

HYBRID FUEL DISPENSER AND EV CHARGING STATION

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ABSTRACT

creation and design of an automation system for gas pumps based on RFID. The typical gasoline pump is a hand pump. Vehicle owners must communicate with the driver. Vehicle holders benefit from time savings when they are converted to automation. We can reduce the cost of maintenance by eliminating manual power. An RFID-based gasoline pump automation system is one of the solutions we suggested here. RFID sensor (EM-18) connected to the ESP-32 Controller via UART connections. The relay that powers the AC pump/DC EV charging station is attached to an Arduino digital pin. A 4x4 matrix keypad that is linked to digital pins of an ESP-32 Controller. We must first swipe our RFID cards and enter our passwords for this project. The password is If so, it asks for the amount. The EV charger or petrol pump will turn on and start dispensing fuel based on the amount entered. Buzzer will be on for incorrect passwords. Based on the RFID card, the amount will be deducted. amount entered. A buzzer will be activated if there is not enough. This data will all be shown on a 16x2 LCD screen.

Keywords: RFID Reader, ESP32, Hybrid Fuel, Vehicle

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1. INTRODUCTION

As transportation technology advances at a rapid pace and the demand for electric cars (EVs) rises, contemporary fuelling systems that can effectively service both conventional fuel-based and electric vehicles are required. By integrating EV charging and gasoline distributing capabilities into a single automated device, the Hybrid Fuel Dispenser and EV Charging Station is made to satisfy this growing need. The human interaction required for fuel dispensing at conventional fuel stations can result in delays, human error, and increased maintenance expenses. The suggested solution uses RFID technology and the ESP32 microcontroller to automate tasks in order to overcome these obstacles. RFID

cards facilitate safe transactions and user authentication, while the ESP32 controller controls every step of the process, including password verification, energy or fuel dispensing, and LCD screen presentation of data.

A relay-based control mechanism is also incorporated into the system to alternate between EV charging and gasoline delivery. A buzzer improves the system's security and dependability by sending out alerts for bad passwords or inadequate balance. Furthermore, data analysis, remote monitoring, and effective energy management are made possible by IoT integration.

The overall goal of this project is to create a hybrid filling station that is intelligent, contactless, and easy to use for both electric and fossil fuel vehicles. This will promote the goal of intelligent and sustainable transportation networks.

The suggested Hybrid gasoline Dispenser and EV Charging Station increases efficiency and convenience for contemporary transportation demands by

combining traditional gasoline distribution and electric vehicle (EV) charging into a single automated system. The ESP32 microcontroller serves as the system's main control unit and interfaces with relay modules, an LCD display, buzzer, RFID reader, and keypad. Users can enter the necessary gasoline or charging amount via the keypad, and secure user access and cashless transactions are guaranteed by the RFID-based authentication. Depending on the user's choice, the system then turns on the EV charger or the gas pump after verification. Real-time feedback is provided by the LCD panel, which monitors and shows the entire operation. Furthermore, the incorporation of IoT connectivity facilitates data logging and remote monitoring for enhanced analytics and management. In addition to lowering maintenance expenses and minimizing manual intervention, this hybrid system encourages the use of intelligent, energy-efficient refueling infrastructure that can accommodate both conventional and electric vehicles

2. LITERATURE SURVEY

There has already been a great deal of experimentation with RFID for traffic management, toll collection, and vehicle

identification. In order to control fuel dispensing in Indian cities, this article suggests implementing RFID technology. Automobile drivers must pay for fuel with cash, and because station employees may not have little change, they may have to pay more than the amount of fuel that is given. The Arduino program's underlying hardware and software are designed to make working on electronic projects easier. The ATmega2560 is an electronic circuit board that helps you create shared objects by analyzing real-world data, processing it, and then appropriately triggering action in the real world This study focuses on designing an automated gasoline pump that uses RFID technology to eliminate the need for human intervention and to establish an auto-led technique that uses RFID technology to do tasks serially. Radio frequency technology has enhanced traditional data collection techniques Due to its inexpensive cost and wide scan range, UHF band RFID technology has gained widespread acceptance. In terms of the overall system structure, the antenna is crucial. Therefore, in order to satisfy the needs of the clients, the antenna designer must thoroughly examine all aspects, such as performance, integration environment, and actual space and cost requirements. Keeping an eye on and managing the gasoline station's variables is its second goal. In 2019, S. Kumar et al. The authors suggested an automated gasoline dispensing model utilizing RFID technology for safe identification in their work on "RFID-Based Smart Fuel Dispenser Automation System." The system's goals were to increase transaction accuracy at gas stations and decrease human interaction.

