ENG5223: Real-Time Embedded Programming System

Smartphone-based Automated Dispenser

REPORT BY:

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Index

Abstract

Nowadays when everything is getting digitalized, the billing system at the gas station is still the same. So, to change the billing system at the gas stations, we introduce Smartphone-based Automated Dispenser. The basic idea behind this device is to automate the dispensers for fuelling the vehicles' tanks once they get the serial code from the RFID tag attached to the vehicles. With the help of this device, customers would not have to wait in queues at the billing counter to pay for fuel. Instead, they can just fuel up their vehicle and receive the invoice on their smartphone application. Does not it sound very convenient and easy-going process?

Introduction

In this generation of digitalization, people mostly rely on app-based digital payment methods. They find digital payment methods more convenient and relevant way as it saves them time. One of the emerging concerns nowadays is the gas station billing system, which is time-consuming and somehow annoying. So, to save our time while re-fuelling our vehicles' tanks, we introduce the Smartphone-based Automated Dispenser (SAD).

SAD is a real-time embedded device that is used to automatically deduct the balance for the fuel dispensed from it by getting the details from the server and presenting it on the smartphone application. The whole environment includes an RFID module, database server, dispenser application, and smartphone application.

The first fuel dispensing machine was invented in the late 1800s, known as a "bowser." It was a hand-operated pump used to dispense kerosene for lamps and stoves. In 1905, the first fuel pump was introduced, which used a hose and nozzle to dispense gasoline into cars. By the 1920s, electric fuel pumps became widespread and allowed for faster and more efficient fueling. In the 1930s, automatic pumps were developed, and by the 1960s, credit card readers were added to pumps for convenience.

Today, modern fuel dispensers come equipped with digital displays and advanced security features to ensure safe and efficient fueling.

Although the dispensers have been modernized and are equipped with all kinds of security features, they are not yet fully automated to make the billing on their own and save the customers' time. To make this work we introduce Smartphone based Automated Dispenser.
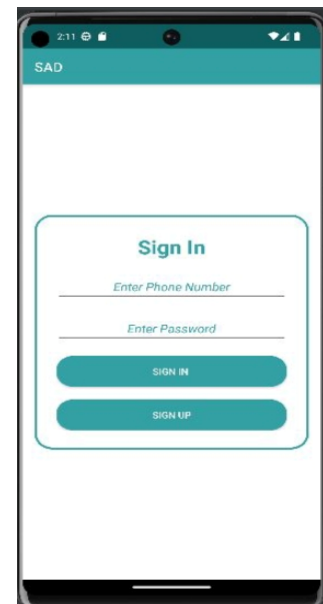
Methodology

Smartphone Application

The mobile application targets people that need fuel filling from fuel stations around the world. The application has the features to track the money spent on fuel along with the frequency of fuelling providing them, with a comprehensive view regarding fuel expenditure. This helps in optimizing fuel usage along with helping them to monitor their vehicle health.
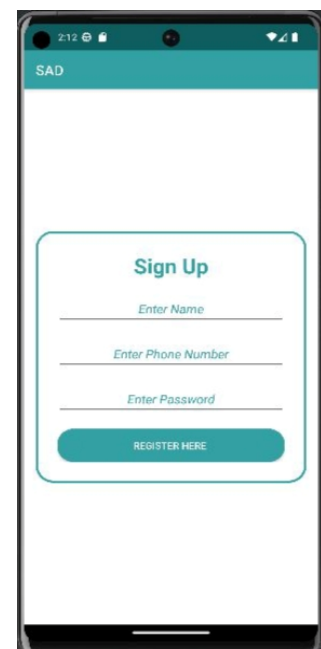
Login page:

Whenever the user downloads the app and opens it, they will be directed to the login page. Inside the login page, there is a sign-in block where the user needs to put their phone number and password if they have already registered themselves in the SAD database. If not, then they need to click on sign-up to get themselves registered first.

Sign-Up page:

After downloading the application when the user opens the app, they will be directed to the Login page where a sign-up button is present to take the user to the sign-up page. Sign-up accepts the username, phone number, and password of him registered with SAD. After the registration process, the user is directed to the Homepage to fill in their car details and generate their SAD wallet.
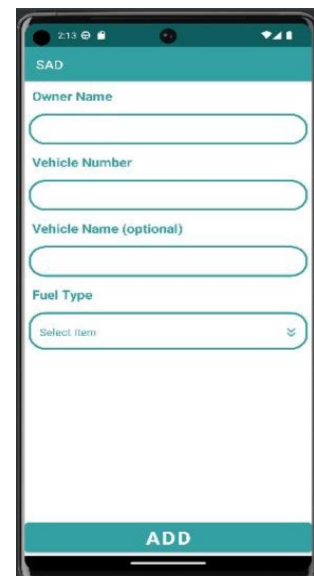
Homepage:

Once the user is registered with SAD, they will be directed to the homepage whenever they open the application. Inside the homepage, there are three blocks showing wallets, vehicles, and orders. Wallet block shows how much balance is left in your SAD wallet for dispensing the fuel. The vehicle block shows vehicle names that the user has registered with SAD. The orders block shows all the transaction history of the fuel dispensing done by the user.

