Survey on Smart Toll Tax Collection

Shubham Palkar[1], Aniket Kadam[1], Shashank Padma[1], Nikita Patil[2]

[1]Student, Dept. of Computer Engineering, Atharva College of Engineering, India
[2]Assistant Prof, Department. of Computer Engineering, Atharva College of Engineering, India

Abstract

The growth in the population of cars has increased a lot and is predicted to burst through in the coming years. All of this introduces more traffic, more pollution and more cost to people. We cannot control the growth in the population of cars but can do a thing or two by tweaking some functionalities in some of the systems used by these cars. One such system is a Toll system and we could change the traditional way of a Toll system working into a modern way by utilizing the technology available to us. Here we introduce a new way of functioning of Toll System making use of Geofencing and real-time database, which greatly reduces the efforts taken at the toll and helps both the human and nature.

1. INTRODUCTION

The main issue in toll plazas is the unending queue and the resultant traffic congestion. This queue occurs mainly because the arriving rate of vehicles is much higher than the servicing rate. The congestion is caused due to the vehicles stopping completely at toll booths for toll payment. This leads to an insane waste of time, easily avoidable fuel consumption and air pollution caused by vehicle exhausts. Using an app to pay in for the toll offers to ease up these issues as the vehicles will not stop completely. The worst-case scenario would be slowing down of the vehicle and not a complete stop. This will also stop the excessive fuel consumption caused by waiting in unending lines and reduce the consequent air pollution.

2. LITERATURE SURVEY

* • Abhishek Singh et.al has proposed a geofence is a virtual perimeter for a real-world geographic area. A geofence could be dynamically generated—as in a radius around a point location, or a geofence can be a predefined set of boundaries (such as school zones or neighborhood boundaries).The use of a geofence is called geofencing[1]
* • Chunnu Khawas et.al explains the application of Firebase with Android. It also gives detailed information about its concepts, related terminologies, advantages, and limitations. The paper also tries to demonstrate some of the features of Firebase by developing an Android app. Firebase is a relatively new technology for handling large amount of unstructured data.[2]

D. Suganthi et.al details the concept of geofencing.It also presents Vehicle Tracking which is an application of geofencing. Geofence is basically a set boundary area which alerts you when a vehicle enters or exits the area. The drivers can just get right down to business. GPS tracking devices coupled with geofence alerts gives your equipment much more security[3]
• lrich Baret et.al introduces geofencing and back-ground tracking. It also demonstrates how location-based recommender systems work. It is shown that the upcoming generation of LBS will be determined by background tracking and geofencing applications.[4]
• Lakshmi K, Megha et.al proposes a system which includes RFID. It matches the gps data with the one at the toll and deducts the amount from the users account . As it makes use of RFID tag it does take part in hardware . The paper aims in designing a system, which automatically identifies the vehicle that advance towards the toll plazas and observes the vehicle number and the time of arrival[5]
• Likhita M et.al explains An IoT module is used in this paper, which does the task of sending a confirmation message to the user. All the transactions are done online because there is no chance of errors in any of the transactions. Online transactions also make the process speed up. But the system requires a hardware module, which is not the case with our system.[6]
• Manav Singhal et.al outlines the challenges encountered by conventional toll collection systems in India and brings out the need for having an automated toll collection system such as FASTag; a program rolled out by the National Highways Authority of India (NHAI) for Electronic Toll

Collection on National Highways.[7]

• Navnath Dahifale et.al explains This paper also makes use of the hardware-based technique, which is the RFID tag. Along with this, it includes the AVR microcontroller, which is used to control the DC motor and the GUI display. This system does the work but does include hardware a lot which is the thing we do not want to involve The amount of deposits will also update simultaneously at the two database of the toll gate because of XBee network. By using this system, it will save time, i.e. by avoiding long queue as no need to stop the vehicle and no need of manual transaction at the toll gate[8]

• Neena Sidhu et.al proposes a system is proposed which includes automatic toll collection, anti-theft system. The components used in this system are radio frequency identification(RFID), Arduino Uno microcontroller, GSM SIM 800, Em 18 reader and a computer host. A system uses radio frequency identification (RFID), Arduino Uno microcontroller, GSM SIM 800, EM 18 reader and a computer host. Passive RFIDs are widely popular for its applications in the field of transportation and they are extensively used in motor vehicles for automated toll collection[9]

