

E-Toll Management using NFC

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Abstract - Automated toll Collection framework is considered as a viable technique keeping in mind the end goal to conciliate movement blockage and jams, upgrade the comfort and security of voyagers, and minimize fuel consumption and air pollution for environmental protection need. The paper proposes Architecture for collecting toll using Near Field Communication (NFC) technology. The basic idea is that the client having NFC enabled android mobile taps his NFC card on NFC enabled toll tab at toll station, which reads the information like NFC Id and automatically sends an acknowledgment to the owner of vehicles and simultaneously the request is forwarded to the server. The system proposed shows a high transparency level in transaction and amount collected. The system is able to develop the auto-generated message as acknowledgment for toll station, client and the server. The automated toll collection system is also able to audit road maintenance fees. This system is necessary to improve expressway management.

Key Words: Toll Plaza, Near Field Communication, Automated, Toll Management, Android.

1. INTRODUCTION

Tollgates are commonplace in today's bustling and increasingly congested highway networks. Once they stood barely queued, but today, rarely empty. This has spurred a need to make these necessities faster in their process and more efficient due to the huge number of vehicles moving through them.

A novel solution would be to use something that we have with us all the time, the ubiquitous mobile phone, which is becoming smarter with each passing year. One of the new and exciting features of smartphones is Near Field Communication, NFC for short, which a short-range wireless technology that is used for transfer of small amounts of data. NFC can be used for quick and easy payment of toll at a tollgate and this is the subject matter of this project.

NEAR FIELD COMMUNICATION

Near Field Communication (NFC) is a form of contactless communication between devices like smartphones or tablets devices over a distance of less than 10 cm. NFC is a short-range radio technology that operates on the 13.56 MHz frequency, with data transfers of up to 424 kilobits per second. NFC communication is triggered when two NFC-

compatible devices are brought within close proximity, around four centimeters. Because the transmission range is so short, NFC-based transactions are inherently secure.

At the time of writing the NFC standard has three modes of operation: the peer-to-peer mode that lets two smart phones swap data, a read/write mode in which one active device picks up info from a passive one, and card emulation, in which an NFC device such as a smartphone can be used like a contactless credit card.

2. LITERATURE SURVEY

Paper 1:

Supriya Sutar, Sayali Chopade, Arti Ekdari, Lomesh Ahire [1]

In this paper, toll collection using RFID and android application is proposed. The difficulties in the existing system have been addressed and Electronic Toll Collection (ETC) systems in various countries have been discussed highlighting many of their features and problems associated. The security aspect has been given a focus where the generation of a unique ID associated with the RFID card has been discussed in detail.

Paper 2:

Rohan Kelkar, Abhishek Bharambhe, Akshaykumar Prajapati, Mansi Kambli [2]

This paper proposes a system using just a NFC card and NFC reader without an android application or usage of NFC enabled mobile device. Again the ETC systems of various countries have been discussed such as Canada, Italy, Singapore and US. More focus given to the hardware aspects of the system detailing all components like microcontrollers used, their types and also comparisons to barcode system have been made frequently.

Paper 3:

Worku Abebe [3]

The system in this paper uses both RFID and NFC technologies with android application and NFC enabled android device. The system proposed uses a Client-Server model where the client is the android app and server

generates unique NFC ID. This paper also includes various advantages of the system proposed.

Paper 4:

Swapnil Gholap, Sahil Mondkar, Swapnil Khaire, Mayur Mhatre [4]

The Paper proposes Architecture for collecting toll using Near Field Communication (NFC) technology. The basic idea is that the client having NFC enabled android mobile taps on NFC enabled toll tab at toll station, which reads the information like NFC id and automatically sends an acknowledgement to the owner of vehicles and simultaneously the request is forwarded to the server

Paper 5:

Bhavana S, Ashik Kaushik, Harshitha. C.R [5]

In this paper, the NFC Readers mounted at toll booth will read the prepaid NFC tags fixed on users vehicles' windshield and it read the NFC card through NFC reader or smart phones and amount will be deducted automatically respective amount for particular vehicle, user can recharge their card when insufficient balance is found in the card.

