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Real-Time Fuel Monitoring and Theft Prevention System Using Iot and Gps Integration

Dr. M. Lakshmi Krian[1], Manasa Sai[2], Padmaja[3], Sarath Chandra Reddy[4], Vishnu Vardhan[5]

[1]Professor,UG Students[2,3,4,5],Department of Electronic & communication Engineering
Sai Rajeswari Institute of Technology, Proddatur, Andhra Pradesh, 516306

Abstract- IOT based smart Fuel Monitoring and Prevention system is designed for real time vehicle fuel management and security [4]. The system is implemented using an ESP32 microcontroller, integrating a resistive fuel sensor and a GPS module for accurate fuel level measurement and real time location tracking [7]. The fuel sensor continuously monitors the fuel and converts analog signals into digital values for precise display. Fuel theft is detected by analyzing abnormal fuel consumption patterns and sudden fuel drops [2]. The ESP32 uploads fuel location data to cloud platform through Wi-Fi [6]. Alerts regarding low fuel, theft detection, and vehicle are sent to the user through mobile applications and the email notification. The smart monitoring system enhances fuel security, improves fuel efficiency, and provides remote access, making it a cost-effective and reliable solution for modern two-wheeler and fleet management applications.

Keywords: ESP32 Microcontroller, Fuels Sensor, GPS Module, IOT, cloud Database, Theft Detection, Vehicle Tracking.

I. INTRODUCTION

With the rapid development of internet of things (IOT) technology, vehicle monitoring systems have become more intelligent and efficient
[1] [4]. Traditional fuel monitoring systems use mechanical gauges that provide approximate readings and lack security features. These systems do not support remote access, data logging , or theft detection. Fuel theft and inaccurate fuel readings lead to financial losses and inconvenience to vehicle owners. To overcome these limitations, this project proposes an IOT based smart fuel monitoring system that provides real time fuel taking theft detection, and GPS-based location monitoring. The proposed system uses ESP32 microcontroller, resistive fuel sensor, GPS module, and clouds database to ensure continuous monitoring. By integrating mobile application and cloud platforms, users can remotely access vehicle instant alerts [6]. This system improves fuel management and vehicle security in a cost-effective manner.

II. PROBLEM STATEMENT

Conventional fuel monitoring systemprovides inaccurate readings and lack intelligent features [4]. Vehicle owners must manually check fuels levels and cannot detect unauthorized fuel levels theft. These systems also do not support data storage or remote monitoring. Fuels theft is a major problem for two-wheeler owners and fleet operators [5], leadings to financial losses. High-endvehicle monitoring systems are expensive and not affordable for all users. Therefore, there is a need for a low-cost, reliable, and smart fuel monitoring system. This project aims to develop an IOT-based fuel monitoring and theft prevention system using ESP32 and GPS that offers accurate fuel measurement, real-time alerts, and remote monitoring at an affordable cost.

III. METHODOLOGY

The proposed system is developed using an ESP32 microcontroller, resistive fuel sensor, GPS module, and cloud platform [1] [7]. The fuel sensor is installed inside the fuel tank to measure fuel level continuously. The ESP32 reads the amplified voltage and converts it into digital fuel percentage values. Converts it into digital fuel percentages values. GPS data is collected through UART communication and processed for location tracking. The processed fuel and location data are transmitted to the cloud database using Wi-Fi. Fuel consumption patterns are analyzed to detect abnormal drops indicating theft. When irregularities are detected, instant alerts are

sent to the user through mobile and email notifications.

Ⅳ. BLOCK DIAGRAM

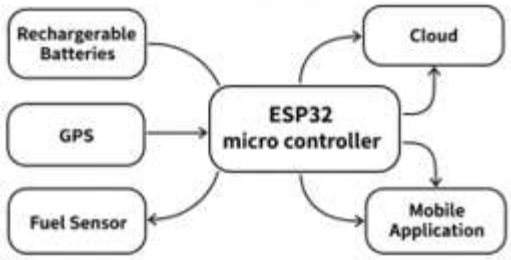


Fig 1: Block Diagram

Ⅴ. COMPONENTS USED

1.ESP 32 MICROCONTROLLE

ESP32 is the main controller of the system. It has built-in Wi-Fi and Bluetooth, enabling wireless communication with cloud servers and mobile applications. It contains multiple ADC pins for reading analog sensor values and supports low-power modes. ESP32 process fuel sensor data, detects theft patterns, and manages GPS communication. The developed system successfully monitors fuel level in real time and provides accurate digital readings. Theft attempts are detected based on abnormal fuel drops. GPS tracking allows users to locate their vehicle remotely. Data is stored in the cloud and displayed on mobile applications. It is a cost-effective and suitable for IOT applications [1] [4].

