TOLL PLAZA AUTOMATION USING IMAGE PROCESSING

MINOR PROJECT REPORT

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF

BACHELOR OF ENGINEERING
(Computer Science and Engineering)

Submitted By:

Deepanshu Goyal	UE143030
Dinker Goel	UE143032
Haritima Manchanda	UE143038
Kunal Taneja	UE143053

Submitted To:

Ms. Ravreet Kaur
Asst. Professor
Department of CSE

Department of Computer Science and Engineering
University Institute of Engineering and Technology (UIET)
Panjab University, Chandigarh

Abstract:

The project is aimed at providing an effective solution for the problem of manual toll collection system applied at the toll gates. As of now, at each poll the vehicle has to stop for paying the toll leading to the wastage of time, energy and resources. In order to reduce the problems of vehicle congestion and time consumption the toll collection is made automatic using the number plate detection technique for identification of vehicles. Automatic number plate recognition is a mass surveillance method that uses optical character recognition on images to read the number plates on the vehicles. Existing old circuit televisions or road-rule enforcement cameras, or specifically designed systems can be used for the purpose.

Any registered user can pay the toll before the start of the journey and the necessary details of payment will be saved in the database. When the car reaches the toll plaza, the number plate will be captured using high resolution cameras and the license number of the car will be generated. This number can be used to verify whether the toll has been paid for the specific vehicle or not. Once verified the gates would be opened.

The intended benefits of this system are to reduce overall toll-collection costs, provide an acceptable level of service for toll patrons, increase data quality, and reduce traffic congestion, air pollution, and fuel consumption on toll roads.

Acknowledgement

I express our deep sense of gratitude towards Ms. Ravreet Kaur, Assistant Professor, Department of Computer Science and Engineering, Panjab University, for giving the team an opportunity to experience dynamic professional environment during the project. We are much obliged to the college for giving us an opportunity and a congenial atmosphere to learn while working without bound. We will be failing in our duty if we don't express our heartiest thanks to our respected parents for providing us every kind of support during the completion of this project. Last but not the least we feel very honourable to thank all our friends for their encouragement and moral support for making this project and at last how can we forget god the almighty who is helping everybody.

"World acknowledge those who acknowledge the world."

Thanks to you all.

Table of Figures

Table of Contents

Chapter 1 – Introduction

1.1 Introduction to Project

The amount of traffic in recent years has been steadily increasing due to the ever increasing number of vehicles .Everyday, millions of commuters take to their own personal vehicles in place of public transport systems .This leads to steady increase in vehicle traffic in developing countries. The only possible solution is to build more number of wider roads. Often the government is in short of funds, hence “tolling systems” are used to collect funds as the vehicles use these toll roads. Conventional tolling system requires the vehicle to stop at a toll gate and the toll fee is manually paid. This is a slow system as manual processing often leads to delay and customers have to wait. An advancement to this system is the use of some automated electronic mechanism.

This system is defined as automated toll collection technique where collection of tolls can be done automatically using image processing technique where we can detect the number plate of a vehicle and there by verify the amount paid by the driver at the start of the journey. If the database show that the toll has not been paid then the toll will have to be paid manually by the driver at the toll booth and then only the vehicle would be allowed to move.

Automatic toll accumulation is considered as one of the canny transport frameworks. It is gone for making toll tax collection more proficient, dependable, and safe and environment well disposed. Before, client would need to hold up at the toll corner to pay the collector, making movement blockage, contamination and obviously of a great deal of dissatisfaction. Today Programmed toll accumulation effectively evacuates pointless movement delays. This is conceivable as the vehicles going through the toll court don't have to stop to pay toll and the payment naturally takes place from the record of the client.

