall riding experience. The proposed system's compact size and wireless connectivity make it well-suited for motorcycle applications, where space is limited and ease of use is paramount.

The paper introduces the concept of Digital Fuel Indication and Fuel Theft Identification, leveraging advanced technologies like fuel level sensors, microcontrollers, and communication modules. These components work in tandem to provide real-time monitoring of fuel levels and detect anomalies or unauthorized fuel withdrawals. By analysing usage patterns and sensor data, the system can identify potential theft or leakage, triggering instant alerts and enabling swift response. This proactive approach represents a significant advancement in fuel security, offering vehicle owners and fleet managers a powerful tool to protect their assets and optimize operations.

As the global demand for efficient and secure fuel management solutions continues to grow, the concepts presented in this paper hold considerable promise. By digitizing fuel and oil monitoring, the proposed system offers a user-friendly, cost-effective way to enhance operational efficiency, reduce costs, and deter theft. As vehicle technologies evolve, innovations like Digital Fuel Indication and Fuel Theft Identification will play an increasingly vital role in shaping the future of fuel management.

## 2.3 IOT Based Fuel Efficiency Monitoring System Using Raspberry PI [volume 4, issue 8, april-2017]

The paper presents an innovative Internet of Things (IoT)-based fuel efficiency monitoring system specifically designed for four-wheelers, with a primary focus on cars. In an era of rising fuel costs and growing environmental concerns, improving fuel efficiency has become a paramount goal for vehicle owners. The system aims to achieve this by providing users with actionable insights by tracking and optimizing fuel consumption through monitoring the mileage graph of a car. By empowering users with data-driven knowledge, the system enables them to make informed decisions that enhance their vehicle's fuel efficiency, reduce operating costs, and minimize environmental impact.

This cutting-edge system considers various factors that significantly impact fuel consumption. Speed variations are a key consideration, as rapid acceleration and braking can lower fuel efficiency. The system's speed sensor continuously monitors the vehicle's speed, providing real-time data on acceleration patterns and suggesting smoother driving techniques to optimize fuel use. Road conditions also play a crucial role, with rough roads and heavy traffic often leading to increased fuel consumption. The terrain sensor detects road conditions, offering insights on how different terrains impact mileage and providing tips for more fuel-efficient navigation.

Prolonged engine use and excessive heat can also diminish fuel efficiency. The system monitors engine temperature, alerting users to extended idling or high temperatures that may be affecting performance. Frequent gear changes, particularly in manual transmission vehicles, can lower fuel efficiency if not done optimally. The system provides feedback on gear shifting patterns, suggesting improvements for smoother transitions and better mileage.

The system utilizes several key components to deliver its fuel efficiency monitoring and optimization capabilities:

- **Speed Sensor:** This sensor continuously monitors the vehicle's speed, providing real-time data on acceleration, cruising speeds, and braking patterns. This information is used to offer personalized feedback on how driving habits impact fuel efficiency.
- **Terrain Sensor:** This advanced sensor detects road conditions, such as rough roads, steep hills, or heavy traffic, providing insights on how different terrains impact fuel

consumption. Users can then adjust their routes or driving styles accordingly to optimize fuel use.

- **Graphical Representation:** Users can view their car's mileage graph through a user-friendly, web-based application. This visual representation clearly illustrates fuel efficiency trends, highlighting areas of improvement and the impact of various factors on mileage.
- **Analysis:** The graphical view and associated analytics help users understand their car's efficiency in detail, enabling them to make informed decisions to enhance fuel economy. The system may provide comparisons to industry benchmarks or similar vehicles, giving users a broader context for their car's performance.

By leveraging IoT technology and advanced sensors, this fuel efficiency monitoring system offers a powerful solution for car owners seeking to optimize their fuel consumption. Its user-centric design, personalized feedback, and data-driven insights make it an invaluable tool in the quest for improved fuel efficiency. As the global focus on sustainability continues to grow, innovative systems like this will play an increasingly vital role in transforming the way we monitor and manage fuel consumption in vehicles.

## 2.4 Automatic Fuel Management and Remote Monitoring System [Volume 2, Issue 4,03 Feb 2019]

The paper discusses the development of an innovative Internet of Things (IoT)-based fuel management system that seamlessly integrates real-time monitoring and remote control capabilities. In an era of increasing fuel costs and environmental concerns, effective fuel management has become paramount for vehicle owners and fleet operators. The primary objective of this system is to address the complex challenges of fuel management by providing real-time monitoring and control capabilities, improving accessibility, optimizing tracking, and enhancing overall efficiency. By empowering users with timely, actionable insights, the system enables data-driven decisions that reduce fuel waste, lower operating costs, and minimize environmental impact.

The system consists of several key components, each playing a critical role in its overall functionality:

- **Sensing Units:** These advanced sensors collect real-time data related to fuel levels, consumption rates, and other relevant parameters. Installed within the vehicle's fuel tank or system, the sensors continuously monitor the fuel status, capturing even slight changes. This real-time monitoring provides an accurate, up-to-the-minute picture of fuel inventories, enabling proactive management and minimizing the risk of unexpected fuel shortages.
- **Actuating Units:** These units enable remote control actions, offering an added layer of security and control. For example, in the event of theft or unauthorized use, the system

can remotely shut off the fuel supply, preventing further fuel loss and potential damage. This remote shut-off capability is particularly valuable for fleet operators or owners of high-value vehicles, providing an immediate response to potential theft or misuse.

- **Central Processing Unit (CPU):** The CPU, an ATmega 328 microcontroller, serves as the system's brain, connecting the sensing and actuating units. The CPU processes the real-time sensor data, executes control commands, and facilitates communication with the user interface and remote platforms. Its robust processing power and reliability ensure smooth system operation and accurate fuel management.

To provide visual feedback to users, the system incorporates an intuitive LCD display. Users can view real-time updates on fuel availability, consumption rates, and other key metrics directly on the display. This at-a-glance visibility enables users to monitor fuel status, track consumption trends, and make informed decisions to optimize fuel use. For example, users may adjust their driving habits or maintenance schedules based on the insights gained from the real-time fuel data.

The system leverages GSM (Global System for Mobile Communications) technology to enable seamless communication via mobile phones. Users can receive instant alerts and notifications related to fuel levels, consumption anomalies, or security events, such as remote shut-off activation. These push notifications ensure that users remain informed and can respond promptly to changing fuel conditions or potential issues, even when they are not physically near the vehicle.

The system's data is securely accessible through a web platform called ThingSpeak, a popular IoT analytics platform. Users can remotely monitor their vehicle's fuel status, track historical consumption patterns, and analyze trends through intuitive dashboards and reports. This remote access enables users to make data-driven decisions, identify opportunities for fuel savings, and optimize their fuel management strategies over time. For fleet operators, the platform offers a centralized solution for monitoring multiple vehicles, streamlining fuel management across the entire fleet.

`Overall, the IoT-based fuel management system offers a comprehensive solution for managing fuel resources effectively, especially in scenarios where remote monitoring and control are essential. Its real-time monitoring, remote control capabilities, and data-driven insights make it an invaluable tool for vehicle owners and fleet operators seeking to enhance fuel efficiency, reduce costs, and minimize environmental impact. As the global demand for innovative fuel management solutions continues to grow, systems like this will play an increasingly vital role in transforming the way we monitor and control fuel resources.

