

Global Positioning System based Automated Toll and Traffic Management System for Indian Roads

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Abstract: In India, toll plazas at the express highways use manual toll collection system at present, where the toll collector enters the data of the vehicle, collects the cash and provide receipt in return. But this procedure leads to heavy traffic at the highways and the vehicles have to wait for long time in queues. To overcome this issue of traffic congestion at the toll booths and time management and also to bring automation in the field of toll management system, we have developed an optimized, innovative and revolutionary system. This is a cost-effective and efficient technique of automatic toll collection system. This application is a software-based system which works on the principle of mobile GPS network and will use various Google APIs for service. The toll tax to be paid at the toll booth is as per the government has decided the toll booth charges. Systems will use online payment gateways to collect those toll taxes. If the account balance of user is low then it can be recharged at the booth itself. At the user's end, if the toll tax payment is delayed by certain time limit then user will be notified about the same and if delay still exists then proper penalty will be charged along with some strict actions. This system will prove a novelty to the existing toll system. Our system will minimize fraud and cheating cases and will also provide convenience to the user. The operational efficiency of the toll collector at the toll booth will also be enhanced by this system.

Index Terms : Toll and Traffic Management System, GPS, Google API

I. INTRODUCTION

As per the report of National Highway Authority of India (NHAI), the length of national highways is around 142,120 Kms and it is increasing with every passing year with great pace. But this results in the establishment of new toll plazas which in return results into delay and rush of the vehicles on the highways. According to the report released in 2016, regarding of vehicles on highways per km is 38 vehicles/ km. And this density is having a growth ratio of about 2.3 times with respect to the growth in road length. In the manual toll collection system, to pay the toll tax each vehicle needs to wait for some time. Assuming the approximate time as required by the vehicle is 60 seconds, therefore for a week it will be approximately 420 seconds ($=60*7$). It will be around 2, 16,200 seconds ($=1800*12$) for a year, equal to 6 hours. From this data, a vehicle if enter the toll gate at least one time a day in a year then it will waste approximate 6 hours of his total journey for paying the toll tax only. This wastage of 6

hours in a day increases the fuel consumption.

II. LITERATURE SURVEY

In the present world, traffic vehicles are increasing rapidly, and hence we require an effective traffic control system for management. The most important constraint of all is time. For an instance, it will take less waiting time if all the vehicles passed immediately after paying the toll.

In digitalizing the toll collection system, image processing and number plate recognition are the two methods. By determining the letters and numbers of the vehicle plate, the details of the vehicle from the central server can be fetched by the computers. High quality cameras angled towards the number plate setup at the toll booth, are used to get the image of plate. Computers use an embedded system with this setup to recognize and to understand the letters and numbers. But number plates are easily replaceable and hence this process is not as much authentic and leads to misinformation about the vehicles. The most time-consuming process in the entire drive through is when the user stops at toll booth to pay the toll tax. But with the automation of toll collection, this process will be automatic and user will stop the vehicle only if there is any exception. Our system is one such method which will reduce this waiting time.

Table 1: Roadtag Available Facilities

Name of roadway	Type of roadway	Owned by	Operated by	Location
FASTag	Highway	NHAI	Indian Highways Management Company Limited	Pan-India
NH-6 toll road	Highway	NHAI	TollTrax Toll Collection System	Kharagpur, India
Bandra-Worli Sea Link (Rajiv Gandhi Sea Link)	Highway	MSRDC /HCC	MEP Infrastructure Developers	Mumbai, India
Delhi Gurgaon Expressway	Highway	NHAI	Metro Electronic Toll Collection Systems	Delhi, India
Lucknow Sitapur Expressways Ltd	Highway	NHAI	Rajdeep - Toll Management System	Uttar Pradesh, India
GMR Ambala-Chandigarh Expressway	Highway	NHAI	Rajdeep - Toll Management System	Haryana & Punjab, India
GMR Ulunderpet Expressway	Highway	NHAI	IBI Group	Tamilnadu, India
Kumarapalayam toll road	Highway	NHAI	Efkon Group	Tamilnadu, India

III. SYSTEM DESIGN AND METHODOLOGY

A. System Design and Architecture

The following architectural diagram is showing the internal working of the application:

