Smart Fuel Station Controlling System

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Abstract. The prime outcome of the research is to design a smart fuel bunk system and fuel dispensing system by using RFID technology. It combined with secure payment and exit gate control. Here, in the Microcontroller, 4×4 matrix keypad, LCD, RFID reader and GSM module has included for secure payment system and transaction confirmation. After getting command from the microcontroller, the relay has controlled by the pump motor. Besides, this motor has operated for oil supply in a dispenser. Subsequently, Servo motor, photodiode, and IR sensor have used to control the exit gate. As a result, the exit gate control has provided secure bill payment. So, reducing the misuse of the fuel, time, and the employer is good merit of the system. Therefore, this fuel station becomes smarter.

1. Introduction

Fuel is the most significant creation of nature. It is the most widely used commodity today, owing to the growing amount of automobiles being routinely used for transport, as the mode of commutation [1]. These days, the fuel stations have operated manually. Here, required more employ and time to provide service of the consumer [2, 3]. The vehicle driver has to pay for fuel with cash and may have to pay more than the amount of dispensed fuel due to the lack of small money change available with the station operator. Moreover, it has a few more demerits like theft of the fuel, illegitimate fuel selling, transactions robbery, and so on [4].

Therefore, to overcome those problems, in this research, we have operated a system into three units, where two of them have placed at fuel station which take care of customer’s needs and continuously monitor the whole process. In the third unit, the database has regarded a backup of data. Here, RFID has used for providing complete security and automation in the distribution of fuel. Previously much researcher work on it such as Rashida et al [5] used GSM and AT super 328 to incorporate automated fuel filling program. This system will enhance fueling cycle to make it simpler, more efficient and more stable. This program seeks to supply fuel efficiently and reliably, meaning that the consumer gets the same quantity of fuel for what he / she pays, thereby effectively preventing any form of malpractice that might happen at various fuel stations.

Sailaja et al [6] proposed the fuel level identification tests the fuel level from the sensor; they identify the vehicle by using the Global Position System (GPS). They gather data from fuel sensor, GPS and speed sensor by using Arduino. After that, Transfer it to the server at the base station utilizing GSM. Furthermore, Md. Badiuzzaman et al [7] illustrates a model in which a device should be able to track the number, expense and time of fuel refilling of a car, and then inform the owner of the vehicle of the refill. Areeg Abubakr Ibrahim et al [8] built a fuel management system that measures the fuel level of
June Myint Mo et al [9] proposed method by using online firebase database to store the information and used a web application for tracking the program in the checked paper author, while the proposed method used a smartphone device monitoring tool. Therefore, our proposed research is better than past research work because there is a database system to collect all information on the fuel dispenser. Along with that, this system reduces time and manpower in the fuel station. A user who has insufficient balance in his RFID card can recharge his RFID card in the fuel station. Moreover, both authorized and unauthorized persons can fill fuel. So, the whole system becomes flexible.

2. Methodology

2.1. Block Diagram
A Block Diagram of the system shown in figure 1, the switched-mode power supply (SMPS) has utilized as a force gracefully in Arduino Mega 2560. In this framework, there are plenty of input devices have been used, Such as RFID Reader for Identity and pay the bill. Also, Obstacle Sensor for the passage and leave entryway Control, Two 4*4 keypads for information section. On the contrary, in the output section, three servo motors have used for entry and exit, a GSM module with a sim card for informing to the Customer. Moreover, a relay has worked as a switching purpose where it controls the pump motor, here additionally use two LCD, one for Customer and another for Manager. A PC has operated to Record the Data of Customer and Entry-Exit Status.

2.2. Circuit Diagram
In Figure 2, the whole circuit diagram has displayed where the Arduino Mega 2560 has used. First of
all, RFID reader Module Pin Tx has amalgamated at pin Rx3. Thereafter, pin 2, 3, 4 have joined with three Obstacle Sensor. Then, Pin 30, 31, 32, 33, 34, 35, 37, 36 have connected with keyboard-1 which has used by the customer and pin 22, 23, 24, 25, 26, 27, 28, 29 have Connected with Keyboard-2 which has operated by manager. Subsequently, Rx, Tx of GSM has connected with Tx2 and Rx2 pin respectively.

More to the point, the pin of 49, 51, 53 has joined with Servo 1, 2, 3 and U11, U12 (relay1 and relay 2) have Connected with pin 5, 6. Similarly, 39, 41, 43, 45, 46, 47 pin link up with LCD (16x2) and 7, 8, 10, 11, 12, 13) pins of LCD has linked up with LCD (20x4).

Figure 2. Circuit Diagram of the system

2.3. Flow Chart
2.3.1. Fuel Dispatch Process for Authorized person. In Figure 3 (left image), when an authorized person wants to dispatch fuel. At that time, the Customer has to show the RFID card. If the RFID card matched then customer press the button “A”. LCD Display asks to enter the desired amount of fuel. If the balance is sufficient then the LCD display shows the confirm option. Then, A SMS send to
customer mobile and pump motor become ON. Eventually, Fuel dispense data save to the PC.