## 2.5 IoT Based Smart Fuel Monitoring System [Volume 1,Issue 6,Sep2019]

In today's fast-paced world, monitoring systems play a crucial role in tracking environmental changes and improving our understanding of current scenarios. The same applies to fuel tanks in vehicles. By closely monitoring fuel intake and consumption, vehicles can become more fuel-efficient and cost-effective.

This paper presents the implementation of an IoT-based fuel monitoring system designed to protect fuel customers from theft at gas stations and formulate better conservation strategies. The system utilizes Internet of Things (IoT) technology to achieve its goals. Here are the key points:

**2.5.1. Objective**:

- The primary goal is to monitor fuel levels in real time using electronic sensors and data communication technologies.
- Preventing fuel theft is a key focus.

**2.5.2. Components**:

- The system incorporates flow sensors to measure fuel flow rates and load sensors to monitor fuel tank weight (indicating fuel level).
- An Atmega 16 microcontroller handles data processing and communication.
- Wi-Fi connectivity enables communication with cloud services.
- Edge analytics provide real-time insights at the device level.
- Fuel data is stored and managed in a cloud server. By leveraging IoT technology, this smart fuel monitoring system enhances security, accountability, and efficiency in fuel management

| No. | Name of the Paper | Name of the authors | Publisher & Date of publish | Approach used | Disadvantages |
|---|---|---|---|---|---|
| 1 | A Microcontroller-Based System for the Monitoring of a Fuel Cell Stack | Giovanni Bucci, Edoardo Fiorucci, Fabrizio Ciancetta and Francesco Vegliò | IMTC 2005 – Conference Ottawa, Canada, Volume3,17-19 May 2005 | Microcontroller (PIC18F452) is used to transmit the data provided by the sensor to the user via a display (LCD module). | It is bulky and costly as well as it doesn't support remote access of data |
| 2 | Fuel Monitoring and Vehicle Tracking | Sachin S. Aher, Kokate R. D | International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 3, March 2012 | This sort of information tracking makes use of hall effect sensor and the fuel levels and the fuel consumption. | As the system implements only methods to share GPS information<br><br>We can't track fuel data remotely |
| 3 | IOT BASED FUEL EFFICIENCY MONITORING SYSTEM USING RASPBERRY PI | S. Rohini, B. Umamaheswari, K. Ramya, L. Sharmi, R. Vishnupriya, M. Rajalakshmi, Dr.S. Padmapriya | International Journal For Technological Research In Engineering Volume 4, Issue 8, April-2017 | The system uses a Raspberry Pi microcontroller to collect data from sensors, such as ultrasonic fuel sensors, and then analyzes the data to determine fuel consumption pattern. | Raspberry pi is costly and one is needed to login through web to see the details |

| | | | | | |
|---|---|---|---|---|---|
| 4 | Automatic fuel management and remote monitoring system | T.Khalid<br><br>M. Mennanno<br><br>A. Ali | IEEE<br><br>Phnom Penh, Cambodia<br><br>Volume 2, Issue 4,03 Feb 2019 | ATmega 328 microcontroller<br><br>Is used as the main cpu which derives the output through an LCD display | This system is Expensive and complex |
| 5 | IoT Based Smart Fuel Monitoring System | Vijayakumar P<br><br>, Ganesan V, Patwari P, Singh R, Sharmila A<br><br>, Tayade P.P, Rajashree R, Tamilselvi M. | Blue Eyes Intelligence Engineering and Sciences Engineering and Sciences Publication - BEIESP<br><br>Volume 1,Issue 6,Sep2019 | Atmega 16 microntroller and Iot is used. | Dependancy on internet, complexity and potential failures. |

Table 2.1 Brief Literature Review Comparisons

# CHAPTER 3
# PROPOSED SYSTEM

The Remote Fuel Monitoring System is an innovative solution designed to leverage the power of modern technology to ensure efficient fuel management. At the heart of this system lies an Arduino microcontroller**,** which serves as the brain of the operation, interfacing seamlessly with a liquid level sensor to gauge the amount of fuel present in any given tank. This could range from a small vehicle's fuel tank to large-scale industrial storage tanks.

The system's GSM SIM900A module is pivotal for communication, enabling the transmission of real-time fuel level data directly to a central monitoring station or end-users. This is accomplished through the ubiquitous medium of Short Message Service (SMS), ensuring that the information is accessible even in areas with limited internet connectivity.

Moreover, the system boasts a user-friendly web interface, allowing users to check fuel levels conveniently from any location. This interface is designed with the end-user in mind, prioritizing ease of use and accessibility.

Detailed Objectives of the Remote Fuel Monitoring System:

- Fuel Level Monitoring**:**

- **Continuous Surveillance**: The system is engineered to provide uninterrupted monitoring of fuel levels, ensuring that the readings are accurate and up-to-date. This is crucial for operational efficiency and can prevent unexpected downtimes.

- **Maintenance Alerts**: By maintaining a constant watch over the fuel levels, the system can predict when refueling is necessary, thereby facilitating timely maintenance operations. This proactive approach can help in avoiding the pitfalls of running out of fuel unexpectedly.

➢ Remote Data Transmission**:**

- **Real-Time Updates**: The essence of the system's functionality is its ability to send real-time updates regarding fuel levels. These updates can be sent to a centralized monitoring system or directly to the users' mobile devices.
- **GSM-Based Alerts**: Utilizing the GSM network, the system can send SMS alerts to notify users of critical fuel levels. This feature is particularly useful for immediate and actionable insights.

➢ User Accessibility:

- **Web-Based Access**: A dedicated website serves as the portal for users to access fuel level data. This digital platform is designed to be intuitive and user-friendly, ensuring that users of all technical backgrounds can navigate it with ease.
- **Interface Simplicity**: The focus on simplicity in the user interface design ensures that users can obtain the information they need without unnecessary complexity or technical jargon.

The Remote Fuel Monitoring System operates on a sophisticated yet intuitive principle, designed to streamline the process of fuel management. Here's an expanded explanation of its working principle:

## 3.1. Hardware Components:

- **Arduino**: This microcontroller is the cornerstone of the system, tasked with orchestrating the communication between the sensor and the GSM module. It's programmed to interpret sensor data and initiate actions based on predefined conditions.
- **Liquid Level Sensor**: Employing an ultrasonic sensor, such as the HC-SR04, this component measures the distance to the fuel surface, thereby determining the fuel level. Its precision allows for accurate monitoring, which is critical for the system's reliability.
- **GSM SIM900A Module**: This module is a gateway to the GSM/GPRS network, enabling the system to send SMS messages and communicate with users regardless of their location.
- **Power Supply**: A stable power supply is essential for the uninterrupted operation of the system, ensuring that all components remain active and functional.

### 3.2. Installation:

- **Sensor Placement**: The liquid level sensor is installed within the fuel tank, positioned to provide optimal measurement accuracy.
- **Arduino Connection**: The sensor's output is linked to the Arduino through one of its digital pins, facilitating data transfer.
- **GSM Module Integration**: The GSM SIM900A module is connected to the Arduino using serial communication, allowing for seamless data exchange.

### 3.3. Data Acquisition:

- **Periodic Measurements**: The sensor conducts regular measurements of the fuel surface distance, providing a continuous stream of data to the Arduino.
- **Data Interpretation**: The Arduino reads this data and translates it into understandable fuel level metrics, such as liters or percentage full.

