
Software Requirements Specification for Automatic toll booth system

Prepared by

- 1) Tanay Singh – PES2UG20CS364**
- 2) Siddhant Verma – PES2UG20CS338**
- 3) Supreeth Shivakumar – PES2UG20CS357**

Date Created: 09/09/2022

Introduction

Purpose

- The product whose software requirements are specified in this document is the Automatic Toll Booth System.
- The product's purpose is to redefine the toll booth systems all across the country in order to reduce waiting times at toll booths along with a fairer price system of the toll in order to charge drivers based on the required distance of usage.
- The following SRS describes the entire system of the Automatic Toll Booth System.

Intended Audience

- The intended audience for this project primarily is the Ministry of Road Transport and Highways, India.
- Other than the government, the project is also intended for respective stakeholders of the NHAI and drivers who use National Highways, Expressways or any other Toll related systems in their daily lives.

Project Scope

- This project is developed in order to improve the current system of the Toll Booths in the country. It serves a purpose of reducing waiting times by quicker FastTag scanning, classifying vehicles and calculating the required toll based on the entry point to the roadway with the assistance of Deep Learning Models designed specifically for these two use cases.
- Benefits:
 - Fairer Toll calculation for Drivers.
 - Reduction in both Queue Length and Time at toll booth.

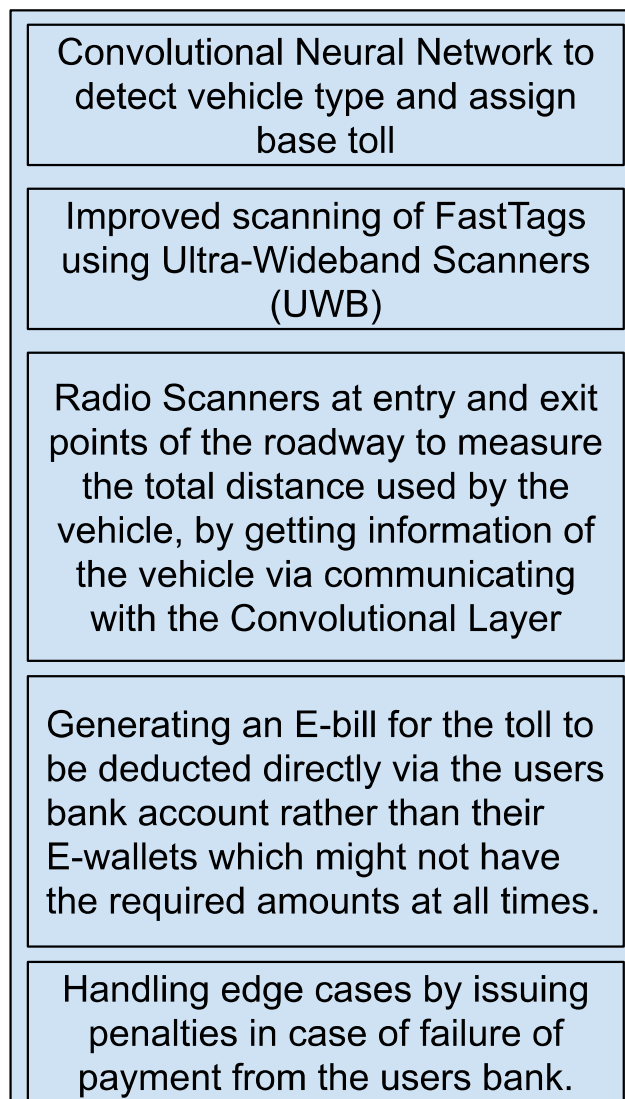
-
- Special Lanes for emergency vehicles for instant transition from one roadway to another.
 - Slow transition to complete automation of the toll system.
 - Objectives:
 - Development of Deep Learning Models (mainly Convolutional Neural Networks) to classify vehicle classes and assign base toll rate.
 - Faster scanning of FastTag on vehicles using much more improved RFID scanners.
 - Taking care of edge cases in everyday situations such as failure in payment, scanning issues etc.
 - Goals:
 - Updating the current FastTag systems.
 - Significantly reducing traffic at toll booths.
 - Charging users based on the entry point to the roadway rather than them paying for the entire stretch of the roadway.
 - Eventual elimination of toll booths and replacing it completely with Electronic toll collection systems so that users don't have to wait at all at toll locations.