3. SYSTEM ANALYSIS**A. Problem Definition**

An Automated Toll Collection System (ATCS) provides paperless system for toll gates with fully automated toll collection. The main aim is to demonstrate secure toll transaction with better interaction features and transaction through website and Android App. The basic idea is that the client having NFC enabled android mobile taps on NFC enabled toll tab at toll station, which reads the information like NFC Id.

After this automatically an acknowledgment is sent to the owner of vehicles and simultaneously the request is forwarded to the server and transaction is completed.

B. Scope

An Automated Toll Collection System using NFC is an efficient method in order to control traffic congestion and jams, enhance the payment system without much delay and minimizes the pollution and fuel consumption for environmental protection need. ATCS system determines whether the vehicles passing are enrolled in the program, checks balance, debits electronically the account of registered vehicles and updates the balance both in the user's device and toll booth database. If user doesn't have enough balance in account, then it prompts user to update and notifies nearest toll station. At the end of each month, the complete collection can be exported to Excel and remaining deadlines can also be viewed.

C. Proposed System

We propose a fully automated and secure system, which uses NFC-enabled smartphone interacting with a payment terminal to quickly and securely process the transaction involving toll collection and receipt delivery. The new system also maintains a database that logs all transactions. In case of failure to pay toll, the system tracks the vehicle and delivers and email to the defaulter with outstanding charges.

D. Working**User Process**

User will login to the app and after looking at the nearest toll plaza, tap their NFC card to the toll booth's NFC enabled tab or phone. Then transaction will take place and balance will be deducted from user's account and the user will be notified of the same by an in-application notification. User can view history of all transactions done along with the date, time and amount along with the remaining balance. If the account has insufficient balance then user has to recharge before reaching another toll booth. Also user can see the nearest registered toll booth on the map along with its name and location.

Toll Plaza Process

After the user taps on the toll plaza's NFC enabled tab or phone, the NFC reader present will take all the user details like their unique NFC ID, name.

If all details are found to be valid the amount corresponding to the current transaction is deducted from the user's account and changes are reflected in the database. The toll plaza device can also view all the transactions done during the day and also calculate total collection according to per day, per week and also per month and also export to excel file. If the user requests for a recharge then toll plaza device sends the request to admin and then if admin approves then it will initiate the recharge. It can also blacklist certain users who don't pay and will send user the outstanding amount and will also alert the nearest toll plaza.

Admin Process:

Admin can manage users and can also de-activate user's account. They can manage all registered tolls and can view all their transactions. Also can look at the total collections of all tolls and see if they met the required deadlines. The collection analysis is done by exporting total collection to Excel files. Also they can approve request of user wallet recharge done by user and toll booth device. Manage the blacklisted vehicles and if required de-activate their account.