### 3.4. Data Processing:

- **Data Analysis**: The Arduino processes the incoming fuel level data, applying logic to determine if action is required.
- **Threshold Activation**: Should the fuel level fall below a certain threshold, the Arduino is programmed to respond accordingly.

### 3.5. SMS Alert Generation:

- **Critical Alerts**: Upon detecting a critical fuel level, the Arduino utilizes the GSM SIM900A module to dispatch an SMS alert.
- **Alert Content**: The SMS includes vital details like the current fuel level, tank ID, and other pertinent information, sent to a designated recipient.

### 3.6. User Website Access:

- **Data Upload**: The system is capable of uploading fuel level data to a cloud server or a web-based platform.
- **Website Interface**: Users can log in to the dedicated website to view real-time fuel levels, historical data, and any generated alerts.
- **Display Features**: The website is designed to present information in an easily digestible format, highlighting key data points and trends.

### 3.7. Maintenance and Refueling:

- **Timely Notifications**: Users are alerted via SMS when fuel levels approach critical lows, prompting timely maintenance or refueling actions.
- **Proactive Measures**: This feature ensures that users can address fuel levels proactively, avoiding potential operational disruptions.

### 3.8. Advantages:

- **Real-Time Monitoring**: The system provides immediate notifications, enabling users to react swiftly to changes in fuel levels.
- **Cost Savings**: By preventing fuel shortages, the system helps to reduce the costs associated with emergency refueling.
- **Remote Accessibility**: Users can monitor fuel levels from any location, using either SMS alerts or the dedicated website.

In essence, the Remote Fuel Monitoring System is a comprehensive tool that combines hardware ingenuity with software intelligence to deliver a seamless fuel management experience. Its meticulous design and user-centric features make it an invaluable asset for anyone looking to optimize their fuel usage and ensure continuity in operations. Whether for personal or commercial use, this system represents a significant advancement in remote monitoring technology.

# CHAPTER 4
# SYSTEM IMPLEMENTATION

` The System Implementation of the Remote Fuel Monitoring involves a sophisticated integration of various hardware components and advanced communication technologies. This system is meticulously designed to streamline the process of fuel management, ensuring accuracy and reliability. Here's an expanded description of the system's implementation:

## 4.1 Hardware Components:

The hardware is the backbone of the remote fuel monitoring system, consisting of several key components that work in tandem to monitor and report fuel levels.

### 4.1.1. Arduino:

- **Central Control Unit**: The Arduino acts as the brain of the operation. It is responsible for interfacing with the sensors and the GSM module, orchestrating the flow of information and ensuring that data is processed correctly.
- **Data Collection***:* It continuously collects data from the liquid level sensor, which is crucial for determining the fuel level within the tank.
- **Signal Conversion**: The Arduino is adept at converting the analog signals received from the sensors into a digital format that can be further processed or transmitted.

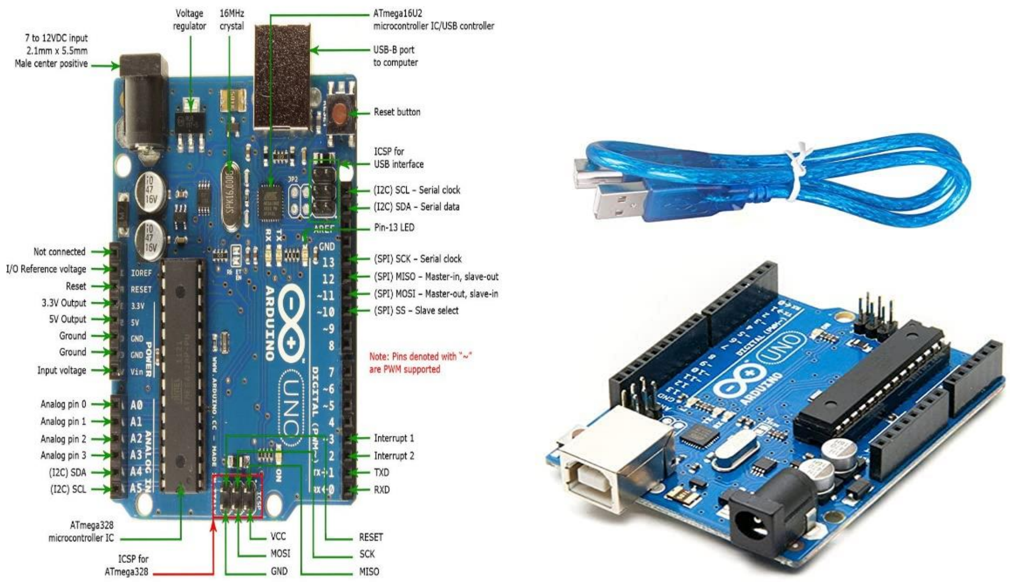


Fig.4.1 Arduino

### 4.1.2 Liquid Level Sensor:

- Installed inside the fuel tank to measure the distance to the fuel surface.
- Sensors measure the fuel levels and convert them into electrical signal
- The Water Level Depth Detection Sensor for Arduino has Operating voltage DC3-5V and Operating current less than 20mA. The Sensor used is the Analog type which produces analog output signals according to the water pressure with its Detection Area of 40x16mm

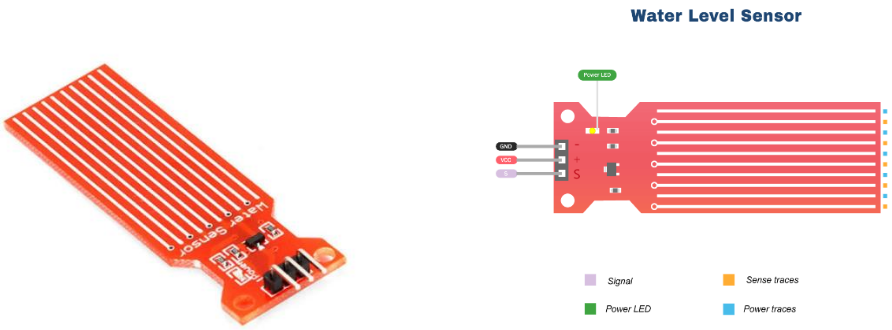


Fig 4.2 Liquid level sensor

### 4.1.3 GSM SIM900A :

- **Communication**: This module is essential for the remote transmission of data. It connects to the cellular network to send SMS messages, providing updates on the fuel levels to users or a central monitoring system.

- **Alert System**: In addition to sending regular updates, the GSM module can also send alerts when the fuel level reaches critical thresholds.

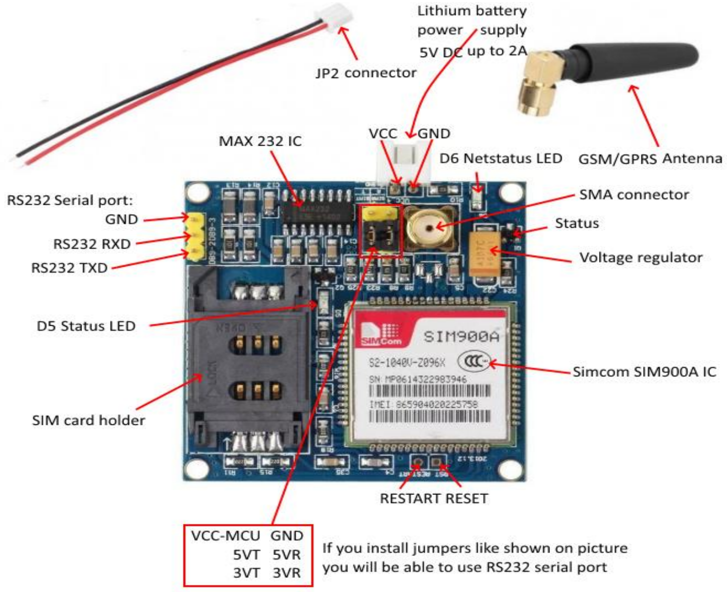


Fig 4.3 GSM900A

## 4.2 Power Supply:

- **Stability**: A consistent and stable power supply is critical for the system's operation. It ensures that all components are powered and can perform their functions without interruption.
- **Safety**: The power supply must be designed with safety in mind, protecting the system from power surges and other electrical issues.