• Parita Danole et.al proposes the use of an android application for toll payment. This system is quite similar to our in terms of not including the hardware but in this system the user has to decide the path in advance due to which the user cannot change his mind afterwards causing lost.[10]

• Sachin Antil presents a study by observing the current situation of heavy traffic at toll plazas. It also gives some solutions that can reduce waiting time of the customers and also save their money with the help of Queuing theory. a conclusion is drawn using Queuing Theory which can be recommended or used at other toll plazas throughout the country.[11]

• Segun I. Popoola et.al proposes a framework for Electronic Toll Collection (ETC) in smart and connected communities. Wireless sensor nodes, web and mobile applications, and a cloud platform are the main components in this architecture. The implementation of this system will improve the toll collection efficiency in terms of speed and flexibility.[12]

PROPOSED SYSTEM

The system consists of two parts: the client and the server. The client is on an android -based cell phone, and the server is Google Firebase providing us with features like mobile authentication, real-time database, real-time query. The toll collector would be provided with an interface wherein he would be able to see the list of vehicles passed through the toll with all the information such as,

• Name of the vehicle
• Cost of toll
• Image of the vehicle
• Cost of vehicle

• Name of the user

The real-time query would be fired whenever the user reaches a particular distance from the toll. The fused location provider is the one that is used. The fused location provider is a location API in Google Play services that intelligently combines different signals to provide the location information that your app needs.

Geofences in our system are identified by circles having a blue radius; these geofences are identified by three components, which are the latitude and longitude and the radius of the geofence. In this system, we make use of notifications when a user reaches a distance from toll, he is notified about the name of the toll he is approached by our distance calculation algorithm, and then the cost the of the toll for that type of vehicle is pulled from the database and then the balance is deducted.

Our system won't allow a user to use the application until and unless he has a certain minimum balance in his account. This minimum balance criterion for a particular user is based upon the type of vehicle he has registered, suppose the vehicle registered is an LMV then the minimum balance is set to Rs 45 as from the information gathered we came to know that the minimum balance for an LMV vehicle is Rs 45, so a user has a balance of Rs 45 with our application would be allowed to proceed with using of the application. Still, if in case this user owns a vehicle of type bus, then he won't be allowed to use the application and will be shown a low balance notification which he has to overcome and then only would he be allowed to make use of the geofence feature of the application or else he would have to pay normally/manually [12].So the user is free from all the unnecessary work that he had to do, such as scanning tags, scanning QR codes etc.[8] Limitations of this system include depending on mobile technology as we need to be connected to the internet for the application to work.

3. EXPECTED RESULT

The system is built in a way such that it could be used by all of the ages; the user just needs to register and add his details and the required amount in his account, where in this amount would be automatically deducted when the user enters the geofence and exits it. The user entering the geofence is known by GPS of the user as he enters the geofence. When the user enters a notification is sent to him. The only reason for this notification is to notify the user that the application is running and tell him the upcoming toll name. This also makes the user know that the required amount will be deducted from his account as he exits the geofence depicted in Fig. 1 and Fig. 2, respectively.
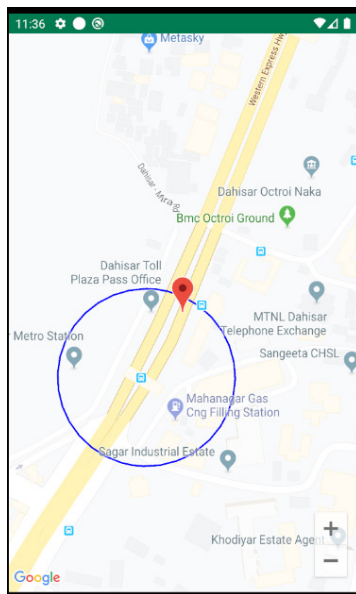
After the user exits the geofence, he would again get a notification indication the amount deducted depending on the vehicle type and the Toll price as depicted in Fig. 3 user enters the geofence and exits it [5]. The user entering

