



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 consumes 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.

Index Terms - RFID technology, Arduino Uno, Petrol dispensing system, Unmanned Automation

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 phenomena 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 [12]. 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 [1]. 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. It reads the data stored in its memory from the RFID reader and performs the action according to the customer requirements and delivers fuel to the vehicle. On the other end, the respective amount will be deducted automatically from the user's account [7].

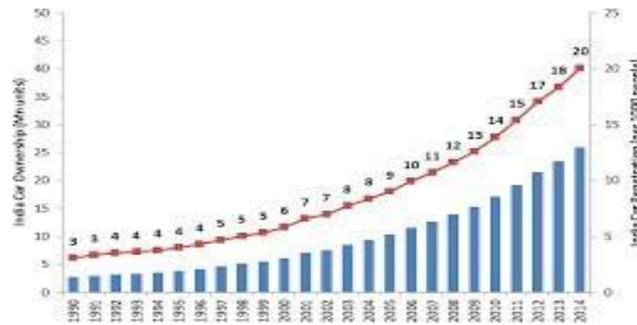


Fig A. Graph

II. LITERATURE REVIEW

This system uses RFID technology which is Radio Frequency Identification based automatic identification technology. It is used to retrieve the stored data on the RFID Tags without any physical contact. RFID system comprises of: RFID Tag, RFID Reader and Database Management System (DBMS). RFID tag has an antenna on its microchip. The chip stores the Electronic Product Code (EPC) of the scanned product, which is a unique number used for the identification of a specific item. RFID reader is used to gather the data from a tag using radio waves. RFID Reader's antenna transmits electromagnetic waves which are received by RF tag's antenna. This tag transmits the data back to the reader. Data collected and then transferred to the host system where it is stored in the cluster database.

III. PROPOSED MODEL

This system is using RFID technology where each user will be having a Prepaid RFID card. It can be rechargeable at any time. These cards consist of RFID tags having unique verification codes. The RFID reader captures the digital data encoded in radio frequency tags. When a customer brings the card close to the RFID reader, it captures the digital data and then sends the corresponding signal to the microcontroller. The microcontroller compares the captured information with stored details of various cards. If the respective match is found, the amount entered by the user is deducted from that account. The microcontroller activates the relay driver for that particular amount in respect of time and the desired stipulated fuel is dispensed into the tank. In such a way, user gets fuel for the deducted amount from the user's prepaid card [3].