## 4.3 Software

- Arduino IDE is used to control the behaviour of the arduino and the connected sensors.
- HTML,CSS and JavaScript is used to develop a Website that displays the output derived by the sensors.

### 4.3.1 Data Acquisition:

- The liquid level sensor continuously measures the fuel level.
- Arduino processes the sensor data to determine the fuel quantity.

### 4.3.2 Alert Generation:

- When fuel levels reach a critical point (e.g., low fuel), the Arduino triggers an SMS alert.

- The GSM module sends an SMS containing relevant information (fuel level, tank ID) to a predefined mobile number.

#### 4.3.3 **User Accessibility**:

- Fuel data is uploaded to a cloud server or website.
- Users can access real-time fuel levels remotely via the website.

### 4.4 **Advantages**:

- Real-time monitoring prevents fuel shortages.
- Cost-effective maintenance planning.
- Remote accessibility for users.

# CHAPTER 5
# SYSTEM ARCHITECTURE

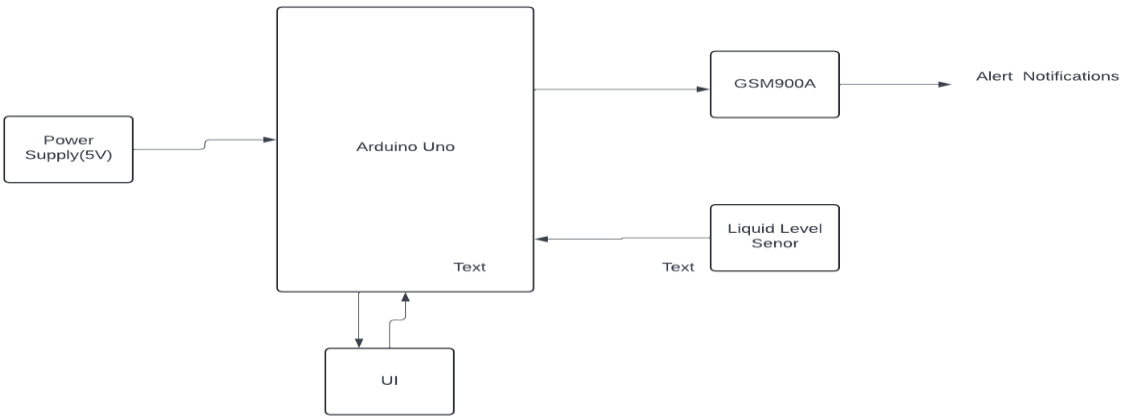


Fig 5.1 System Architecture

System Architecture plays a pivotal role in visually delineating the operational processes and the various integral components of a system. It serves as a blueprint that illustrates the intricate workings and interconnections within the system's structure. In the context of our specific application, we employ a Liquid Level Sensor, which is tasked with the continuous monitoring of the fuel level. This sensor diligently records the fuel quantity and relays this critical data to the Arduino Uno microcontroller.

The Arduino Uno, serving as the central processing unit, is programmed to vigilantly observe the fuel metrics. Upon detecting that the fuel level has dipped below a predefined safety margin, it promptly activates the GSM900A module. This module is an essential communication device that is responsible for dispatching alert notifications to the concerned parties. Concurrently, it ensures that the fuel level is accurately reflected on the User Interface (UI), providing a transparent and up-to-date view of the system's status.

This architecture is designed to facilitate real-time monitoring, enabling a swift and efficient response to any instances where the fuel levels are found to be critically low. It is important to recognize that the exact operational functionality of this system is subject to variation, contingent upon the specific programming nuances and the implementation strategy adopted for the Arduino Uno. Such flexibility allows for customization and optimization of the system to meet diverse application needs and to ensure robust performance under varying conditions.

By integrating these components into a cohesive framework, the System Architecture ensures that each element functions harmoniously to achieve the overarching goal of maintaining optimal fuel levels. This not only enhances the reliability of the system but also instills a layer of proactive safety measures, safeguarding against potential operational disruptions caused by fuel scarcity. The architecture's adaptability and precision underscore its significance in the realm of automated monitoring systems

# CHAPTER 6
# DATA FLOW DIAGRAM

A Data Flow Diagram (DFD) is a graphical representation that illustrates the flow of data within a system. It shows how information enters and exits the system, what processes change the information, and where data is stored

## 6.1. DFD Level - 0 :

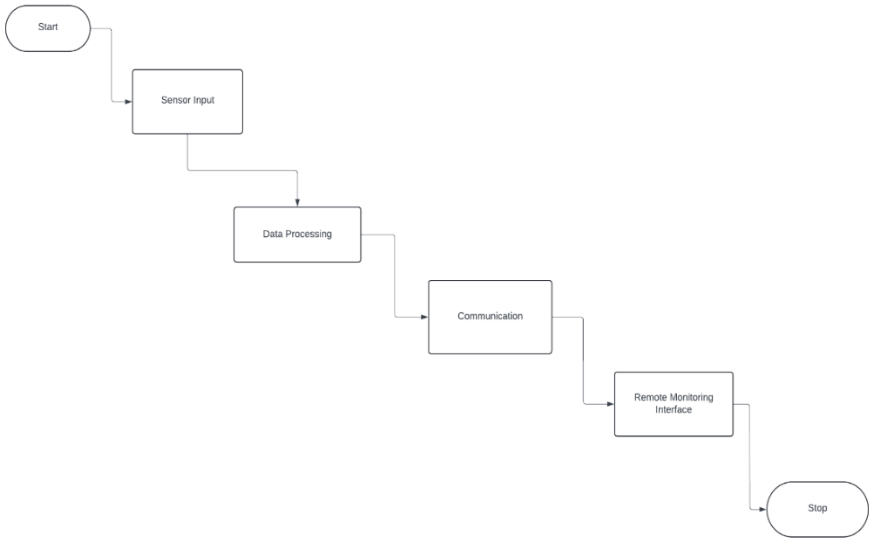


Fig 6.1 DFD Level – 0

This DFD illustrates the sequential flow of data from collection to monitoring, highlighting the transformation of raw sensor data into actionable insights. It begins with the **start** of the process, where data is collected from various sensors under “Sensor Input.” This raw data is then processed in the “Data Processing” stage to convert it into meaningful information. Following this, the processed data is communicated through the “Communication” stage, which ensures that the information can be effectively transmitted. The final stage is the “Remote Monitoring Interface,” where the processed data is made available for real-time monitoring and analysis by users or systems. The process concludes with the **stop** of the operation.

