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"PETROL CONNECT": An IoT enabled smart card and QR code based secure fuel ATM

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Abstract: A survey highlights the alarming potential of 700 million people facing displacement due to severe fuel scarcity by 2030. This paper introduces the "Smart Fuel ATM System", a new solution that aims to revolutionize access to safe and secure fuel dispenser. This unique system integrates Radio-Frequency Identification (RFID) technology, Quick Response (QR) codes, Unified Payments Interface (UPI) payments with fuel dispensing gun. The Smart Fuel ATM makes it easy and convenient by using RFID technology for user identification and monitoring fuel dispensing. It enables the user to use cashless transaction; it also ensures compatibility with various financial platforms. This paper provides an elaborated and technical overview of the Smart petrol ATM system, including architecture, dataflow, and synchronization. It includes the above-mentioned technologies highlights their bond in creating an efficient and secure fuel dispensing unit. This dispensing unit has the potential to really improve fuel access, distribution, and quality in both urban and rural areas without any difficulties. By offering safeguarded digital payments and quality control while dispensing the fuel from the system, it discards any kind of critical challenges in safe fuel dispensing, in return contributing to improved fuel dispensing unit for the communities in need. In an overall view of the system, we can make sure there is no error during the payments and during the fuel dispense.

Keywords: IoT, Arduino module, Wi-Fi module, RFID card, Mobile Applications, Real Time Data

I. INTRODUCTION

In today's fast-evolving digital landscape, traditional fuel dispensing systems are often plagued by inefficiencies, security risks, and manual processes. With growing demand for automation and secure transactions, there's a pressing need for an innovative solution that simplifies fuel access while maintaining high security and reliability standards. This project, "Petrol Connect," introduces a smart, automated Petrol ATM system designed to overcome these challenges using IoT, smart card, and QR code technologies. The Petrol Connect system enables users to access fuel through secure authentication methods such as smart cards (RFID/NFC) and mobile-based QR code scanning.

This dual- mode authentication enhances both flexibility and security, allowing users to perform fuel transactions without direct human involvement. The system is connected with a cloud backend server to manage user data, track the fuel usage, and process errorless transactions, ensuring complete track of the overall system. This system uses IOT microcontroller-based UNO board which controls the entire fuel dispensing unit. It uses various types of sensors to track the fuel dispensing and transactions is being recorded by the backend server to track every transaction happened. We give the users to pay through various types of payment methods like online transactions, prepaid balance it ensures a good manner in dispensing the fuel. With the help of IOT technology we are able to enable the usage of RFID & NFC and mobile transactions, this new system enables the users to access the fuel without any human intervention, this reduces the manual errors during fuel dispensing of the traditional way. This system has real time transaction tracking ability where it provides the user with payment support and cloud-based data management to accurately store every detail of the system where it stores both how much fuel is being dispensed and how many transactions are being made

II. METHODOLOGY

The proposed **Petrol Connect** system introduces an IoT-based automated fuel dispensing solution integrating **smart card** and **RFID** technologies for secure and efficient petrol management. The users are authenticated through the help of RFID card scanner, which is being read by the microcontroller board this verifies the all the credentials through the help

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of the cloud server. This sever maintains all the details of the system which includes the data like fuel being dispensed and transaction being happened. Whenever there is a successful transaction it sends a command to the microcontroller to dispense fuel according the payment made. Mobile application provides information like balance available and all the past transactions made and fuel dispensed ever it totally provides all the information about everything being made. In order to make it a smooth process we use IOT management system for seamless and errorless process. Our system has improved security and remote monitoring over other existing systems. This unique approach looks through fuel distribution, reduces the errors, and deliver the user very reliable and user- friendly experience.