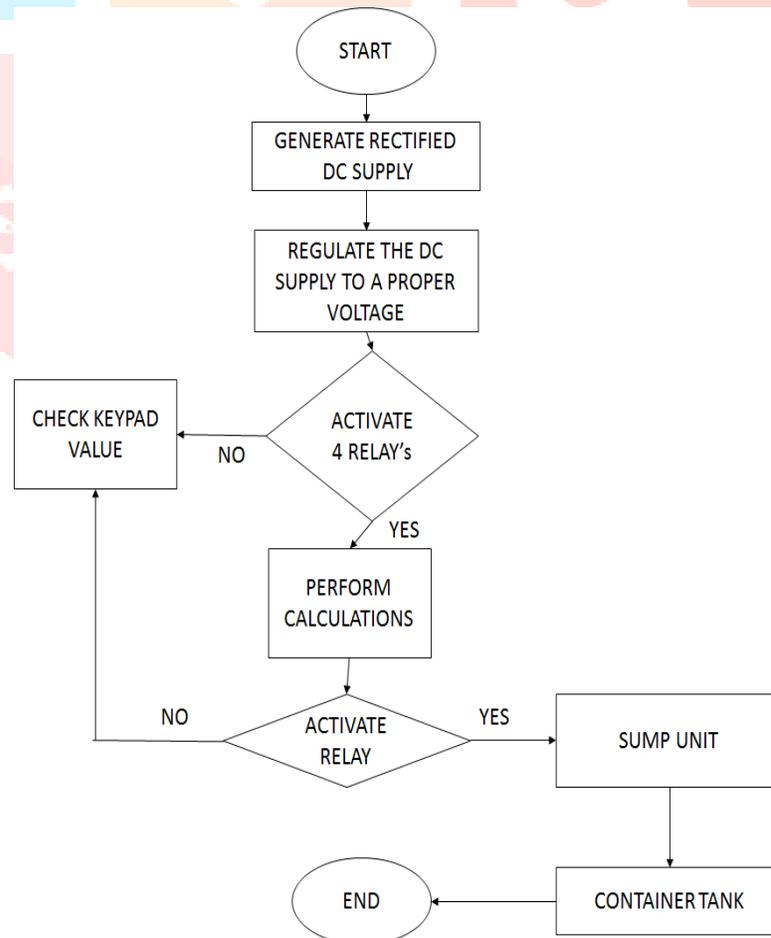


Fig B. Flow chart of the proposed system

IV. WORKING

In this proposed model, we have made an automated fuel station using the RFID in addition with the Arduino Uno. The proposed model works in 2 sections, namely Analog and Digital. The analog part deals with the measurement of time, quantity and amount for the scanned product in dealing and the digital parts works for the suction and pump (SUMP) unit. The model here works for different amounts of money entered by user. The data for each amount is fed in the separate RFID tag and the account of their respective frequencies is stored in a RFID Reader [10]. The RFID works at a specified frequency of electromagnetic waves ranges from 125KHz - 2.4GHz. As soon as the frequency is matched with the tag scanned, the reader reads the amount specified by the customer and actuates the Arduino Uno to calculate time and quantity for the given amount. The Arduino Uno signals the motor and the dispensing is done accordingly. The system contains five relay switches, among which four enables the choice to the user to enter up to 4 digit amount and one relay is used to switch ON and OFF the DC motor. The SUMP unit sucks up the desired fuel and pumps it in the container tank. The complete proposed system has been depicted in figure C and and Circuit Diagram has been clearly narrated in figure D.

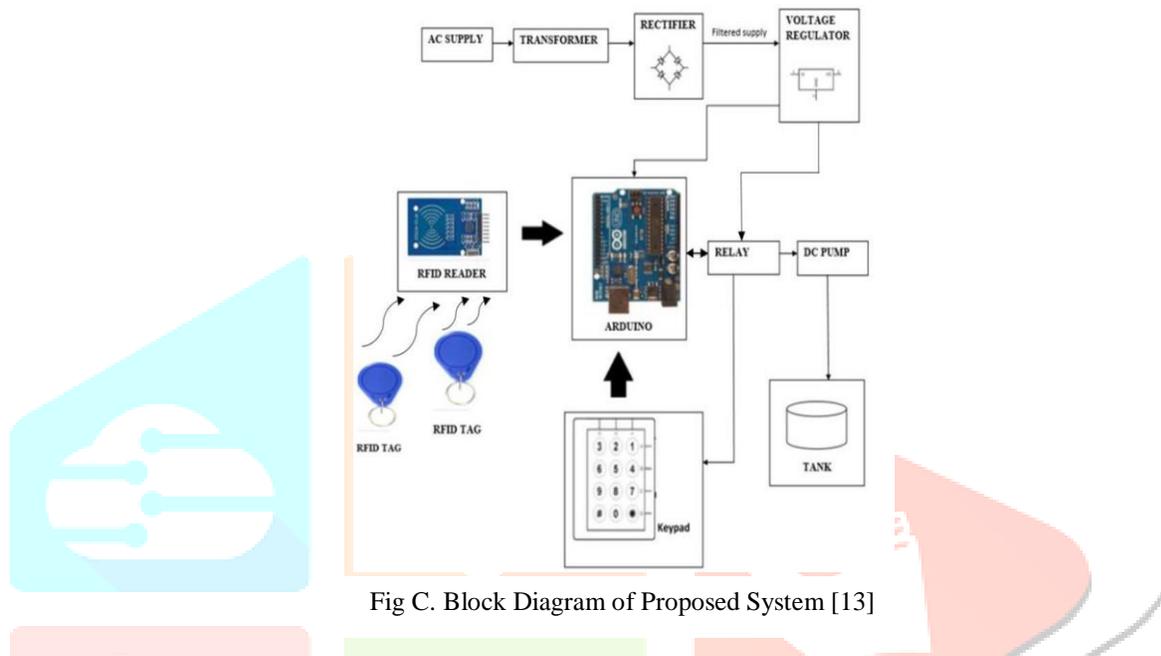


Fig C. Block Diagram of Proposed System [13]

The working of different part of proposed system has been concisely given as follows.

AC SUPPLY: We have used 220V, 50 Hz AC supply from the available source. It is available everywhere and hence system can be operated at every place.