Overall Description

Product Perspective

- Toll Booths are an enclosure placed along a toll road that is used for the purpose of collecting a toll from passing traffic. They have historically been staffed by transportation agents who manually collected the toll. But in the modern day, these systems have been improved with the latest additions of the FastTag system in India to automate some parts of the toll collection systems. But even after this, we see that the traffic at toll booths often occurs mainly due to system issues, FastTag scanning failures, some drivers still using cash for the toll payments etc. These above reasons also cause the need of manual labor as agents need to sit at the booths and assist drivers in case of these edge cases. To overcome the above mentioned issues, and many more underlying issues our team came up with the idea of the complete automation of the toll booth system. Using an automatic toll system would eventually lead to the complete extinction of toll booths around the country since automation will be able to handle all the use cases in order to almost nullify any waiting time at these booths.
- This project is a completely new and self-contained project.

-
- A diagram signifying the major components of the overall system is as follows :



Product Functions

- Product functions include :
 - Effective scanning of vehicle number plates to identify the user using the roadway.
 - Allocation of the correct base toll charge based on the identification of the vehicle type (MCWG/MCWOOG, LMV, HMT, HGMV etc.)
 - Recording the entry point ID of the roadway where the user enters the toll induced road in order to calculate final toll charge as :
$$\text{total_toll} = \text{base_toll_price}_{\text{based on vehicle type}} * \text{total distance used}$$
 - Allowing the user to link their bank account to the toll system for smoother transaction.
 - User troubleshooting and assistance at any point of the travel for better user experience.

User Classes and Characteristics

- This project is aimed at a wide range of User classes but majorly on the following:
 - Government workers of the NHAI and MORTH.
 - Characteristics :
 - The MORTH and NHAI are the major government bodies that are dedicated towards the improvement and development of National Roads and Expressways.
 - Logistic Companies who frequently use toll roads for product transportation.
 - Characteristics :
 - Logistics companies such as Amazon, Flipkart require quick transportation to deliver their products to their customers as quickly as possible, for which they need faster transportation on roadways.
 - Everyday Civilians who often use toll roads.

Operating Environment

- The product will operate in an open environment at national highways, state highways. Expressways.
- Hardware will include High-Definition Cameras, RFID and UWB scanners, Radio scanners at both entry and exit points.
- Operating System will be preferably the Windows Operating System.
- Software will include a backend database to store the records of the users using the roadways, frontend mobile app to provide an interface for the users to link their bank account, check previous travel records, raise issue tickets for previous travel records, and a troubleshooting system to contact the officials for further assistance.

Design and Implementation Constraints

- Constraints include :
 - Quality of Cameras used.
 - Server statuses to update backend information.
 - Scanner qualities (both RFID and Radio).
 - Accuracy level of the Deep Learning Model to identify the respective vehicles programmed by the developers.
 - Other overhead issues such as weather conditions that might damage one or more of the above items.

Assumptions and Dependencies

Factors that can affect the requirements:

- Depends on the user acceptance
- Education of the user and basic understanding of the program
- Funding via government or angel investment
- Calculation on time taken to finish the goals/achieve goals etc.
- Requires both software and hardware components:
 - Can be delayed if car isn't fitted RFID tag
 - Can be delayed if user phone/ account doesn't have basic computing requirements

Similar software is being used as a standard for European drivers, to bring that technology and to bring diversity to suit the Indian Market.

