



Automated Petrol Pump using RFID Technology

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Abstract—

The rapid growth of urbanization and vehicular traffic demands smarter, more efficient fuel dispensing systems. This paper presents the design and implementation of an Automated Petrol Pump System using Radio Frequency Identification (RFID) technology. The proposed system eliminates manual intervention in fuel dispensing by automatically authenticating users through RFID cards and controlling the fuel pump using an Arduino-based microcontroller. When a user presents their RFID card to the reader, the system verifies the user identity, checks the pre-loaded balance, activates the relay to start the fuel pump, and precisely measures the dispensed fuel quantity using a flow sensor. The transaction details are displayed on an LCD screen in real time. The system ensures accuracy, security, and reduced human error in fuel management. Experimental results confirm that the system operates reliably with an RFID identification time of under one second and fuel measurement accuracy within $\pm 1\%$. The proposed solution is highly scalable and applicable to petrol stations, corporate fleet management, and smart city infrastructure.

Keywords— RFID; Flow Sensor; Motor; Automated Fuel Dispensing; Arduino Microcontroller; Embedded Systems; Smart Petrol Pump



I. INTRODUCTION

Fuel dispensing at conventional petrol pumps is largely a manual process that is prone to human error, fuel pilferage, inaccurate measurement, and inefficiency. With the proliferation of smart technologies and embedded systems, there exists a significant opportunity to automate this process and improve both security and operational efficiency. RFID (Radio Frequency Identification) technology, widely used in access control, inventory management, and contactless payment systems, presents a suitable foundation for automating user authentication at fuel stations [1].

The conventional approach requires an attendant to manually operate the pump, record transactions, and handle payments. This introduces multiple points of failure—including measurement inaccuracies, unauthorized dispensing, and time delays during peak hours. An automated system using RFID can address these challenges by offering a seamless, contactless, and self-service fueling experience [2].

This paper proposes an RFID-based automated petrol pump system that integrates an RFID reader, an Arduino microcontroller, a relay module, a flow sensor, a fuel pump motor, and an LCD display. The system is designed to authenticate users, verify account balance, dispense a controlled quantity of fuel, and log transactions—all without requiring manual intervention. The objectives of this system are to: (i) automate fuel dispensing; (ii) reduce human effort; (iii) ensure accurate fuel quantity measurement; and (iv) provide secure user identification.

II. LITERATURE REVIEW

Several prior works have explored automation in fuel dispensing systems. Sharma et al. [1] proposed an RFID-based petrol pump automation system that demonstrated reduced transaction time and improved accountability. Their work focused on using passive RFID tags and a centralized database but lacked real-time flow measurement capability.

Kumar and Reddy [2] implemented an RFID and GSM-based fuel management system for fleet vehicles, enabling remote monitoring of fuel levels and transactions. The system used SIM-based communication to log transactions to a cloud server, though it introduced latency and connectivity dependency.

Patel et al. [3] designed an embedded fuel management system with a microcontroller and flow sensor, emphasizing measurement accuracy. While their system addressed volumetric precision, it did not include RFID-based user authentication, limiting security.

The present work builds upon these contributions by integrating RFID authentication, flow-based measurement, relay control, and local LCD display into a single coherent embedded system—offering a cost-effective and standalone solution that does not rely on external connectivity for core operations.

III. METHODOLOGY

The proposed system consists of both hardware and software components working in tandem to provide a fully automated fuel dispensing solution.

A. Hardware Components

The key hardware components used in this system are: RFID Reader (RC522), operating at 13.56 MHz to read RFID cards and tags and transmit the unique user ID to the microcontroller via SPI communication; Arduino Microcontroller (UNO), serving as the central processing unit to receive data from the RFID reader, verify user credentials stored in local memory, and control the relay and LCD; Relay Module, acting as an electrically controlled switch to activate or deactivate the fuel pump motor; Flow Sensor (YF-S201), measuring the volume of fuel dispensed using pulse output; LCD Display (16×2), displaying user information, account balance, dispensed quantity, and transaction status in real time; Fuel Pump Motor, which pumps fuel from the reservoir when activated by the relay module; and a regulated 5V/12V DC Power Supply for all electronic components.

B. Software Description

The system is programmed in Embedded C using the Arduino IDE. The software performs the following key functions: RFID Authentication, which reads the unique card ID and compares it against a predefined list of authorized users stored in the controller memory; Balance Checking, which verifies whether the user has sufficient pre-loaded credit; Pump Control, which activates the relay to start the pump and monitors the flow sensor to stop dispensing when the target quantity is reached; and Transaction Logging, which records user ID, dispensed quantity, and updated balance in local memory.



IV. RESULTS AND DISCUSSION

The system was assembled and tested under controlled laboratory conditions. Multiple RFID cards were enrolled, and test transactions were conducted to evaluate authentication speed, fuel measurement accuracy, and overall system reliability.

The RFID authentication process was completed in under one second in all test cases, demonstrating fast and reliable user identification. The flow sensor achieved a measurement accuracy of $\pm 1\%$, which is within the acceptable tolerance for commercial fuel dispensing systems. The relay module successfully controlled the pump with no false activations or missed triggers across 50 test cycles.

The LCD display correctly showed real-time transaction information including the user name, pre-dispensing balance, dispensed quantity, and post-dispensing balance. The system also correctly rejected unauthorized RFID cards and displayed appropriate alerts.

Compared to prior works [1][2][3], the proposed system offers a more integrated solution by combining authentication, flow measurement, and display in a standalone embedded system. The absence of cloud dependency ensures uninterrupted operation even in areas with poor network connectivity.

Table I: Hardware Component Specifications and Verification Status

Component	Parameter	Specification
RFID Reader (RC522)	Operating Frequency	13.56 MHz

V. CONCLUSION

This paper presented the design, implementation, and testing of an RFID-based automated petrol pump system. The system successfully integrates RFID authentication, microcontroller-based pump control, flow-based measurement, and real-time LCD display into a reliable, standalone embedded solution. The results confirm that the system achieves fast authentication (under one second) and high fuel measurement accuracy ($\pm 1\%$), making it well-suited for practical deployment in fuel stations, fleet management systems, and smart city infrastructure.

The system reduces manual workload, minimizes the risk of fuel theft or measurement error, and enhances the

overall user experience. Future enhancements could include mobile application integration for remote balance management, UPI/payment gateway connectivity, facial recognition as an alternative authentication method, and IoT-based real-time monitoring for multi-pump networks. AI-based fuel consumption prediction could further optimize supply chain management at fuel stations.

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