## 6.2. DFD level 1:

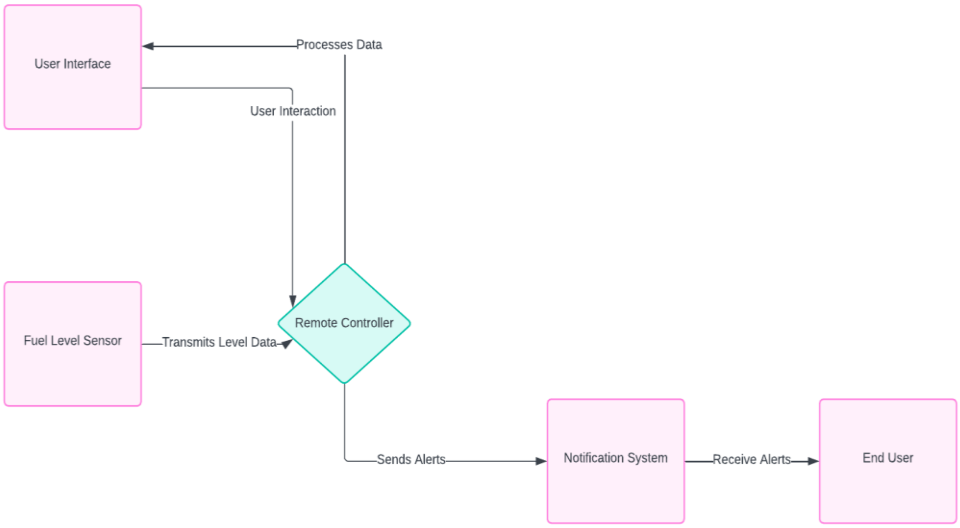


Fig 6.2 DFD Level – 1

The Level 1 Data Flow Diagram (DFD) illustrates a more detailed view of a fuel monitoring and notification system. It expands on the Level 0 DFD by breaking down the main process into smaller, more specific components:

- **User Interface**: This is where users interact with the system. It processes data and facilitates user interaction.
- **Fuel Level Sensor**: This sensor transmits fuel level data, which is crucial for monitoring.
- **Remote Controller**: Acting as the central processor, it receives data from the sensor and determines when to send alerts.
- **Notification System**: Once the Remote Controller identifies a need for an alert, this system sends notifications to the end user.
- **End User**: The recipient of the alerts, who can then take appropriate action based on the information received.

## 6.3. DFD level 2:

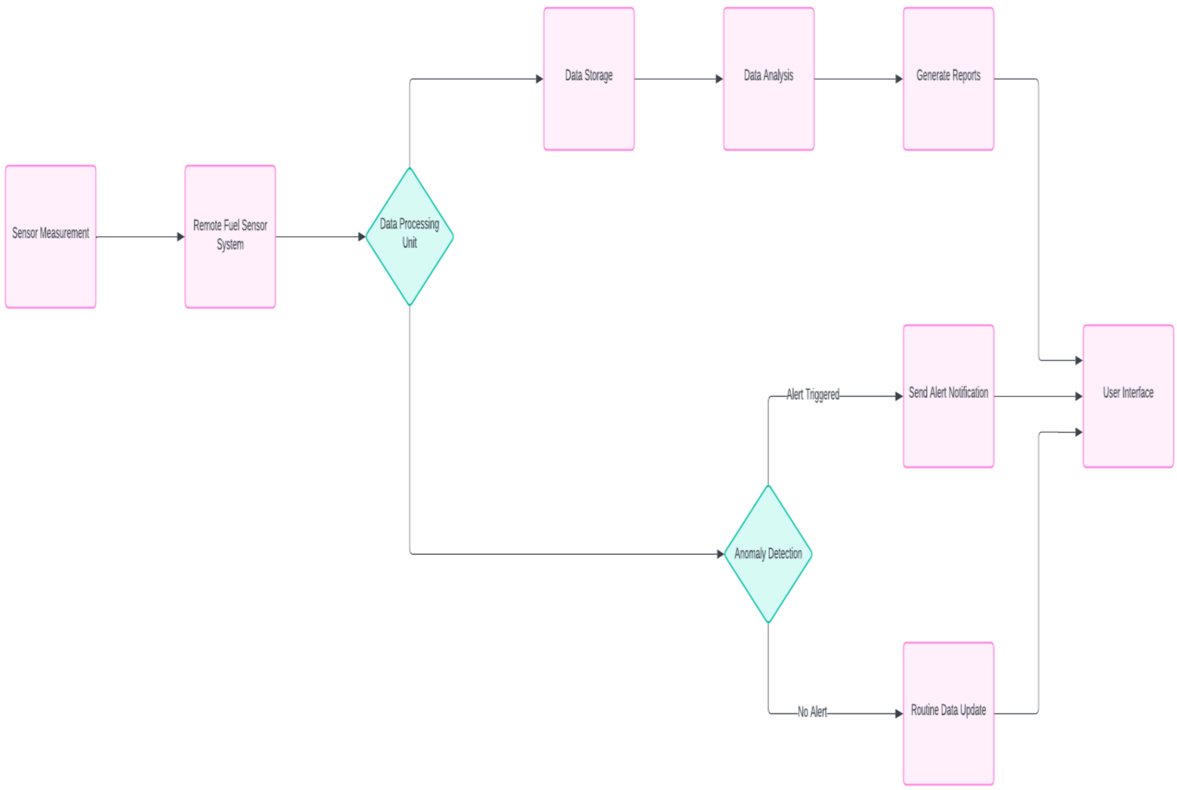


Fig 6.3 DFD Level – 2

The Level 2 Data Flow Diagram (DFD) starts with "Sensor Measurement," where data is collected and sent to the main system. The "Remote Field Sensor System" processes this data and stores it in "Data Storage." Simultaneously, "Anomaly Detection" checks for irregularities, triggering a "Low Alert" if any are found. The data is then analysed, reports are generated, and both are accessible through the "User Interface." Users can receive alerts, provide data updates, and interact with the system in real-time.

This DFD offers a granular look at the system's operations, focusing on data handling, storage, analysis, and user interaction. It shows the intricate process of turning raw sensor measurements into actionable insights and how users are kept informed of the system's status. The diagram is crucial for understanding the specific functionalities within the system and the flow of information between them. It's a step beyond the high-level overview, providing insight into the system's inner workings and data lifecycle.