R. Patel and A. Sharma (2020) The "IoT-Enabled Smart Petrol Pump Management System" was the main focus of their study. It used IoT and microcontrollers to remotely automate refueling procedures and monitor gasoline consumption via cloud connectivity.

M. Rahman et al. (2021): To offer dual functionality and increase energy distribution efficiency, the authors created a "Hybrid Energy Charging Station for Electric and Conventional Vehicles" with a microcontroller-based design.

P. Kaur and T. Singh (2020) A secure identification and invoicing system was described in their study "RFID Authentication for Vehicle Fuel Management" to reduce gasoline theft and guarantee user-specific control over dispensing.

According to J. Lee and H. Kim's (2022) study, "ESP32-Based Smart EV Charging Infrastructure," an Internet of Things-controlled system for charging electric vehicles with functions like load management, automatic billing, and real-time monitoring was presented.

(2018) R. Gupta et al. The authors of the paper "Design of an Automated Fuel Station Using Arduino and RFID" developed a semi-automated, reasonably priced prototype that expedited the payment and dispensing procedures.

N. Roy and P. Das (2021) – Their study, "Integration of Renewable Energy in Hybrid EV Charging Stations," focused on how solar energy and charging stations may

work together to reduce grid dependency and enhance sustainability.

In 2020, S. Mathew and K. Johnson The authors of the paper "Smart Fueling System Using RFID and GSM Technology" described a wireless communication architecture for tracking fuel and transaction updates via GSM modules.

In their 2022 paper, "IoT-Based Hybrid Refueling and Charging Infrastructure," L. Zhang et al. described a cloud-connected hybrid station that optimized energy and performed predictive maintenance using IoT analytics.

G. Rao and V. Reddy (2019) Their study, "Automated Fuel Pump System Using Embedded Controllers," showed how an automation system based on microcontrollers might increase gasoline station operational speed, safety, and accuracy.

3. EXISTING SYSTEM

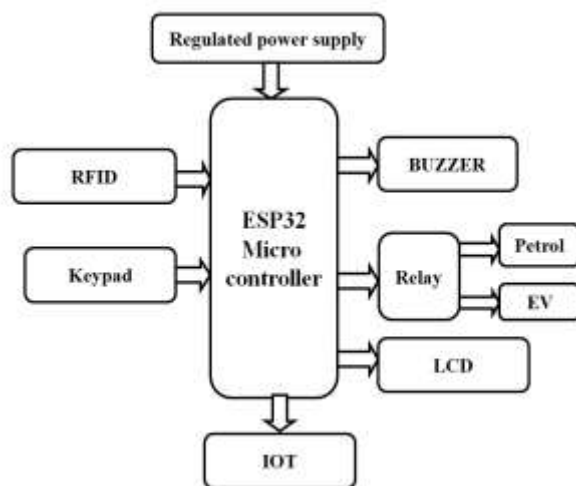
Most gas stations currently have manual fuel delivery systems that aren't automated or intelligently controlled. The fuelling process in these conventional installations entails human interaction between the operator and the consumer. Payment is made individually using cash or a credit card, and the operator physically starts and stops the pump according to the quantity of fuel ordered. Even while it works, this manual approach has a number of drawbacks, including being labor-intensive, prone to human error, and lacking security safeguards. Inaccurate gasoline measurements, unauthorized fuel access, and manual billing can result in operational losses and inefficiencies.

Additionally, information like user identity, transaction history, and fuel use are not automatically logged or examined.

Arduino or microcontroller-based controls have been used to introduce semi-automated systems in recent years. Basic automation features like gasoline measuring and electronic payment processing are provided by these systems, but human oversight is still necessary. These configurations lack IoT connectivity and RFID authentication, which leads to little scalability and little automation.

Furthermore, users must visit different sites for varied energy needs because current EV charging stations and gas dispensers function as distinct entities. Users of hybrid vehicles experience inconvenience as a result of this lack of integration, which also prevents the adoption of unified smart fueling systems.