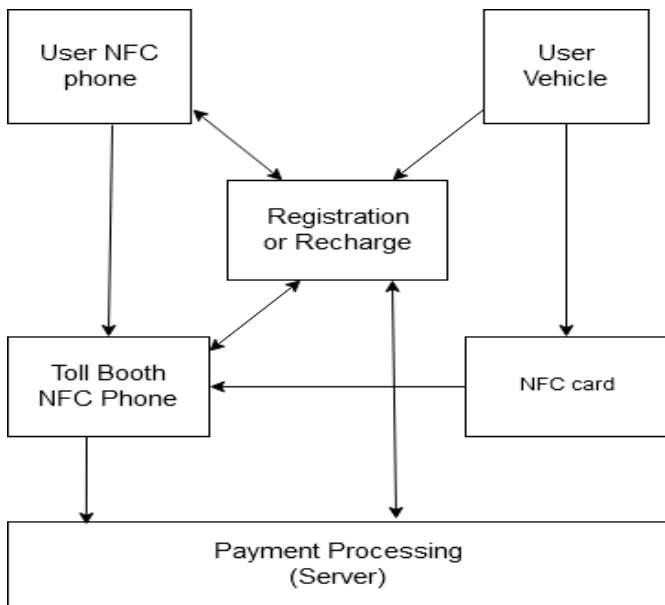


Figure 1: Basic Architecture of the system

An android device with NFC facility can be used as NFC reader that can be used to scan tags of vehicles reaching the toll booth. The device reads and sends the tag id then it will be sent to the server, it retrieves all the information related to the vehicle including the amount available. The toll tax according to type of vehicle is reduced from the user's account. If the vehicle is blacklisted by any authority they will be notified about the arrival of vehicle at the toll booth. User registration, adding vehicle details, etc. are done using website developed. The website is developed used visual studio 2010 IDE using C# and ASP.NET. MySQL is used as the backend. The android application is created using Android Studio IDE and android development tools. Android Studio contains a base workspace and an extensible plug-in system for customizing the environment.

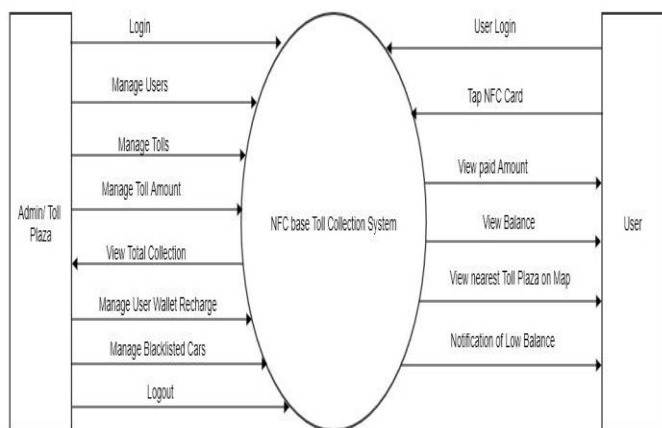
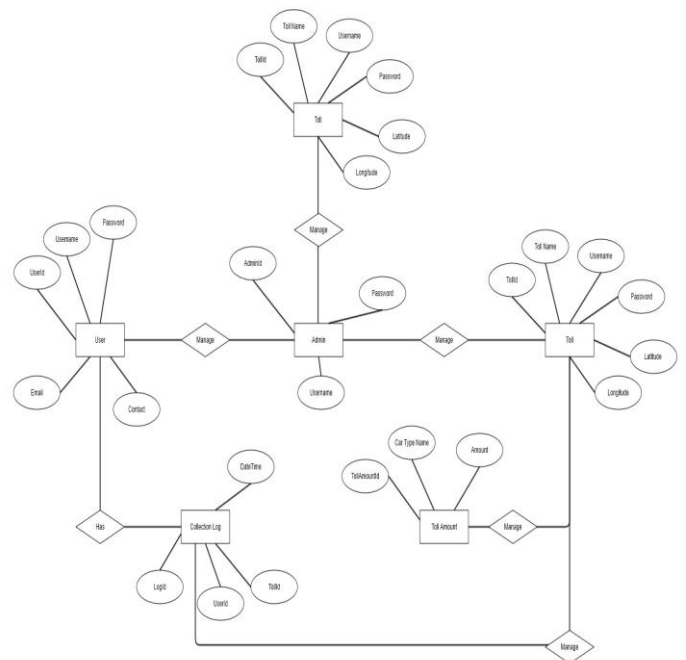


Figure 2: Data Flow Diagram

Entity Relationship Diagram



There will be five tables: User, Toll, Admin, Collection Log and Toll Amount.

- User has Collection Log in their mobile application.
- Toll Amount is managed by Toll Booth.
- Toll also manages the Collection Log as it updates balance then it is reflected in user's device and finally Admin manages all the other tables.