Vehicle Registration page:

Once a user completes their registration, they are directed to the homepage. Then, they will click on the vehicle block to go to the vehicle registration page. On the vehicle registration page, they need to fill in their name, vehicle number, vehicle name, and vehicle fuel type. Thereafter whenever the user enters this page, they will see the registered vehicle details and the option to add new vehicles under their name. All the modifications related to the vehicle details can be done here by the user.
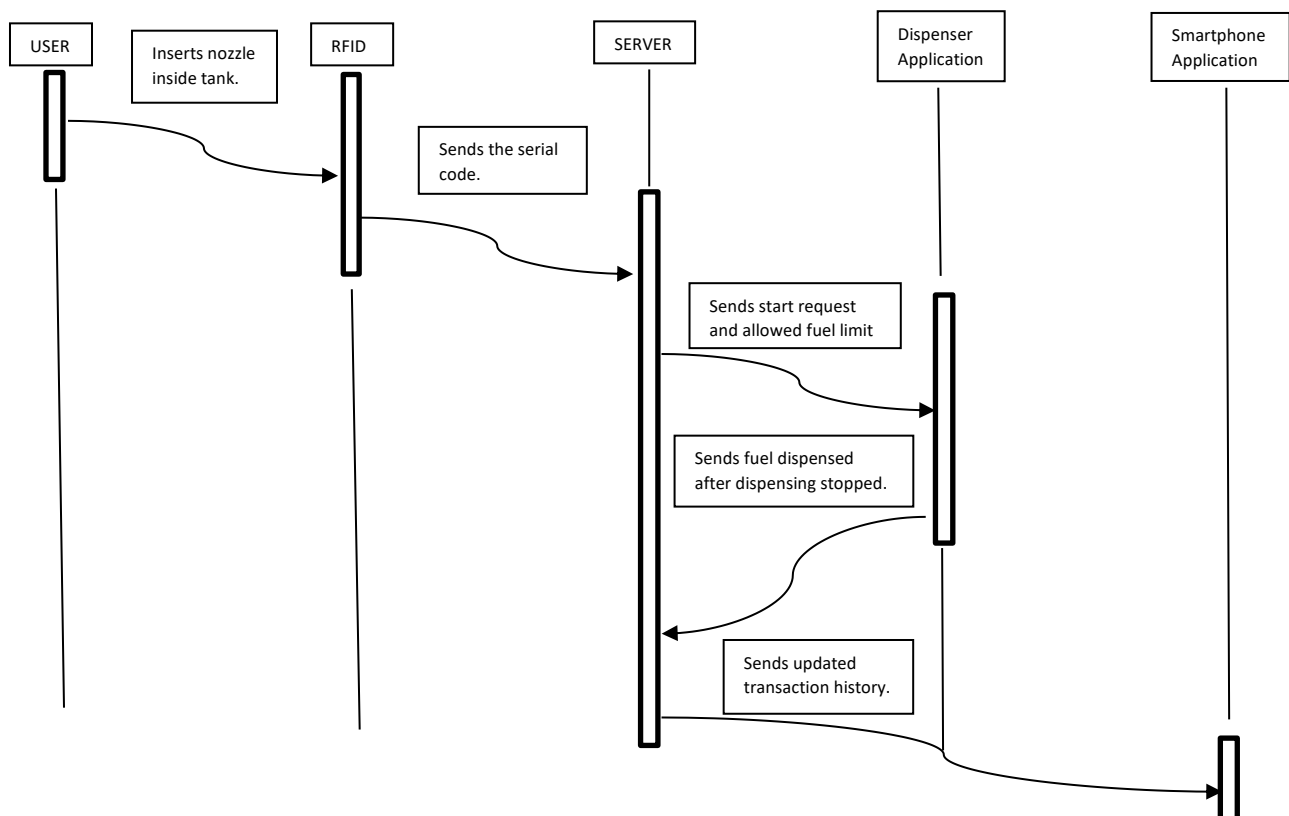
Wallet and transaction history page:

Inside the homepage, there are two blocks named wallet and orders that show the user their remaining SAD wallet balance and transaction history of the fuel dispensed through the application. Once the user enters the wallet and transaction history page, they need to add money to the SAD wallet through their bank account for fuel transactions.
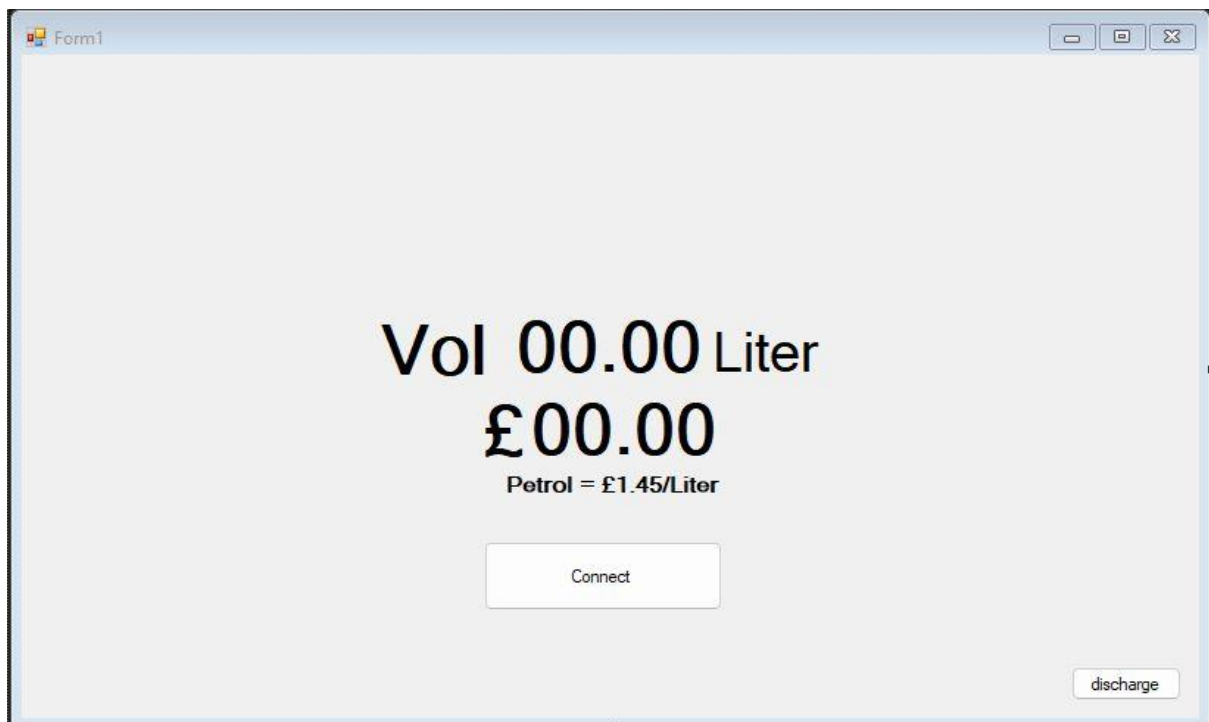
Working Principle

For seamless fuel dispensing, the user just needs to put the nozzle inside the fuel tank of the vehicle, wait for some seconds to return the dispenser display to zero value and then start dispensing the fuel as per their need. The basic working is as follows- A user enters the gas station, puts the nozzle in, the RFID scans the fob, and sends it to the server to get it authorized. Once the server gets the serial code, it checks the user credentials in its database, authorizes it, gets the balance details from the user's SAD wallet, and calculates the fuel quantity that can be dispensed for the balance present. It then sends the fuel cost and how much fuel can be dispensed to the dispensing application. Then the dispenser display is reset to zero indicating the user to start dispensing the fuel as per their requirement. Once dispensing is done, and the nozzle is put back to its initial position, the dispensing application will send the fuel quantity dispensed to the server. Then, the server will calculate the total amount for which the fuel is dispensed, updates the transaction history, and will send a notification to the smartphone about the transaction done.

UML Sequence Diagram

Dispenser Application

The work of the dispenser application is to receive the start fuel dispensing signal from the server and the allowed fuel quantity as per the user's balance. It will reset the counters for the fuel and amount which is being displayed on the dispenser display. Once the user starts dispensing fuel in their tank, the fuel and amount counters start. Once the dispensing is stopped and the nozzle is put back in its initial position, the dispenser will send the fuel dispensed and its corresponding amount details to the server to generate an invoice.

Conclusion & Future Works

Automated fuel dispensers have greatly improved the efficiency of the fueling process and provided a more convenient and secure way for customers to purchase fuel. As technology continues to evolve, there are several potential future developments for automated fuel dispensers, including:

- Increased use of mobile payments: Mobile payments have become more popular in recent years, and they offer a secure and convenient way for customers to pay for fuel without having to use a credit or debit card.

- Integration with electric charging stations: As electric vehicles become more common, there may be a need for automated fuel dispensers to also offer electric charging services.

- Enhanced security features: As fraud and theft continue to be a concern for fuel retailers, automated fuel dispensers may incorporate new security measures such as biometric authentication or real-time monitoring of transactions.

- Integration with loyalty programs: Automated fuel dispensers could be integrated with loyalty programs to provide customers with rewards and incentives for purchasing fuel.

Overall, the future of automated fuel dispensers looks promising, and we can expect to see continued advancements in technology to improve the customer experience, increase efficiency, and enhance security.

References

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Appendix

- https://github.com/nihanth777/embedded.git