4. PROPOSED SYSTEM



In order to combine traditional gasoline dispensing and electric car charging into a single, intelligent, and automated platform, the Hybrid gasoline Dispenser and EV Charging Station is being developed. The ESP32 microcontroller, which acts as the

system's central processing unit and controls all hardware elements and user interactions, forms the foundation of the design. It makes use of RFID technology to securely identify users, guaranteeing that only those who have registered can access the system. The system authenticates the user's credentials once they swipe their RFID card and input their password, enabling them to choose between the EV charging and fuel distribution modes. For users of hybrid vehicles, this integration offers a single solution, doing away with the need to visit numerous stations for various energy sources.

Numerous hardware components, including a 16x2 LCD display, a 4x4 matrix keyboard, relay modules, and buzzer alerts, are used in the automation process. Following successful authentication, the user inputs the required fuel or charge quantity, and the system initiates the procedure by turning on the appropriate relay. The system tracks the energy consumption or flow rate while it is operating and shuts off automatically when the entered quantity is achieved. In order to maintain security and stop unwanted access, the buzzer notifies the user if the balance or password is wrong. Because the LCD panel shows all operating information, such as the user ID, transaction progress, and amount, the process is clear and easy to use.

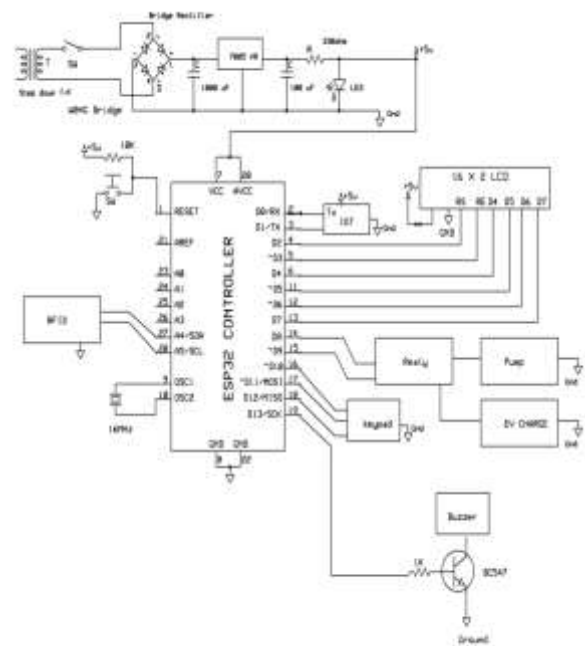
The ESP32's integrated Wi-Fi further integrates IoT features into the system, allowing for remote management, data logging, and real-time monitoring. This enables remote monitoring of energy use, transaction history, and system health by station operators. By accommodating both fuel-based and electric cars, the suggested hybrid model increases efficiency, decreases

human intervention, and advances sustainability. All in all, this contactless, intelligent, and environmentally friendly technology is a cutting-edge method of supplying infrastructure that meets the rising demand for automation and environmentally friendly transportation options. Putting gas stations in remote locations to give customers great service is quite expensive. Unmanned power pumps solve all of these issues because they are efficient, need less time to run, and can be deployed anywhere. The customer must use an electronic clearing system to make the payment before they can use the service.

The relay that powers the AC pump/DC EV charging station is attached to an Arduino digital pin. A 4x4 matrix keypad that is linked to digital pins of an Arduino. We must first swipe our RFID cards and enter our passwords for this project. The sum is requested if the password is accurate. The EV charger or petrol pump will turn on and start dispensing fuel based on the amount entered.

The schematic diagram. Using an RFID card, we are able to get gasoline at various stations owned by various corporations throughout the nation. In our proposed petrol pump automation system, we are integrating all of these stations.

Schematic Diagram



This pin diagram shows the connections between all of the hardware parts. an Arduino microcontroller with twenty-eight pins. whereby 6 GPIO pins and 14 digital pins are included. There is an inbuilt 16MHz crystal oscillator connected. To supply 5v to the Arduino and all input/output modules, a regulated power supply is linked to the step-down transformer, bridge rectifier capacitor with 1000f resistors, and LED.

Digital pins 2, 3, 4,5, 6, and 7 are connected to the 16*2 LCD view. Internal transmitter and receiver pins D0 and D1 are coupled to RFID. Digital pins 9 and 10 are linked to the keypad, and digital pin 13 is linked to the buzzer alert.