Mobile Application User Interface

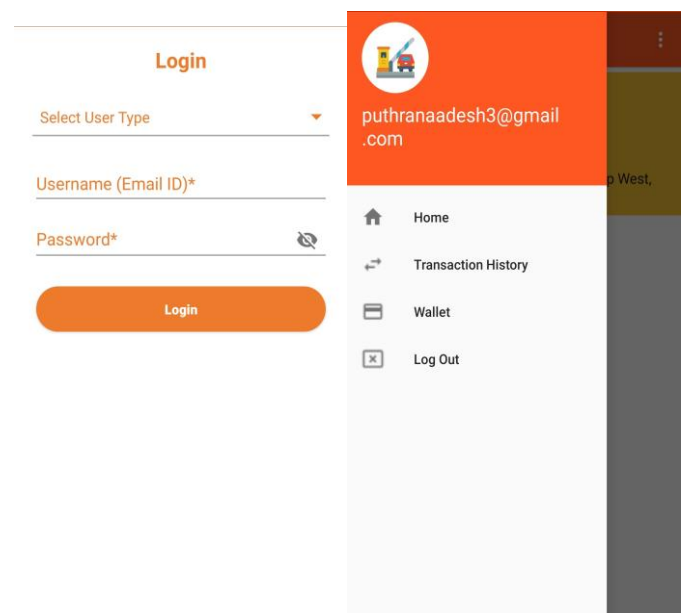


Figure 3: Login Screen Figure 4: User Menu

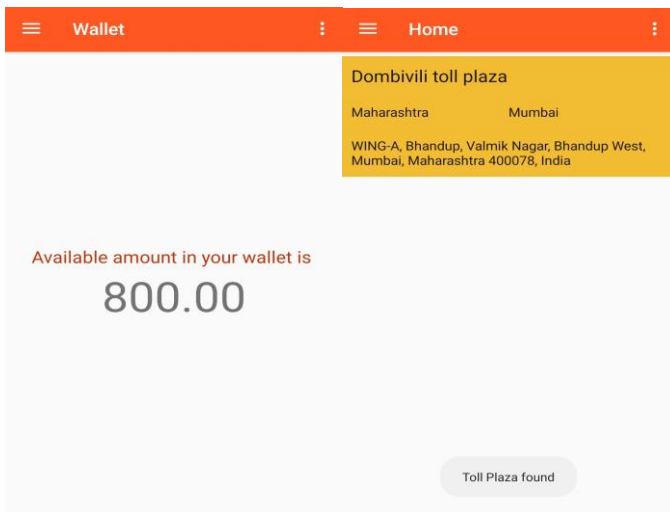


Figure 5: User Wallet

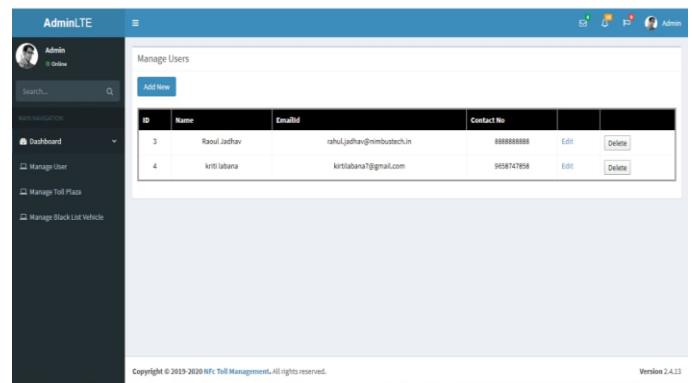


Figure 10: Manage Users Page

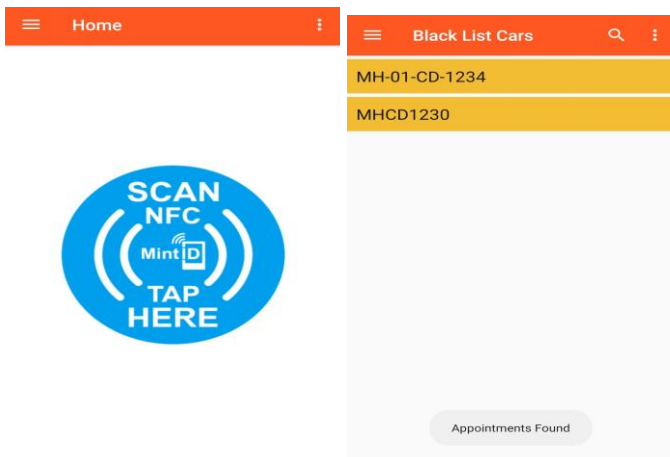


Figure 7: Toll Tapping Screen

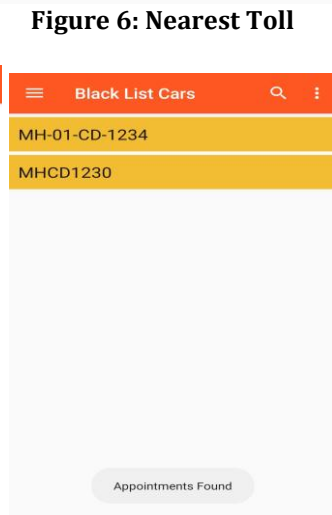


Figure 8: Blacklisted Vehicles

The vehicle number plates of the vehicles that are blacklisted will be displayed in the mobile application of the toll plaza personnel as shown above.

Toll Plaza Website

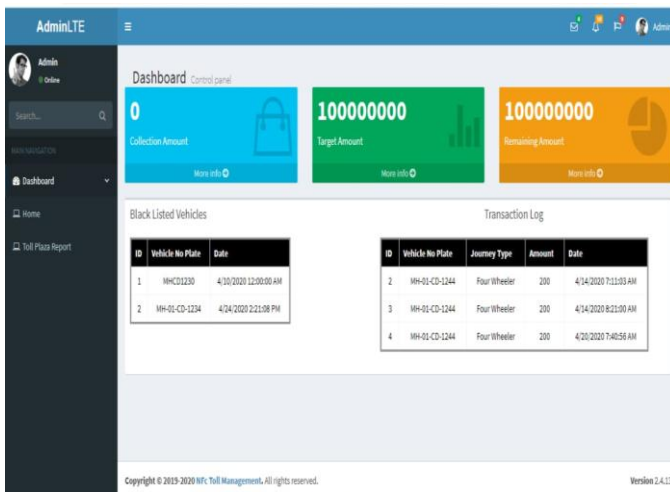


Figure 9: Dashboard

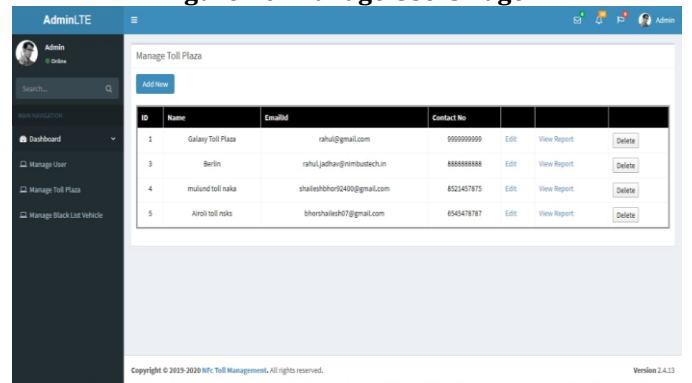


Figure 11: Manage Toll Plaza Page

4. CONCLUSION

We have proposed a new system that enables the collection of user fee at a tollgate using the emerging NFC technology. Furthermore the entire system is built using open frameworks, meaning that it can be easily improved as technologies improve. The framework used to send and receive messages over NFC for Android are open source and can be adapted to any existing system and other applications as well. And lastly, with minimal effort the proposed system can be made compatible with existing NFC Card systems so that new infrastructure costs may be greatly reduced.

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