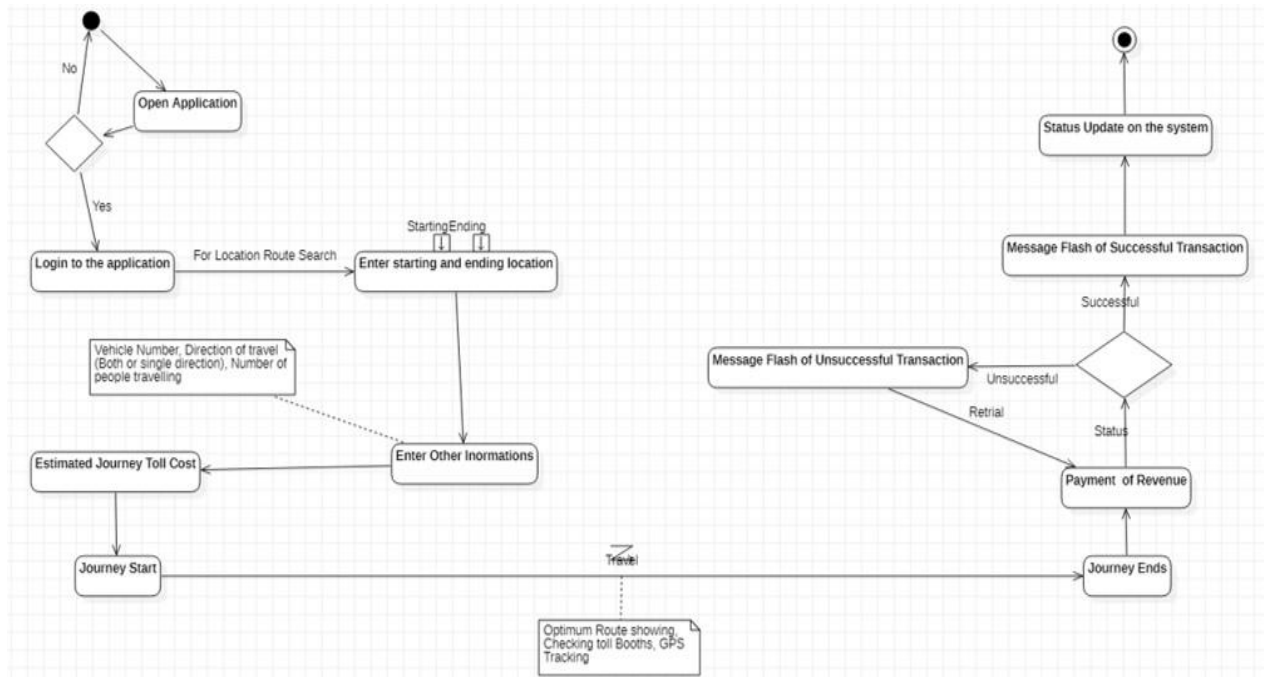


Figure 1 : Activity Diagram of Proposed Model

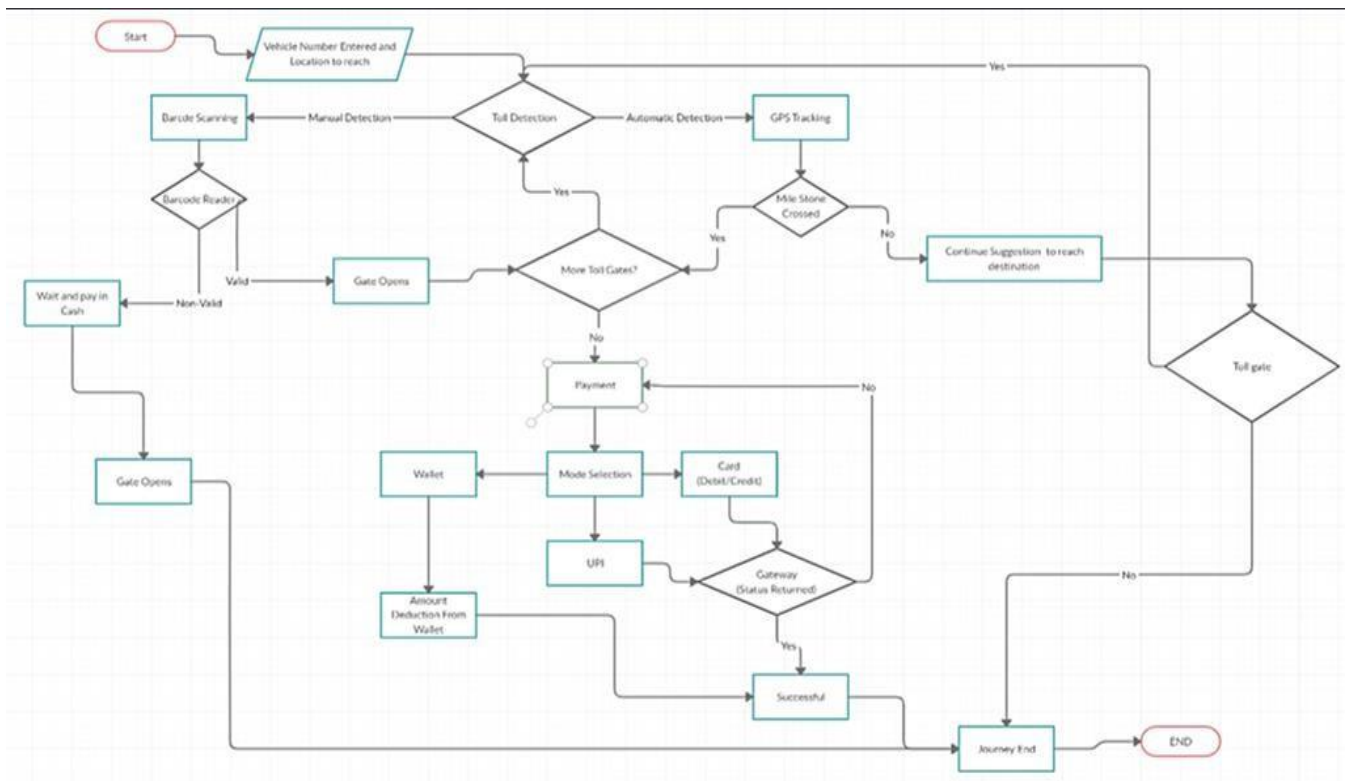


Figure2 . B. Flow Chart Diagram

IV. RESULTS

A. Software and Hardware Requirements

The hardware used in the successful completion of the project are intel core dual 8.0 GHz processor along with 8 GB or more RAM, 200 GB or more hard disk and other essential components like a compatible mouse and keyboard. The software requires Android Studio and Android Visual Studio. In android the version Lollipop and further is recommended with 2 GB or more RAM and 16 GBs and memory. Along with all the software the project is using java and Android/flutter as the basis languages. Database is made using MS SQL server.

B. Assumptions and dependencies

- a. Assumption:
 - GPS network is not hackable.
 - Google Maps Platform is sustainable at low network areas.
- b. Dependencies:
 - Google Maps Platform:
 - Google Maps SDK for Androids
 - Google Places
 - Google Geolocation
 - Google Direction
- c. Flutter Dependencies
- d. Firebase Dependencies
- e. Google / Gmail Login Synchronization