External Interface Requirements

User Interfaces

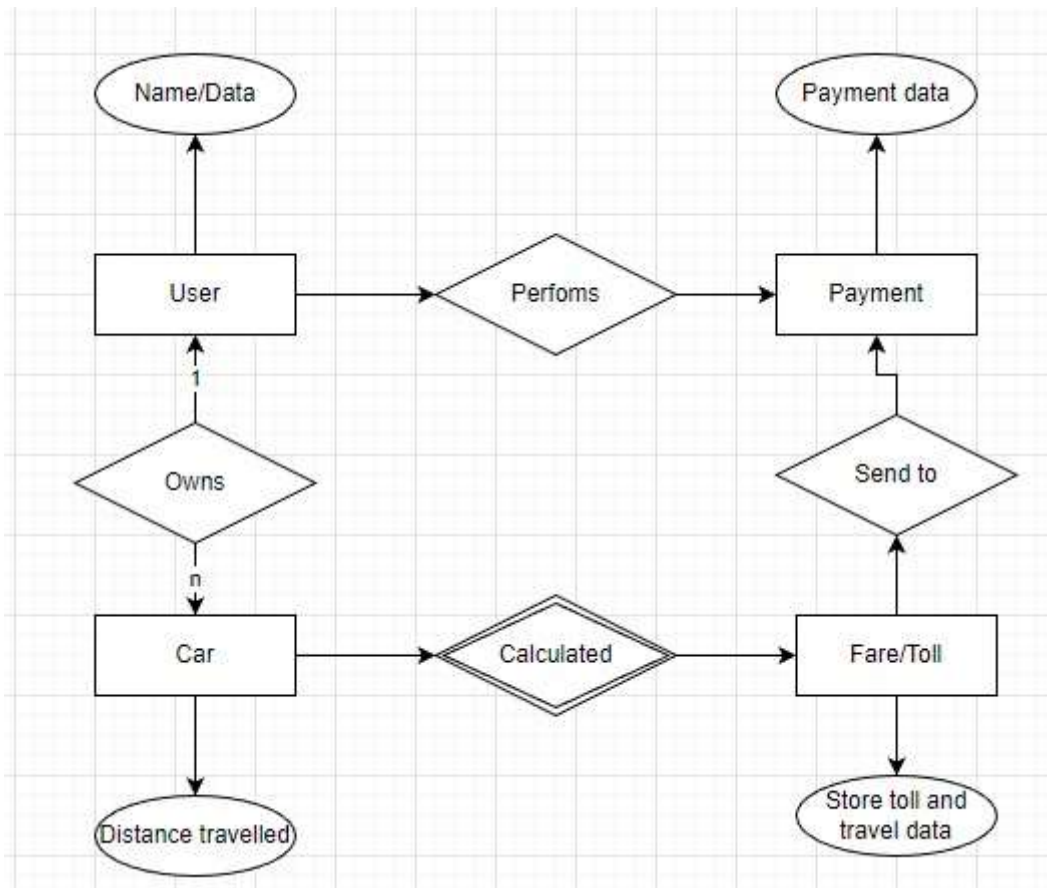
Users can interact via mobile phone or using the car's infotainment system, link their wallet to the account registered to the toll booth system for faster auto-filling wallet.

Track total distance travelled simultaneously, provide similar features to prevent hassle in accessing the data needed, i.e., entry and exit taken by the user to access the road

Adding a simple all in one button to reach three user chosen shortcuts as per the requirement of the user.

Analysis Models

Reference of an ER model (basic architecture of how the system should look like) is attached below:



System Features

Description of basic system features (necessary for operation)

System Feature 1

Description and Priority

Login system: High importance necessary for each user, register one or more vehicles attach license and other necessary documents of the vehicle as well all-in-one safety feature as well

Tracking System: Necessary for understanding where the user is on the map helps them choose the best route to take/ highway to use and which highway they are on to show the toll they need to pay.

Payment system: Need to arrange multiple payment interactions such as UPI,CC,DC etc

Stimulus/Response Sequences

- All functions are user triggered.
- The login is decided by the user and the car is added by them, verified at the entry point via cam to the account for the first time of access to the highway.
- Tracking system is always active within the app and won't allow users to access the app if the app is denied permission to access their location.

Functional Requirements

The backup can be done as a service request by the user by providing the app the correct entry point which can be validated via the user's odometer and cross referenced with the camera set up at the entry/exit points.

Requirement for Adding points.

Requirement for correct payments. The app must also be able to be responsive not drop when it is required to perform.

Other Non-functional Requirements

Performance Requirements

The website to be developed needs to be online 24/7, a requirement for a server that is on and supported by a backup server at the same time. Usage of minimal libraries to ensure lower latency for all users accessing the webserver.

Usage of web-helpers, to help run parallel requests for the server such that the user bottleneck is never encountered.

Since this is a single feature, yet a multipurpose app it needs to focus on speed of the user interactions. All the data that is required should be provided in less than 5 seconds. At the cost of minimal SoC usage.

Safety Requirements

The website should be end to end encrypted using 256 bit AES keys for communicating and transmitting of the data, this will ensure the vehicle data and data related to the user is always kept safe.

Decryption of data is only performed by an algorithm on the server, preventing misuse of the data.

Security Requirements

A simple 2FA should be perfect as only the driver/owner of the vehicle needs to access the app, it will be useless for non-owners.

2FA will be using the email id of the user for a 6 digit OTP, a different OTP will be sent to the mobile completing this procedure.

A code provided if the user opts for Google Authenticator or any other authenticator app.

Software Quality Attributes

The app should have a simple basic UI for quick access. Clutter free and should enable the user to understand what is going on by taking a glance so they aren't distracted while driving.

Should have a voice assistant to tell what the current rate the app is calculating the toll and the exit taken etc.

Main aspect is the app should not affect the user negatively and be tedious to use.

Business Rules

Business perspective with the tasks of adding features solely assigned to the developers.

A set of managers who manage multiple teams that deal with the front-end back end and bringing the two perspectives together

A hardware team dedicated to adding the requirement equipment to the main expressways with government regulations.

Other Requirements

Other misc requirements can be added by the team developing the software based on user feedback and interaction. The user can raise a query regarding what is needed.