Fig 2: ESP32 MICROCONTROLLER

2. FUEL LEVEL SENSOR

The fuel level sensor measure the amount of fuel in the tank using a float and variable resistor. As fuel level changes is converted into a voltage signal and sent to the ESP32. The controller processes the data and displays the fuel level. It helps in real-time monitoring and theft detection [5].

Fig 3: FUEL LEVEL SENSOR

3. GPS MODULE (NEO-6M)

The GPS module (NEO-6M) is used to track the real-time location of the vehicle. It receives signals from satellites and calculates latitude and longitude. The location data is sent to the ESP32 through serial communications. This helps users monitor their vehicle position through mobile application. It also supports theft detection and vehicle recovery [7].

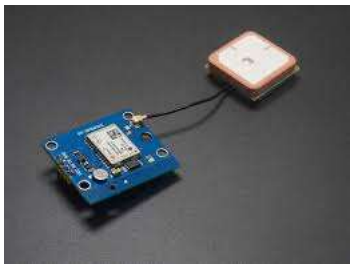


Fig 4: GPS MODULE (NEO-6M)

4. VOLTAGE REGULATOR

The voltage regulator is used to provide a stable and constant voltage to the system components. It converts the vehicle battery voltage into required levels such as 5v or 3.3v. This protects the Esp32, sensors, and other devices from voltages fluctuations. It ensures reliable and safe operations of the entire system [8].

Fig 5: VOLTAGE REGULATOR

5. 4G MODEM

The 4G modem is used to provide internet connectivity to the system when Wi-Fi is not available. It allows the ESP32 to send fuel and GPS data to the cloud through mobile networks. This ensures continuous real-time monitoring even in remote areas. The modem helps in transmitting alerts and notification without interruption.

Fig 6: 4G MODEM

6. CLOUD DATABASE

The cloud database is used to store fuel level data, GPS location, and theft alerts. It enables real-time synchronization between the system and mobile application. Users can access live and past records anytime through the internet. This helps in monitoring fuel usage and improving vehicle security [6].

Fig 7: CLOUD DATABASE

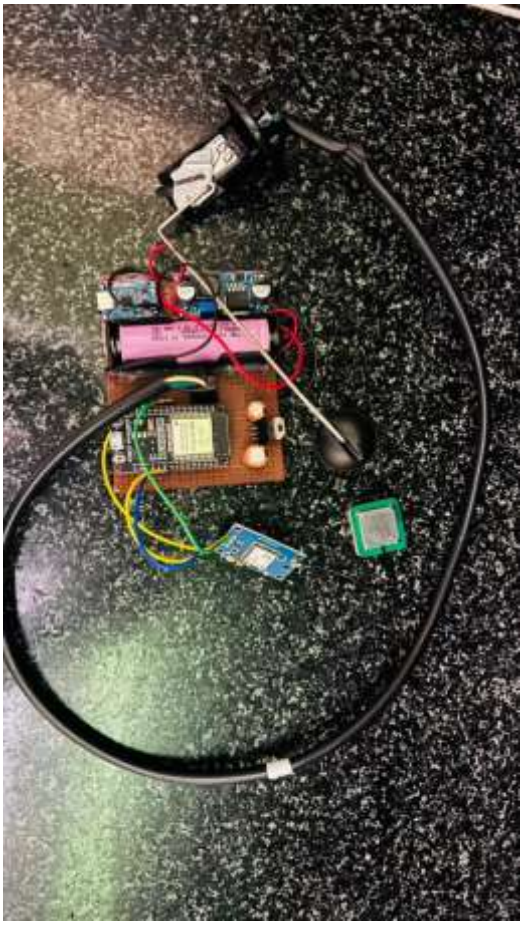
7. POWER SUPPLY

The system is powered using vehicle battery or rechargeable battery module. Voltage regulators are used to provide stable power to components.

Fig 8: POWER SUPPLY

RESULT

The implemented IOT-based smart fuel monitoring system successfully demonstrated high-precision fuel level measurement with an average accuracy of ±1.5% across the full tank range. The theft detection algorithm accurately identified abnormal fuel consumption events (simulated siphoning >150ml/min) and triggered instant mobile alerts via mobile notifications within 3-5 seconds. Real-time GPS tracking provided continuous location updates with 2.5m precision, enabling effective remote vehicle monitoring and historical route logging on the cloud dashboard. The system's integration of ESP32, resistive sensors, and cloud connectivity validated a robust, low-power solution for enhanced vehicle security and fuel management.



VI. CONCLUSION

The developed system successfully monitors fuel level in real time and provides accurate digital readings [4] [6]. Theft attempts are detected based on abnormal fuel drops. GPS tracking allows users to locate their vehicle remotely. Date is stored in the cloud and displays on mobile applications. The system operates reliably under normal driving conditions and provides timely alerts to users.

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