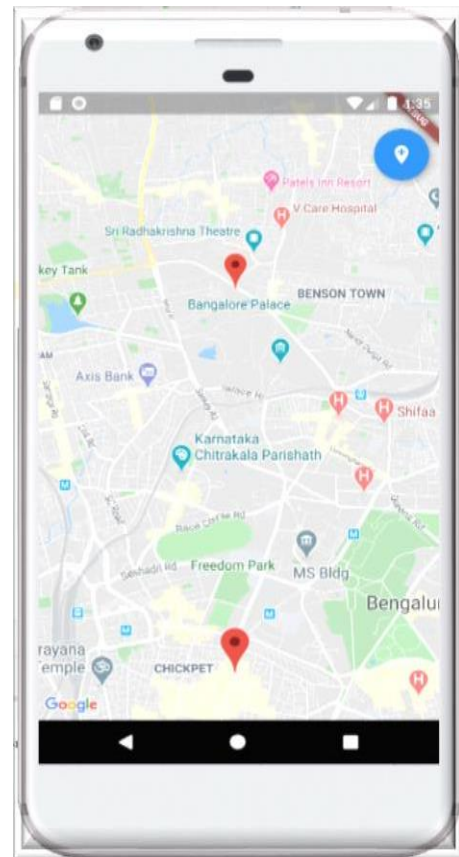


Figure 4. Google Map API

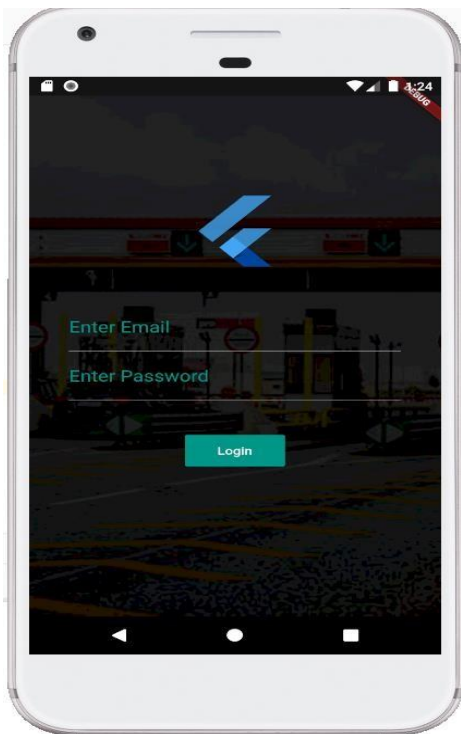


Figure 3 : Login Page

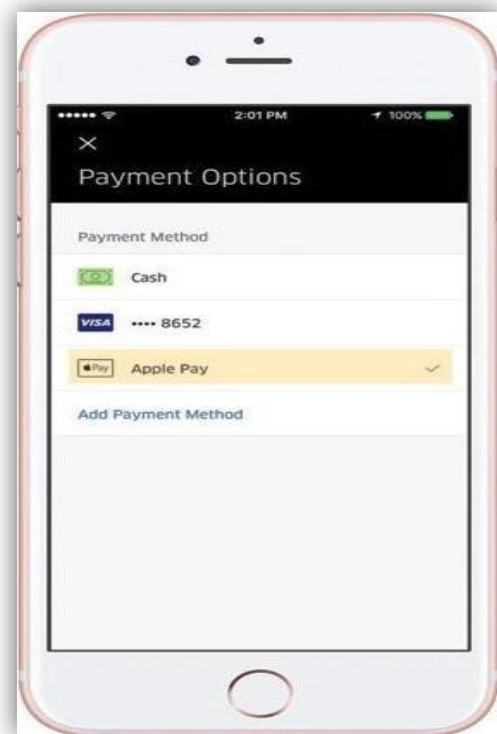


Figure 5: Payment Interface

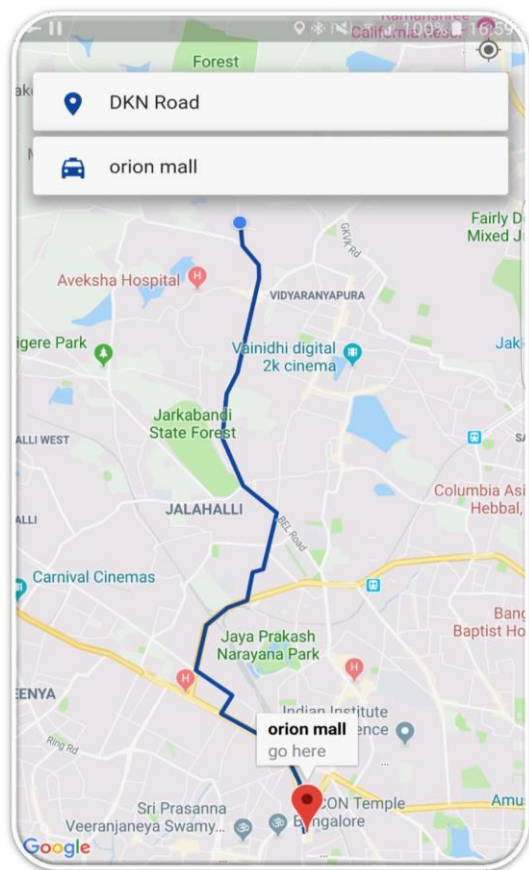


Figure 6: Direction Routing

C. Test Cases

Our system does not have any pre-defined test case, all the test cases will be real time test cases. So, for testing purpose we have to go to the toll booth and then we can test the system. For an instance, as per our survey we get the following details:

Table 2: Different Toll's present-day waiting time

TOLL PLAZA	WAITING TIME OLD (Seconds)
NHAI	13
BEHL	17.4
Dasna, Ghaziabad	10

But we believe that using our proposed methodology, the scenario must be like this:

We have assumed that through the proposed system, the processing time as well as toll collection be 5 seconds which be also the complete waiting time for the toll collection in proposed system. It is due to the fact that in our system vehicles cross toll without interference which makes the complete toll collection time is not for vehicles but for the processing of

system.

Table 3: Proposed waiting time at different tolls

Toll Plaza	Waiting Time (Old) In seconds	Waiting Time (New) In seconds (approx.)
BEHL	17.4	5
NHAI	13	5
Dasna	10	5

V. CONCLUSION

In today's time, one of the most power technologies who is going to be deployed world-wide in the coming years is the GPS which have seen a significant reduction in cost of installation and maintenance because of continuous technological advancements. Our system will be beneficial for the daily travelers and will lessen the burden of toll booth authorities. While this technology seems to be fairly simple, but still for being successfully completion and usage, a wide range of things are needed to be explored and resolved. Comparing advantages and limitations of our system with already existed systems we can conclude that our system does not requires investment on the infrastructure of building advanced toll booths. Thus, saving the money spent on the maintenance. Our system will also help in eliminating the cheating cases. As per the present analysis our system can work endlessly, without the interruptions of the flow of traffic. Since working of our system is software based so hardware cost is also saved and chances of network failure is also less.

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