**Table 1:** Comparative Analysis of Existing Systems and Proposed Systems

	Conventional systems	FASTag	Smart toll pay
Time consumption	High	Average	Low
Fuel wastage	High	Low	Low
Traffic	High	Average	Low
Pollution	Average	Low	Low
Simplicity	Very Simple	Mediocre	Mediocre
Processing	High	Average	Average
Hardware cost	Average	Average	Low
Manpower	High	Low	Low
Payment mode	Cash/Debit card/Credit card	Online	Online
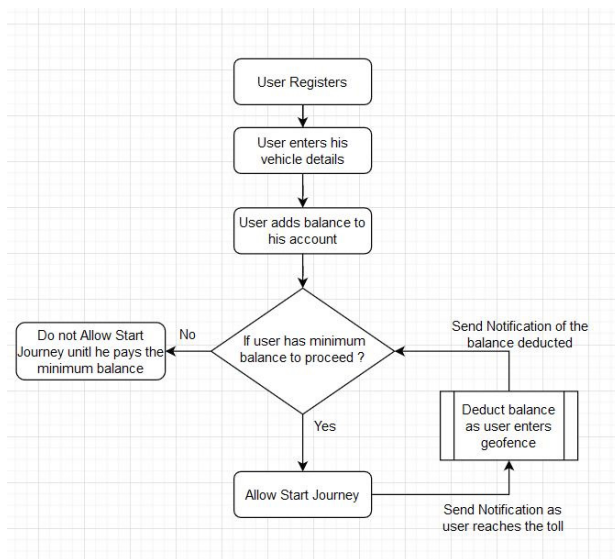
Fig. 1 : Flow Diagram of Proposed System

Fig. 2: User enters the geofence
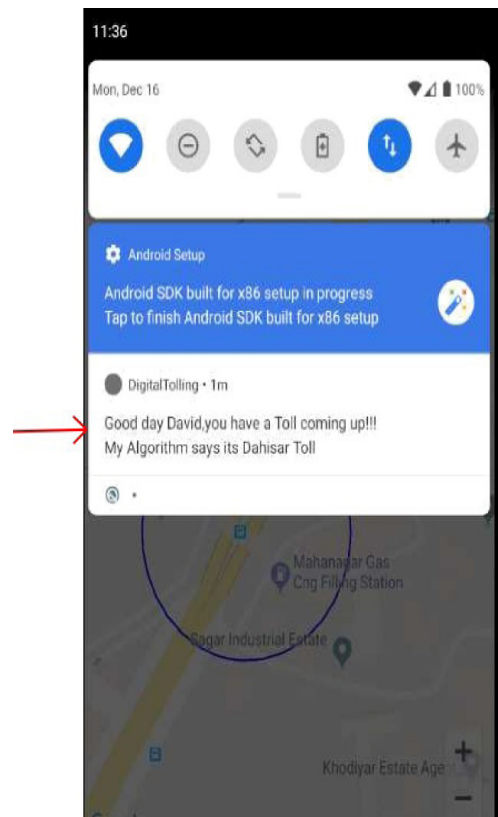
Fig. 3: User gets a notification

geofence is known by GPS of the user as he enters the geofence. When the user enters a notification is sent to him. The only reason for this notification is to notify the user that the application is running and tell him the upcoming toll name. This also makes the user know that the required amount will be deducted from his account as he exits the geofence depicted in Fig. 2 and Fig. 3, respectively.

