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RFID based Fuel Station Automation using Arduino Uno

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ABSTRACT: Petroleum is the foremost and mainstay of modern civilization. It is one of the nature's rare and valuable creation. Its formation takes millions of years which insist proper utilization of the resource. In present scenario, fuel stations are operated manually which consist a controlling unit to perform various tasks. The present manual fuel stations consume more time and requires substantial man power. Moreover, it is prone to malpractices and higher probability of human initiated errors. These limitations restrict installation of fuel stations in distant areas. The main aim of this paper is to deal with all stated problems by developing an automated petrol dispensing system using RFID technology. Such a system enables a user to use a RFID based prepaid card to access petrol at fuel stations. Whenever the user wants to fill the tank from the fuel dispenser, user has to enter the amount first and then place the RFID card near the RFID reader. The Arduino Uno manages to read the data from the RFID reader and perform action according to the customer requirements as well as the amount is deducted from the user's card. The RFID and Arduino Uno are used for improvement of present petrol dispensing system by reducing human work and providing an auto guided mechanism to carry out the tasks consecutively. These systems are highly reliable and conserves the time. At the same time will be using GSM-GPS module to get amount deduction via mail and track down the vehicle with the help of latitude and longitude parameters.

I. INTRODUCTION

India became the fourth largest auto market in 2017-18 and was the seventh largest manufacturer of commercial vehicles in 2018. Around 2.19 million cars were sold in India in 2017-18. According to the Ministry of Road Transport and Highways (MoRTH), there is a tremendous increase in India's Registered Motor Vehicles in the recent years. These increase in the number of vehicles in India has led to a huge usage of petroleum as well. This phenomenon has been represented in graph which is shown in figure A. The consumption volume of petroleum products in India was estimated to be approximately 202.6 million metric tons in fiscal year 2018. The country was ranked third with regard to primary energy and fuel consumption across the globe. Petroleum is the non-renewable resource and it is present in a limited quantity. Its formation takes millions of years. It cannot be replaced rapidly enough to cope up with its current consumption. Thus, it is extremely crucial to ensure the right utilization and consumption of petroleum products so as to preserve it for future generations as well. The dispense of fuel to this large number of vehicles in India attains major interest as numerous complications may involve. A long queue in front of a fuel station due to huge rush at the station is a common scenario. This leads to the wastage of valuable time, energy as well as human hours. The manual pump operation at present leads to various malpractices such as delivering less quantity to the customers and adulteration of fuel. These issues inspire us for automation of fuel stations which is quite necessary to deal with all these recent era problems. The main aim of the project is to design a system which is capable of automatically deducting the amount of petrol dispensed from user card based on RFID technology and controller Arduino Uno. The RFID reader verifies the user from RFID tag placed nearer to it. The amount of required fuel is entered in terms of amount at the unit. These all activities as well as dispense of fuel is monitored and controlled by the Arduino Uno.

II. RELATED WORK

The RFID system is comprised of two components: the RFID reader and the tags. They are also called PCD (Proximity Coupling Device) and PICC (Proximity Integrated Circuit Card).

The RFID reader consists of an antenna to emit high-frequency EM waves and a reader/writer. MFRC522 from NXP is an example of such an integrated circuit. Since we are using high-frequency waves in the megahertz range, the size of the antenna can be small.

The RFID tag can be either passive or active. Active tags are powered by batteries while the passive RFID tags are powered by energy from the reader's interrogating EM waves. The tags are available in different forms or shapes like cards, tags, key forbs, or stickers. Whatever the shape, the RFID tag will consist of an antenna and the RFID chip, which will store all the data.

When triggered by an electromagnetic interrogation pulse from a nearby RFID reader, the tag will transmit data back to the reader. The reader will then analyse this data to identify the tag. Unlike a barcode or a QR code, the tag does not need to be within the reader’s line of sight. This makes it easier to process and can be used for tracking objects in closed space

III. METHODOLOGY

The project revolves around using an Arduino Uno board in conjunction with an RFID reader module to automate the fuel dispensing process at gas stations. The methodology begins with setting up the required hardware components, including the Arduino board, RFID reader, solenoid valve or relay module for pump control, and a display unit. A database is created to store registered RFID tag IDs and associated user information like vehicle details and fuel quotas. The Arduino is programmed to read RFID tag data, search the database for the corresponding user, calculate the allowed fuel amount, and control the solenoid valve to activate the pump for the specified duration. The system displays relevant details on the LCD and incorporates error handling and safety measures. After thorough testing, the system is installed at the fuel station, integrated with existing infrastructure, and deployed with staff training for operation and maintenance. Optional enhancements may include payment gateways, remote monitoring, improved user interfaces, and advanced security features. The system undergoes rigorous testing and calibration to ensure accurate fuel dispensing and optimal performance, followed by careful integration with the existing fuel station infrastructure. Detailed procedures for regular maintenance and updates are established to keep the system functioning optimally.

Furthermore, the methodology allows for optional enhancements, such as integrating the system with payment gateways or billing systems for automated payment processing, implementing remote monitoring and control capabilities for centralized management, enhancing the user interface with touch screens or mobile apps, and incorporating advanced security measures like biometric authentication or camera-based vehicle recognition. These enhancements can further improve the system's functionality, convenience, and security, adapting it to the evolving needs of fuel station operations.