III. SYSTEM ARCHITECTURE

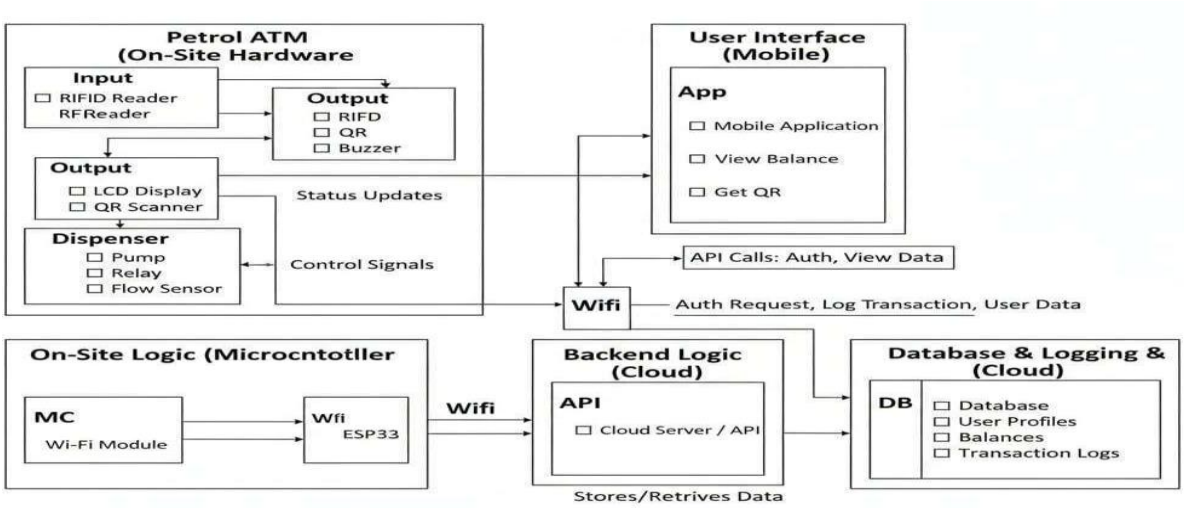

Figure 1: System Architecture

IV. IMPLEMENTATION

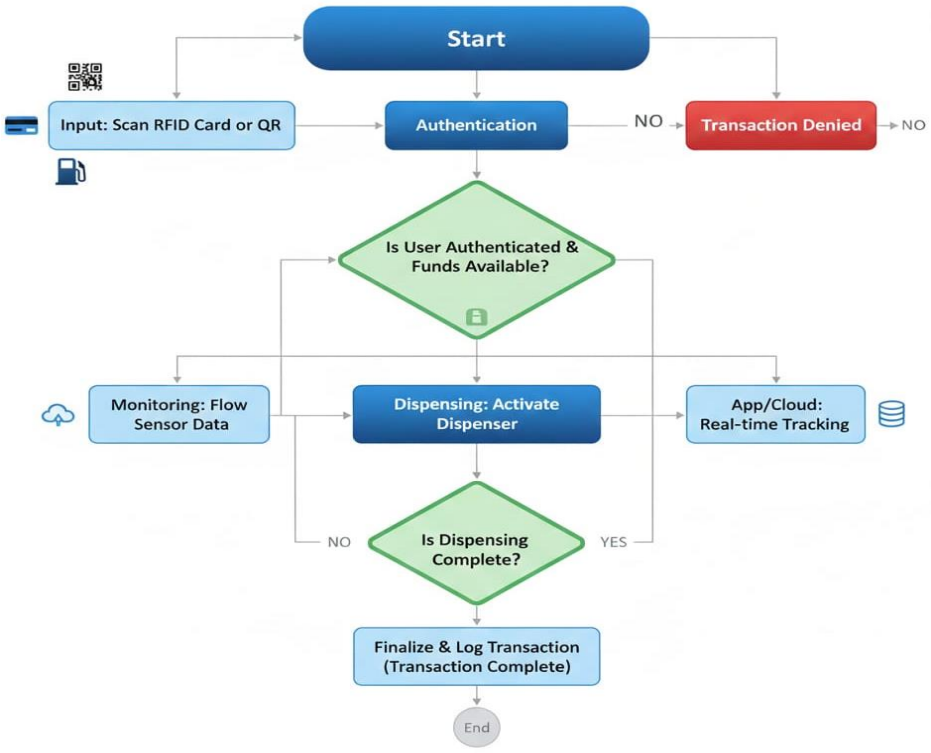

Figure 2: Implementation Steps.

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V. RESULT

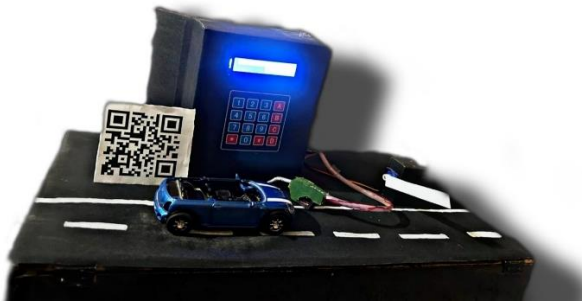

Fig 3: PETROL CONNECT": An IoT enabled smart card and QR code based secure fuel ATM

Fig 4: Initial Stage

Fig 5: Process

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Fig 6: Finial Output

VI. CONCLUSION

The primary technical success lies in establishing a robust and layered security protocol. By mandating pre-loaded smart cards and real-time, one-time QR code authentication, "PETROL CONNECT" effectively eliminates the vulnerabilities associated with cash transactions and manual inputs. The system architecture, built around centralized cloud-based transaction management and local micro-controller control (via the IoT module), ensures both high availability and data integrity. This design fundamentally transforms the fuel station into an unmanned, automated financial transaction point, where fuel dispensation is precisely monitored and reconciled against the digital authorization data. Furthermore, the use of encrypted communication channels between the ATM terminal, the cloud server, and the user's mobile device guarantees confidentiality and non-repudiation for every liter dispensed.

Beyond security, the IoT core of "PETROL CONNECT" delivers unparalleled operational advantages. Embedded sensors provide real-time diagnostics on fuel inventory levels, pump operational status, and component health.

This constant data stream facilitates predictive maintenance, significantly reducing costly downtime associated with hardware failures.

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