5. RESULTS

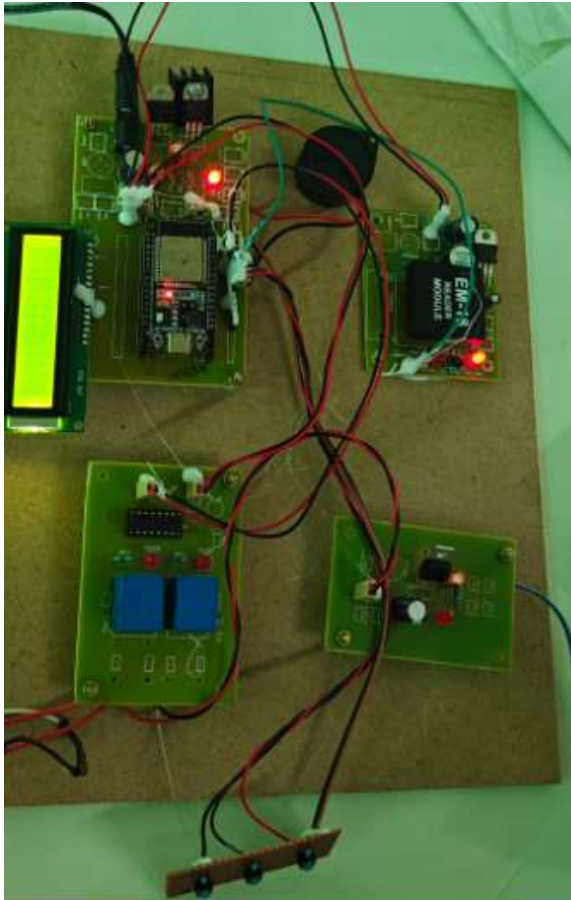


Figure.1 Proposed Hardware Setup
The image shows the prototype model of the Hybrid Fuel Dispenser and EV Charging Station setup. The system is built on a wooden base board, consisting of key electronic components interconnected to demonstrate automation and control. At the center is the ESP32 microcontroller board, which acts as the brain of the system, connected to a 16×2 LCD display for showing user inputs, status messages, and transaction details.



Figure.2. Proposed LCD output

S.No	Item	Date
1	Fuel_Type_Petrol_Currect_Password_Blt_400	2025-10-12 11:08:06
2	Fuel_Type_EV_Currect_Password_Blt_300	2025-10-12 11:07:28
3	Invalid_Card_	2025-10-12 11:01:17
4	Fuel_Type_Petrol_Currect_Password_Blt_400	2025-10-12 11:00:30
5		2025-10-12 11:00:40
6	Invalid_Card_	2025-10-12 11:00:40
7	Fuel_Type_EV_Currect_Password_Blt_300	2025-10-12 11:50:30
8	Fuel_Type_Petrol_Currect_Password_Blt_400	2025-10-12 11:54:35
9	Fuel_Type_Petrol_Currect_Password_	2025-10-12 11:53:08
10	Fuel_Type_EV_Currect_Password_	2025-10-12 11:51:45
11	Invalid_Card_	2025-10-12 11:49:39
12	Invalid_Card_	2025-10-12 11:49:31
13	Fuel_Type_Petrol_Currect_Password_Blt_400	2025-09-23 21:20:15
14	Fuel_Type_EV_Currect_Password_Blt_400	2025-09-23 21:14:47
15	Invalid_Card_	2025-09-23 21:21:18

Figure.3. Proposed Web Server output

Figure.3. Proposed Web Server Shows the complete project output parameter like fuel type, ev and balance amount data will post into IoT server.

A relay driver circuit is used to control external devices like the AC fuel pump and DC EV charger, represented here by the pump motor and cooling fan. The prototype also includes sensors and a buzzer module for security alerts, along with voltage regulators and power supply modules for stable operation. All modules are connected through jumper wires, clearly demonstrating the integration of control, sensing, and actuation elements. This compact experimental model effectively validates the

working principle of the proposed smart hybrid energy dispensing system

6. CONCLUSION

An intelligent, safe, and effective solution for contemporary gas stations and EV charging stations is offered by the suggested RFID-based automated gas pump system. The system's integration of RFID technology with the ESP32 controller guarantees smooth user authentication, automated transaction processing, and accurate fuel or charge delivery without the need for human interaction. By confirming user identity via RFID and password validation, this automation improves security while reducing operational delays and human error. It also lowers maintenance expenses and enhances car owners' general convenience. Therefore, this concept is a major step toward contactless, intelligent, and energy-efficient fueling infrastructure for smart transportation systems in the future.

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