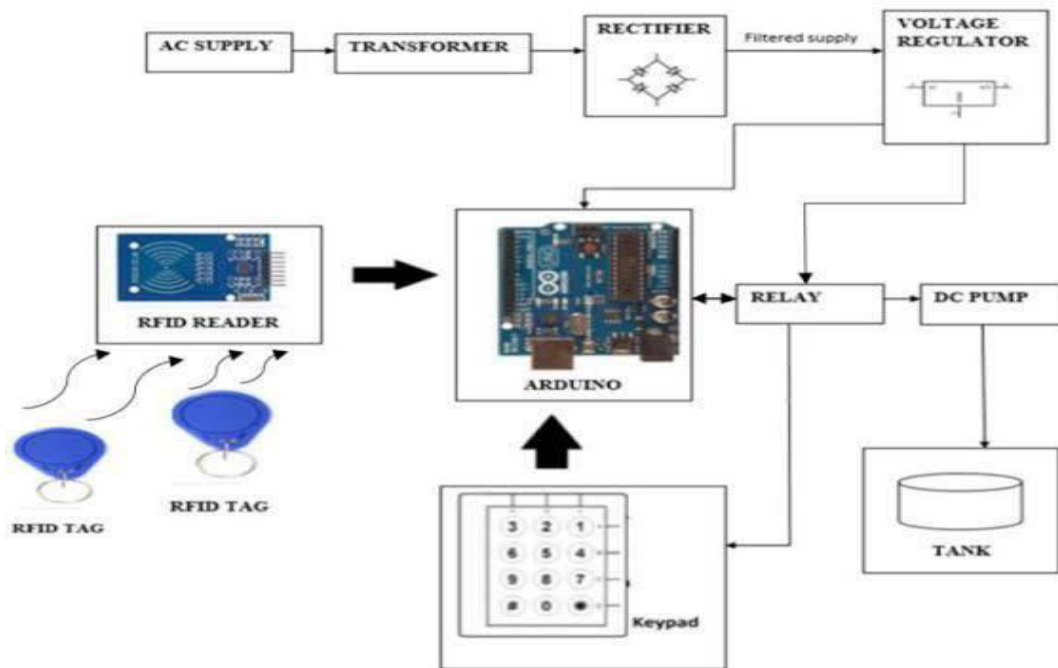


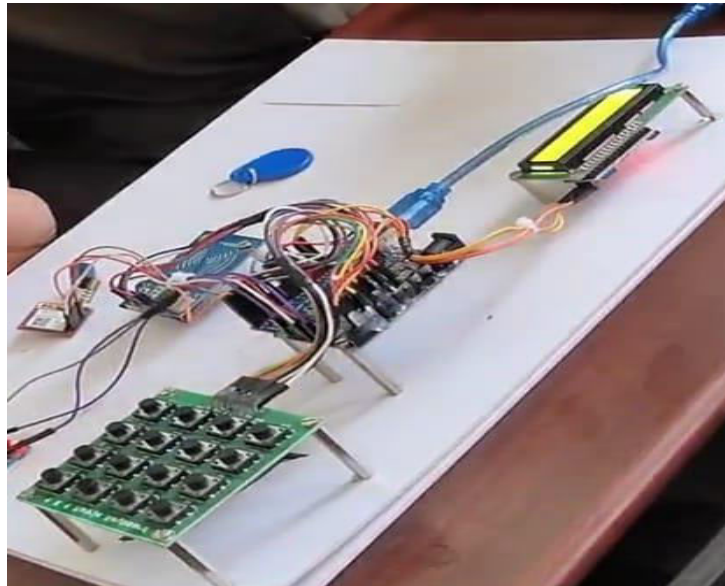
FIG A: BLOCK DIAGRAM OF RFID BASED AUTOMATION FUEL STATION

IV. EXPERIMENTAL RESULTS

The results could include measurements of the system's response time, which is the time taken from when a rfid tag is detected to when the fuel pump is activated. this could be measured in milliseconds or seconds, and it would be important to ensure that the response time is within acceptable limits for a smooth user experience.

Fuel dispensing accuracy: experiments could be conducted to measure the accuracy of the fuel dispensing process. this could involve comparing the amount of fuel dispensed by the system with the expected amount based on the user's fuel quota or the amount requested. the results could be presented as a percentage of deviation from the expected amount.

User experience and satisfaction: experimental data could include user feedback and satisfaction ratings from individuals who have interacted with the rfid-based fuel station automation system. this could be collected through surveys or interviews, and the results could provide insights into the ease of use, efficiency, and overall user experience of the system.



22.00rs refueling done LATTITUDE=
15.1636 N
LONGITUDE=
76.8591 E

22.00rs refueling done Balance =
78.00

Fig b: Project model
FIG C: SMS

V. CONCLUSION

The above-mentioned model proposes to remove all the shortcomings of the manually operated petrol pumps by replacing them with automated ones. RFID is a versatile technology, easy to use and it can be efficiently used in this real time application. The proposed model consists of certain goals like ensuring right amount of fuel dispensed, removing all human errors by the use of RFID cards and ensuring customer's trust for a fair sale of the product [9]. These automated fuel stations provide a lot more advantages as they reduce man power with the automated self-service. With this simple technology in use, any person can easily access for fuel at Fuel Stations. Apart from this all, these systems are less time consuming compared to the traditional ones. The technology proposed is very cost efficient and has low power consumption as well, which sets the major benchmark in today's scenario.

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