SMPS: Switch Mode Power Supply converts 220V, 50 Hz AC to 12 VDC which is essential for microcontroller and other circuitry of the system.

RELAY: The Relay Module uses 5 relays in total. The four relays are used to switch ON the numeric logic digits. The user gets possibility of entering 4 digit amount. The left out fifth relay is commanded by Arduino Uno. The time and quantity for the dispensing of fuel is calculated by the Arduino Uno which in turn gives command to the relay. This relay switches the logic for the DC motor to turn either ON or OFF.

ARDUINO UNO: The Arduino Uno gets the electric pulses from the Voltage regulator and the four relay give the information about the amount entered. The fifth relay circuit which controls the AC drive with its DC power commanding signal.

KEYPAD ARRAY: The 4*3 type keypad array is used to enter the amount and is connected with the Arduino Uno as well as relay circuits.

RFID READER: The RC522 RFID reader has a radio transponder that acts as an antenna and ranges 125 KHz to 2.4 GHz that uses electromagnetic fields to identify the signals corresponding to the RFID tag.

RFID TAG: It is scanned by certain frequency specific to individual RFID tag which in turn contains data that can be transmitted with the same frequency of RFID Reader.

SUMP: It is the suction pump motor that sucks the calculated fuel from reservoir and pumps it in the vehicle container tank.

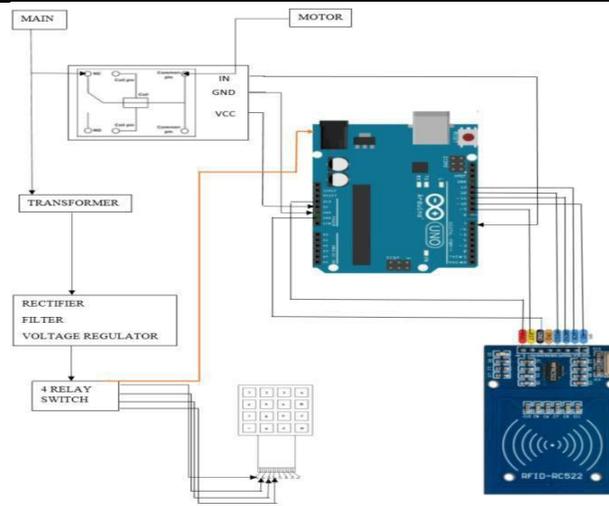


Fig D. Circuit Diagram of Proposed System [6]

V. ADVANTAGES

In our proposed model, the system dispenses the accurate amount of fuel ensuring that customer gets the right quantity of fuel and no adulteration may occur at the fuel station.

- These machines are completely automated and manual operation is not permitted to the sales person. The quantity which is wished by the customer will be entered by user only and the fuel dispensing will cease once the quantity ordered is delivered inside the vehicle's tank [4].
- Man power is reduced because of an automated self- service.
- Easy access and save time at the Fuel stations.
- Misconceptions and arguments have no place at all.
- Due to use of RFID system, robbery of the fuel is avoided.
- Accuracy as well as reliability is maintained in the quantity of dispensed fuel.
- The customers uses prepaid cards for payments at these Fuel stations which results in the systematic record generation of their transaction.
- Power saving as pumps are activated only at the time of fuel dispense.
- Overall speed of transaction of interest is reduced significantly due to implementation of stated technology [5].

VI. FUTURE SCOPE

It has been observed that the proposed system is extremely beneficial as it provides the secure and cashless digital system, which avoids fuel thefts in recent digital India concept. The proposed model of RFID Based Fuel station automation using Arduino Uno can be further enhanced by making it password protected. It can featured on biometric security in which only the person to whom the RFID card belongs, can only allowed to use it for access at fuel stations. In this, each user will be having the unique pin or biometric for their respective RFID card. If the user enters the correct credentials, he will be asked to enter the amount and further process will take place. On the other hand, if the entered credential is wrong, he will be given two more chances for the same, failing which access will be denied and security alarm will be raised alerting for the same. This will help to authenticate as well as secure the user. The unauthorized user is disallowed for any access to the system [3].

Another problem that can be dealt with is adulterations at fuel stations. This can be achieved by conducting density tests. Hydrometers and digital meters can also be used to check the density of the fuel sample.

VII. 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 reduces 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.

VIII. REFERENCES

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