## 6.4. UML Diagram

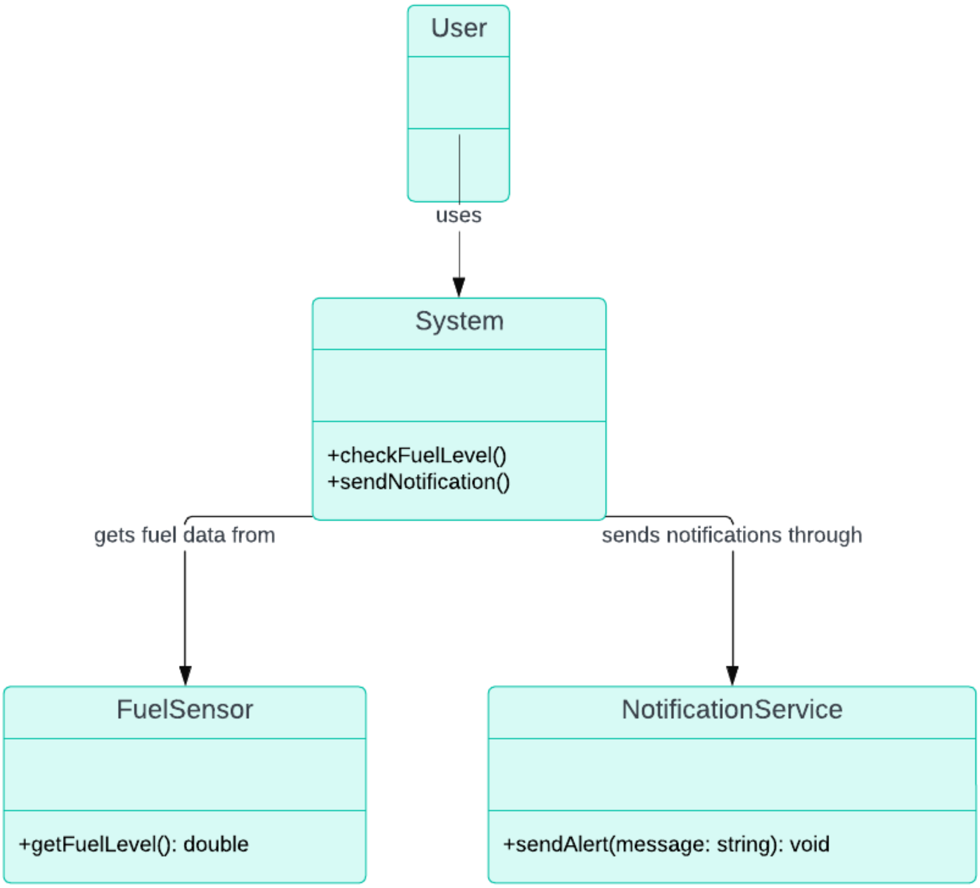


Fig 6.4 UML Diagram

Our system consists of consists of four main components:

- **User**: The end-user who interacts with the system.
- **System**: The central unit that checks fuel levels using the `checkFuelLevel()` method and sends notifications with the `sendNotification()` method.
- **FuelSensor**: A device that measures the fuel level, represented by the `getFuelLevel(): double` method, indicating it returns a numerical value.
- **NotificationService**: This service sends out alerts to the user with the `sendAlert(message: string): void` method, which takes a string message as input and returns nothing (void).

The relationships between these components are depicted with arrows. The "User" uses the "System," which in turn gets fuel data from the "FuelSensor." If the fuel level is low, the "System" sends notifications through the "NotificationService"

## 6.5. Use Case Diagram

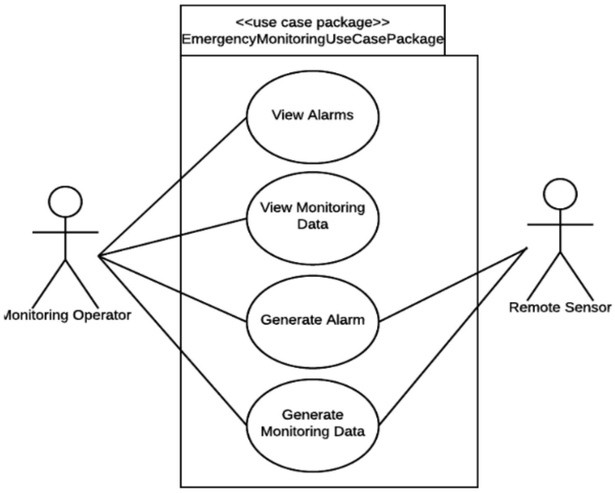


Fig 6.5 UCL Diagram

The use case diagram for our system features two actors: a Monitoring Operator and **a** Remote Sensor. The Monitoring Operator is responsible for three functions: viewing alarms, viewing monitoring data, and generating alarms. These functions are supported by the Remote Sensor's ability to generate both alarms and monitoring data.

In essence, the diagram maps out the flow of information and actions between the operator and sensor, emphasizing their roles in emergency situations. The Monitoring Operator can view and generate alarms as well as monitor data, while the Remote Sensor provides the necessary data and alarm signals.

# CHAPTER 7
# RESULTS

Remote fuel level monitoring system derives its output in several phases. These phases include:

- SMS phase
- Web Phase

## 7.1. SMS Phase

The readings derived through processing of the analog signals from the Liquid Level Sensor is transmitted to a predefined phone number via SMS through GSM 900A by the command of Arduino**.** These SMSs
Contain regular fuel level readings as well as alarm notification in case
Theft is detected.

The Output obtained by through SMS phase will be as follows:

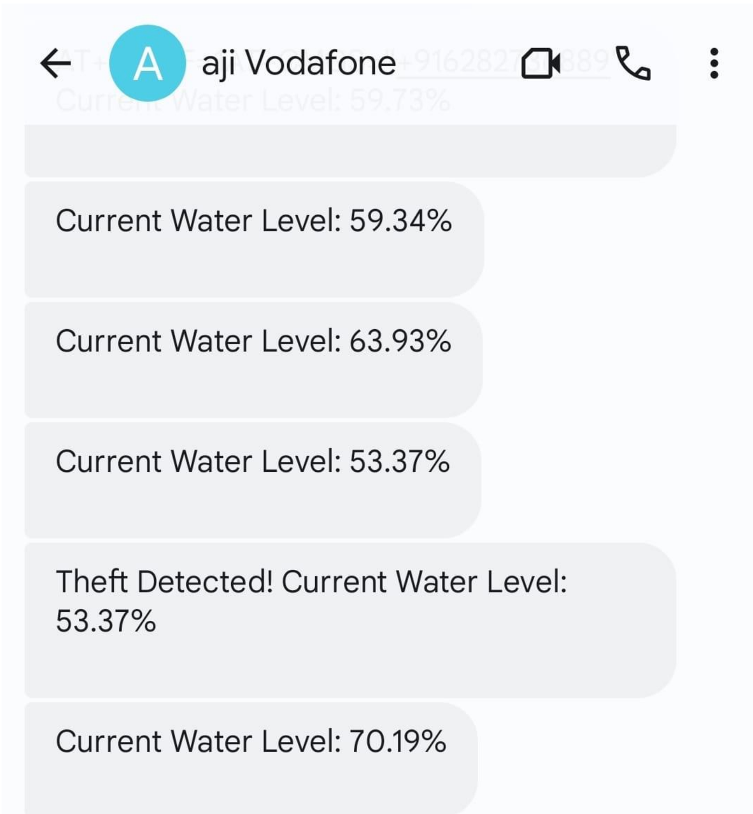


Fig 7.1 SMS output

## 7.2. Web Phase

Arduino forwards the serial readings obtained in the SMS pase to a text File (notepad/texteditor/server etc). This data can be accessed by the user through a website. The website is as Follows:

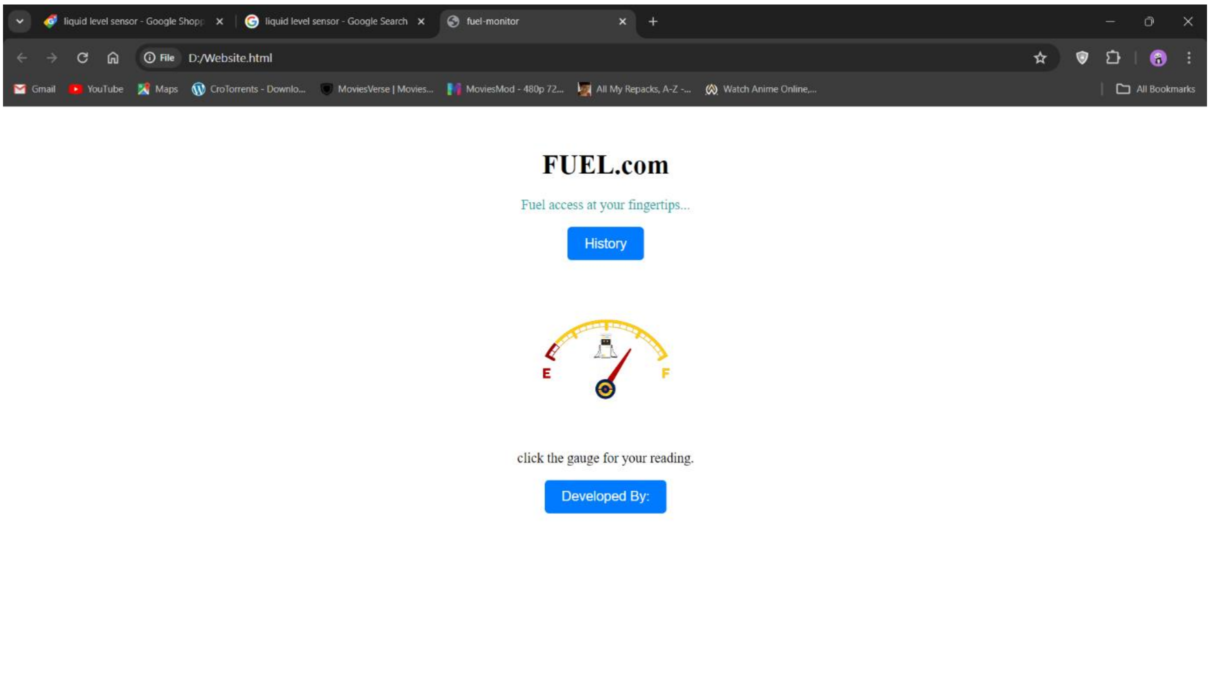


Fig 7.2 Web interface

The website is a user-friendly one which enables the user to access the entire history of the fuel level reading by clicking the History "button". The resultant Output will be:

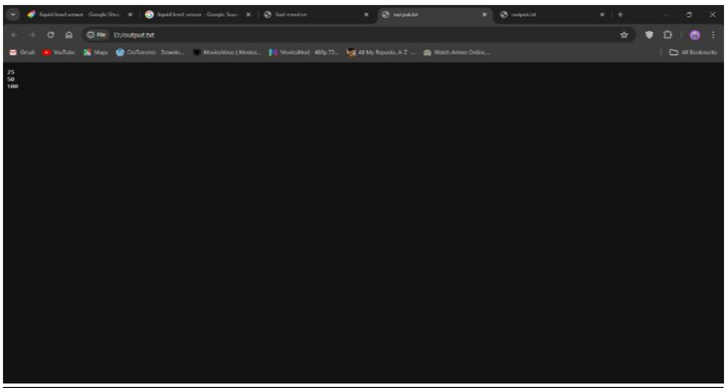

Fig 7.3 Web output 1

If the user only wants to know the current fuel level then he may do so by clicking the "GIF" .

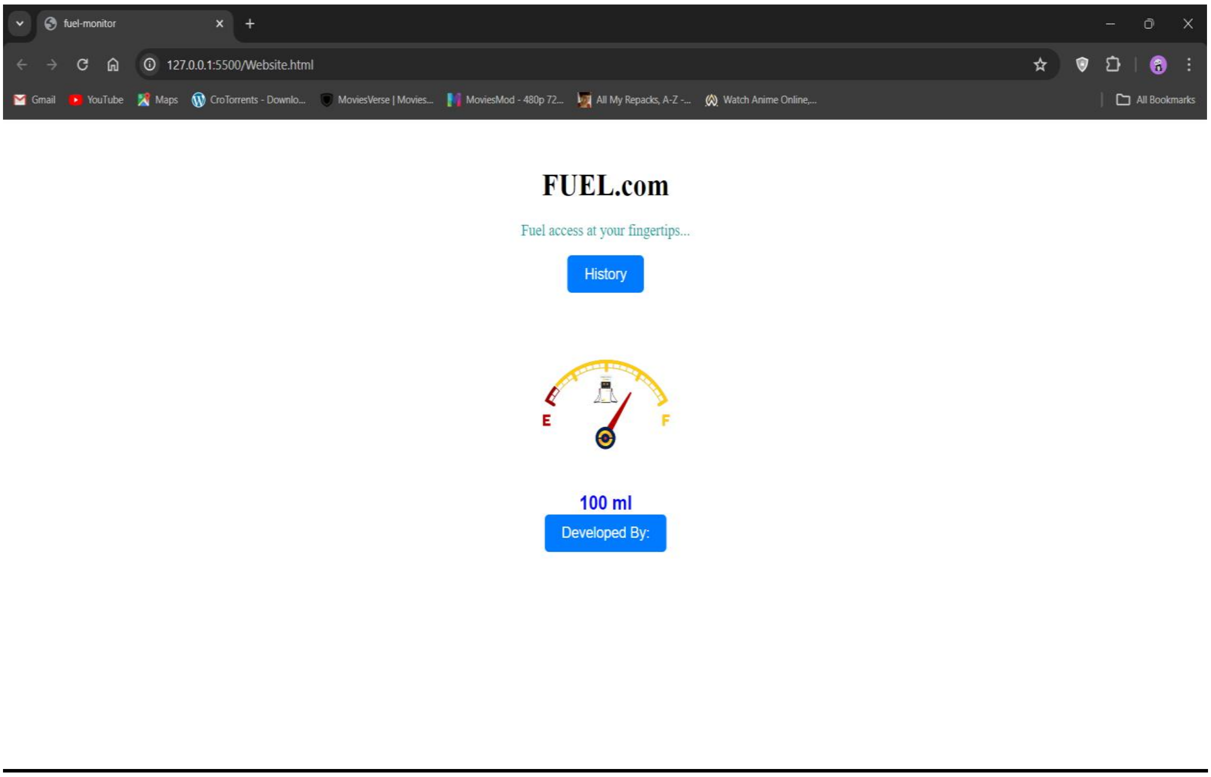


Fig 7.4 web output 2

# CHAPTER 8
# CONCLUSIONS AND FUTURE SCOPE

The implementation of remote fuel level monitoring systems has brought about a paradigm shift in how fuel resources are managed across different industries. These systems offer a multitude of advantages:

## 8.1. Efficient Fuel Management:

- **Real-Time Monitoring**: The ability to monitor fuel levels in storage tanks in real-time is a game-changer. It allows for immediate response to fuel needs and helps maintain optimal fuel utilization.
- **Cost Savings**: Efficient fuel management directly translates to cost savings. By optimizing fuel usage, organizations can significantly reduce unnecessary expenditures.
- **Resource Control**: These systems play a critical role in preventing fuel theft and unauthorized withdrawals, thereby enabling organizations to maintain better control over their fuel resources.

## 8.2. Digital Display and Alerts:

- **Continuous Monitoring**: The fuel level sensor's continuous monitoring capability ensures that fuel levels are always known, allowing for proactive management.
- **Instant Alerts**: In the event of a drastic change, such as a sudden decrease in fuel levels, the system promptly alerts the user via text message (SMS).
- **Web Access**: The data is also accessible through a user-friendly website, which offers additional features for comprehensive fuel management.
- **Decision-Making**: The 24/7 access to fuel consumption data ensures that timely actions can be taken, leading to better decision-making and operational efficiency.