After the user exits the geofence, he would again get a notification indication the amount deducted depending on the vehicle type and the Toll price as depicted in Fig.4
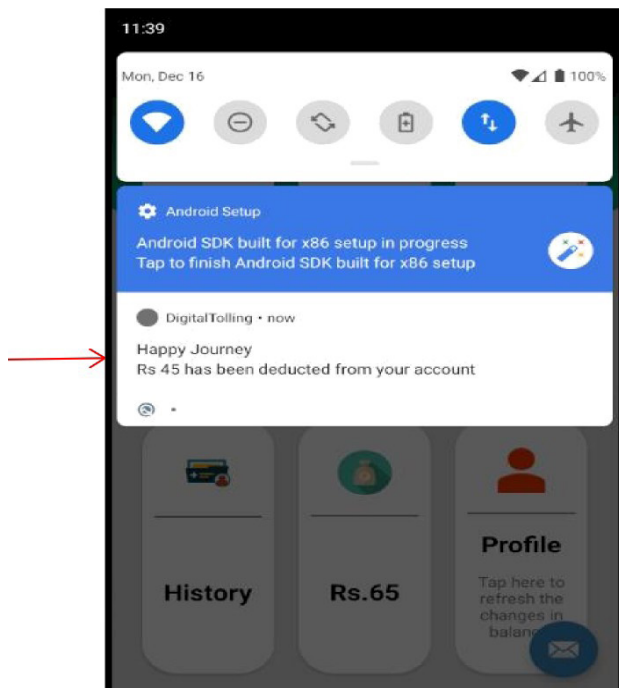
Fig. 4: User exits geofence and balance is deducted

4. CONCLUSION

In this system, we tend to make sure that hardware is not an issue in our Toll Payment Systems as when we try to include hardware it any system, the cost of maintenance automatically increases. Also, the initial setup takes time. If we consider an example of our FASTags systems introduced in India.1 There are many tolls where in some time, the system (hardware) is not working, or the system is down. Our system is totally independent of the hardware will surely save time, cost, and also manual efforts. Our system is needed to be used only when a person needs to travel through a Toll, unlike other systems .Clear differences can be seen from the Table 1 comparing the present two systems with our system[6] . Our system also doesn't need the user to fix the route where the user is going to travel, as in the case of some systems[11].The system is dynamic for its payment module, also wherein modifications in the payment can be done quite easily.As it is the case for other systems, introducing an automated toll payment will surely reduce the traffic caused by vehicles waiting in queues and which would then surely reduce its evil

5. REFERENCES

[1] Abhishek Singh, Ankit Pal, Divyansh Garg, (2018)."Location-based services using geofencing", in International Journal of Advance Research and Development

[2] Chunnu Khawas, Pritam Shah, (2018). "Application of Firebase in Android App Development-A Study", in International Journal of Computer Applications

[3] D. Suganthi, S.Paul Raj John, Shamil J.S, Dhruva G.Patel , (2018). "Vehicle Tracking with Geo Fencing on Android Platform", in International Journal of Engineering Science and Computing

[4] lrich Bareth, Axel Kupper, (2011). "Geofencing and Background Tracking - The Next Features in LBS ", in Proceedings of the 41th Annual Conference of the Gesellschaft für Informatik e.V.

[5] Lakshmi K, Megha R, Abhilasha B K, (2017). "GPS Based Automatic Toll Collection System ", in International Journal of Innovative Research in Computer and Communication Engineering

[6] Likhita M , YaliniDevi S , Hanisha K, (2019). "TOLLZ-E (Online toll system) ", in International Research Journal of Engineering and Technology

[7] Manav Singhal, Anupam Shukla, (2019)."AN INTRODUCTION TO FASTag: A GAME CHANGER IN AUTOMATIC TOLL COLLECTION SYSTEMS IN INDIA", in International Journal of Research and Analytical Reviews

[8] Navnath Dahifale, Sachin Kadam, Swapnil Sabale, (2016)."RFID Based Automatic Toll-tax Collection System", in International Journal for Research in Applied Science & Engineering Technology

[9] Neena Sidhu, Akshita Jain, Yashashwita Shukla, (2018). "Automated Toll Collection coupled with Anti-theft & Vehicle Document Verification System using RFID and Arduino Uno", in International Journal of Computer Sciences and Engineering

[10] Parita Danole, Prachiti Parab, (2019)."Automated Toll Payment using Android Phone", in IOSR Journal of Engineering

[11] Sachin Antil , (2017). "Application of queuing theory on Toll plaza to solve traffic problems", in International Journal for Research in Applied Science & Engineering Technology

[12] Segun I. Popoola, Adeniran Oluwaranti, Oluwafunso Popoola, (2017). "A Framework for Electronic Toll Collection in Smart and Connected Communities", in World Congress on Engineering and Computer Science