2.3.2. **Fuel Dispatch Process for Unauthorized person.** In Figure 3 (right image), when an unauthorized person wants to dispatch fuel. At that time, Customer has to pay money to the manager in cash. Manager press the button “*” and also enter the desired amount of fuel. Finally, Manager Press the confirm button then the pump becomes ON.

2.3.3. **Process for Recharge Money.** In Figure 4, Customer pay money to the manager in cash. Manager Press the button “#” and enter the ID number of Customer’s RFID card then enter the amount in Tk. After that, A SMS sand to customer mobile.

**Figure 3.** Flow chart for authorized (left image) and for unauthorized person (right image)
2.3.4. Process for Balanced Check. In Figure 5, Customer has illustrated RFID Card. If ID Match then press the button “B”. Next, LCD Display shows the current balance.

![Flow chart for balanced check](image)

**Figure 4.** Flow Chart for Recharge money  
**Figure 5.** Flow chart for balanced check

3. Results and Discussions

In Figure 6, we have drawn a proposed Road Map. There is Two Entry road a one exit road. Entry1 is for authorized persons who have RFID card. Entry 2 is for Unauthorized Persons and also the person who has insufficient balance in his/her RFID card. Every Entry and Exit Road have a Servo motor and an Obstacle Sensor which Sand information to the database to ensure the security. A Dispatch pipe, a 16x2 display, a 4x4 Keypad and an RFID reader have used in Entry 1. While, a Dispatch pipe, a 20x4 display, a 4x4 keypad, a PC and manager room have operated Entry 2. The whole System has controlled by Arduino Mega and SAPA power system. A GSM Module is connected with the Arduino to sand Notification to the customer. Besides, the whole system illustrated in Figure 7.
3.1. Result Analysis for Authorized person
Firstly, authorized person entry with the road-1. Then LCD display represents that” Show Your ID” Which indicated in Figure 8.
Figure 8. Entry Process.

Figure 9 illustrates the fuel refill process. Here, Customer Show his RFID card in RFID reader, after present his RFID card, system want to know what he will do. If he presses ‘A’ system ask for desired litters. LCD display shows the total amount after the Customer enters the desired amount. If everything is ok then customer press button “A” for confirming. If need to change the desired amount press button “B” for cancel.

Figure 9. Processing of fuel refill

After that, When Customer press button “A” GSM Module send an SMS to the customer Mobile number and pump motor become ON which demonstrated in Figure 10.

Figure 10. Notification send by GSM
3.2. Check balance
In the check balance process, First Customer Show his RFID Card. Then Press Button “B” in the keypad at this time LCD display exhibits the Current balance that displayed in Figure 11.

![Figure 11. Balance Checking process](image1)

3.3. Recharge Money
In the recharge money process, Customer Pay money in cash. Manager press button ‘#’ and enter the ID no with the amount in Tk. Then, A SMS send to the customer mobile number and LCD display reveals the Current Balance which shown in Figure 12.

![Figure 12. Recharge money process](image2)

3.4. Result Analysis for Unauthorized person
In the unauthorized person process, manager press ‘*’ after Customer pay cash. Then the manager gives the desired amount of fuel and Press the button “A” for confirmation, as shown in Figure 13.

![Figure 13. Result for Unauthorized person](image3)
4. Conclusions
We are proposed smart fuel station controlling system by using RFID and GSM system. In this system, RFID dispenses the accurate amount of fuel which reduces the misuse of the fuel. Also reduces the manpower. Additionally, if the customer tries to swipe with the unauthorized card, the RFID system rejects the card. Therefore, the system is so secured. But, this system has a few limitations like network problem, no use of server system. In the future, we can create a server system for more security and control and use of regular Master Card or Visa Card. Moreover, the IoT with raspberry pi will be added to make this system more reliable.

References
[1] Gawade M, Gawde S, Kanade S 2015 International Journal on Recent and Innovation Trends in Computing and Communication 3(11) 6156-6158.
[2] Ambarita H 2016 Case studies in Thermal Engineering 7 36-46.
[3] Jaska P, Johnson DBA, Nalla J, Reddy NVK, Tadisina R 2010 Review of Business Information Systems (RBIS) 14(3).
[4] Jadhav A, Patil L, Patil L, Sonawane AD 2017 International Journal for Science Technology and Management 6.
[5] Rashida MH, Raseena KR, Risvana MP, Sreemol CV, Velayudhan NC 2019 International Journal of Advance Research, Ideas and Innovations in Technology 5 1.
[6] Gullipalli S, Karri Y, Kota S 2018 GPS International Journal for Research in Applied Science and Engineering Technology 6(3) 2278-2285.
[7] Pranto MB, Rahman MM 2019 Vehicle Fuel Monitoring and Management using RFID authentication and Telematics Notification: An automated petrol refueling & notifying system, 2019 International Conference on Advanced Computer Science and information Systems (ICACSIS), pp 477-482.
[8] Ahmed AAI, Mohammed SAE, Satte MAMH 2017 Fuel management system. International Conference on Communication, Control, Computing and Electronics Engineering (ICCCCEE), pp 1-7.
[9] Khin JMM, Oo NN 2018 International Journal of Science and Engineering Applications 7(11) 433-436.