## 8.3. Future Scope:

As we look to the future, there are several areas where remote fuel level monitoring systems can be improved and expanded:

- ➢ **Enhanced Security:**

- ➢ **Robust Security Features**: Developing more advanced security features to prevent fuel theft is crucial. This includes alarms and automatic lockdown mechanisms in case of unauthorized access attempts.

- **Biometric Authentication**: Exploring biometric authentication or other advanced methods can ensure that only authorized personnel have access to fuel tanks, adding an extra layer of security.

➢ **Integration with Haptic Sensors:**

- **High-Accuracy Sensors**: Integrating the system with haptic sensors can enhance the accuracy of unauthorized access detection.
- **Vibration Detection**: If an attempt is made to forcibly breach the storage tank, the vibration produced can be detected by these sensors, triggering an immediate alert.
- **Cloud Analytics**: Utilizing cloud databases for centralized data storage and analytics can provide deeper insights into fuel usage patterns and potential security breaches.

➢ **Predictive Maintenance:**

- **Maintenance Algorithms**: Implementing predictive maintenance algorithms can help monitor the condition of fuel tanks and predict when maintenance or refilling is needed.
- **Proactive Operations**: This proactive approach can prevent unexpected downtime and optimize operations, ensuring that fuel resources are always available when needed.

➢ **Energy Efficiency:**

- **Optimization**: Exploring ways to optimize fuel usage based on vehicle routes, load, and other factors can lead to significant energy savings.
- **Fuel-Efficient Practices**: Implementing fuel-efficient driving practices based on real-time data can further enhance the system's benefits, contributing to a more sustainable operation.

In summary, remote fuel level monitoring systems are not only providing immediate benefits in terms of operational efficiency and cost savings but also hold the potential for significant advancements in security, maintenance, and energy efficiency. As technology continues to evolve, these systems will undoubtedly become more sophisticated, offering even greater control and optimization of fuel resources. They represent a critical component in the pursuit of sustainable and efficient fuel management practices in the modern world.

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# APPENDICES

**Code Used for Arduino:**

```
#include <SoftwareSerial.h>

// GSM module connected on pin 9 (RX) and 10 (TX)

SoftwareSerial mySerial(9, 10);

// Pin where the sensor is connected

const int sensorPin = A0;

// Function to read the voltage from the analog pin

float readVoltage(int pin) {

  int sensorValue = analogRead(pin);

  return sensorValue * (5.0 / 1023.0);  // Convert the sensor reading to voltage

}

// Function to calculate percentage based on the voltage

float calculatePercentage(float voltage) {

  float baseVoltage = 2.0;  // Voltage corresponding to 40%

  return (voltage / baseVoltage) * 40.0;  // Calculate percentage

}

void setup() {

  mySerial.begin(9600);  // Setting the baud rate of GSM Module

  Serial.begin(9600);  // Start serial communication at 9600 baud
```

```
    delay(100);
    Serial.println("Starting water level monitoring...");
}
void loop() {
    static float lastPercentage = 0;  // Stores the last percentage value
    float voltage = readVoltage(sensorPin);  // Read the voltage from sensor
    float currentPercentage = calculatePercentage(voltage);  // Calculate current percentage
    // Display the voltage and current percentage
    Serial.print("Voltage: ");
    Serial.print(voltage);
    Serial.println(" V");
    Serial.print("Current Water Level Percentage: ");
    Serial.print(currentPercentage);
    Serial.println("%");
    // Send SMS with current water level percentage
    String message = "Current Water Level: " + String(currentPercentage, 2) + "%";
    sendSMS(message);
    // Check if the change in percentage is greater than 10%
    if (abs(currentPercentage - lastPercentage) > 10 && lastPercentage != 0) {
        Serial.println("Theft detected! Sending SMS alert...");
            String message ="Theft Detected! Current Water Level: " + String(currentPercentage, 2) +
"%" ;
```

```
            delay(3000);
    sendSMS(message);
    }
    lastPercentage = currentPercentage;  // Update lastPercentage for next loop iteration
    delay(10000);  // Wait for 10 seconds before the next loop iteration
}
void sendSMS(String message) {
    mySerial.println("AT+CMGF=1");    // Sets the GSM Module in Text Mode
    delay(1000);
    mySerial.println("AT+CMGS=\"+916282736889\"");  // Replace with your mobile number
    delay(1000);
    mySerial.println(message);  // The SMS text you want to send
    delay(100);
    mySerial.println((char)26);  // ASCII code of CTRL+Z to end the SMS
    delay(1000);
}
```

**Code For The Website**

```
<!DOCTYPE html>
<html>
<head>
    <title>fuel-monitor</title>
    <style>
        img { opacity: 1; }
        img:hover { opacity: 0.5; }
        .container {
            text-align: center;
            margin-top: 50px;
        }
        .button {
            padding: 10px 20px;
            font-size: 16px;
            background-color: #007bff;
            color: #fff;
            border: none;
            border-radius: 5px;
```

```
            cursor: pointer;
        }
        .button:hover {
            opacity:0.5;
            background-color: #0056b3;
        }
        #lastReading {
            font-family: Arial, sans-serif; /* Change the font family */
            color: blue; /* Change the text color */
            font-size: 20px; /* Change the font size */
            font-weight: bold; /* Change the font weight */
        }
    </style>
</head>
<body>
    <div class="container"><h1 >FUEL.com</h1>
    <p style="color: rgb(18, 159, 161);" title="Im a tooltip">Fuel access at your
fingertips...</p>
    <a href="output.txt" target="_blank">
        <button class="button">History</button>
        </a></div>

    <div style="text-align: center;">
```

```
        <img id="fuelGauge" src="giphy.gif" style="width: 180px; height: 180px; margin-top:
25px;" alt="fuel gauge" onclick="showLastReading()">

    </div>

    <p id="imageText" style="text-align: center;">click the gauge for your reading.</p>

    <div id="lastReading" style="text-align: center;"></div>

    <div style="text-align: center;">

        <button class="button" onclick="developers()">Developed By:</button>

    <p id="x"></p>

    <script>

        function developers() {

            document.getElementById("x").innerHTML = "Joel Johnson Kochukoikkal <br>
Patric Joe Aji <br> Joseph Babu<br> Joel Abe Thomas";

        }

        </script>

        </div>

    <script>

        function getLastLineOfFile(filePath) {

            return new Promise((resolve, reject) => {

                fetch(filePath)

                    .then(response => {

                        if (!response.ok) {

                            throw new Error('Network response was not ok');

                        }
```

```
                return response.text();
            })
            .then(text => {
                const lines = text.trim().split('\n');
                const lastLine = lines[lines.length - 1];
                resolve(lastLine);
            })
            .catch(error => {
                reject(error);
            });
    });
}

function showLastReading() {
    const filePath = "output.txt";
    getLastLineOfFile(filePath)
        .then(lastLine => {
            document.getElementById('lastReading').innerHTML = lastLine + " ml";
            document.getElementById('imageText').style.display = 'none';
        })
        .catch(error => {
            console.error('Error reading file:', error);
```

```
            });
        }


    </script>
</body>
</html>
```