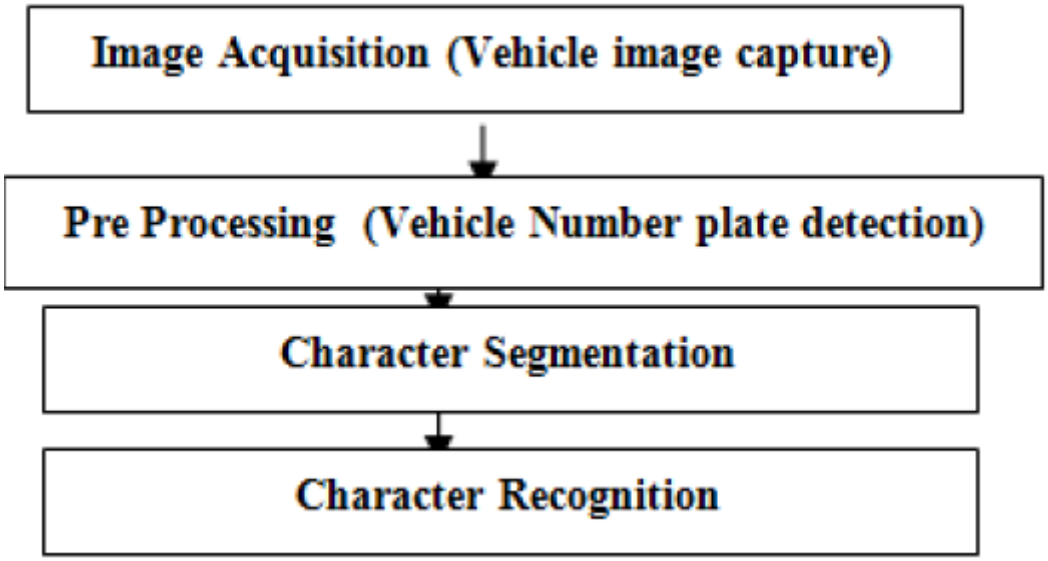


Fig: Basic steps in automatic number plate detection

1.2 Project Category

The project is an industry based project built using the specifications of an android application at the user interface. It would accelerate the functioning of the government bodies involved in collecting and using the toll taxes. It would generate faster revenue leading to faster development and a large scale saving of time and resources.

1.3 Objectives

To design a solution aimed at providing an effective solution for the problem of manual toll collection system applied at the toll gates. It would try to provide the following benefits:

- **Time saving –** Electronic toll system users will not have to stop for paying toll, this helps a lot for saving the travel time
- **Emission control —** Due to the elimination of the acceleration and idling, harmful vehicular emissions will be reduced. Though this benefit only affects the surrounding areas, even then it is highly beneficial for toll plaza areas. Hence, helps in air pollutant reduction.
- **Increased Capacity —** The capacity of the lanes will also increase by approximately by three folds. The toll plaza would be able to accommodate the increasing traffic without additional lanes.
- **Accident reduction —**It will lead to a reduction in the number of accident caused near the toll plazas due to considerable decrement in congestion around toll plazas.

- **Fuel saving –** In electronic toll collection system deceleration, acceleration and idling is completely eliminated. This will help in saving fuel for future purposes. Not only this, it will also play a vital role in reduction of operating cost of the vehicles.
- **Enhanced cash handing –** In electronic toll collection system there will be no cash transaction involved so cash handling is reduced so difficulties with cash handling will be eliminated. This will aid in enhancing audit control by centralizing user accounts.
- **Payment flexibility –** In electronic toll collection system, the commuters will not to have to worry about searching for cash for the toll payment. Since they set up an account for ETC usage, which gives customers the flexibility of paying their toll bill with cards.
- **Congestion reduction —** The toll transaction rate will be highly increased due to the use of Toll Collection systems, since the vehicles will not stop at the toll facility. This will lead to reduced congestion at the toll plaza.
- **Enhanced data collection —** Information such as vehicle count of the day, date, time etc can be obtained due to the deployment of this electronic toll collection system.

1.4 Problem Formulation

The problem can be divided into the following modules:

- **User Interface** – The individual who wants to use the service will have to download an application on their respective mobile phones. He/She will have to enter the required user credentials including the phone number, email address and the vehicle number. The individual can select the route he wants to go to and will have to pay the toll tax accordingly.
- **Automatic Number Plate Recognition -** Vehicle Number Plate Recognition is an image processing system which is used to recognize the vehicles by identifying the number plate. It is basically use for traffic control and security purposes. Firstly, the vehicle will stop at the car gate. The cycle will start when clicked on run button. It will activate the camera to take a snap shot. The system will apply certain algorithm to analyse the vehicle image. Then, the images will be enhance, locating the vehicle plate position and extract the characters from the vehicle plate. The system will try to match the recognized vehicle plate number with the vehicle number plate database.

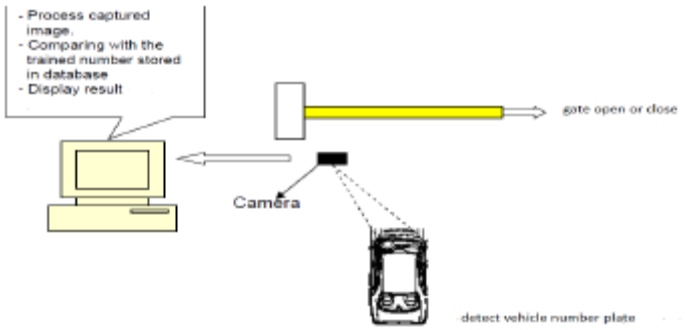


Fig: Basic process of image acquisition

- **Server side –** When the license number of the vehicle has been extracted from the number plate it will be compared to a database at the server side. For this purpose a web app is needed which would verify the details entered and the amount paid by a particular individual to the updated credentials in the database.

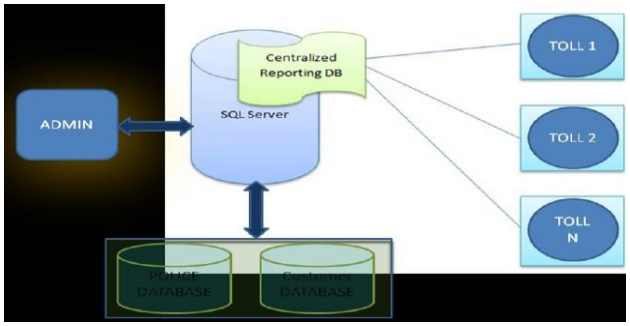


Fig: Basic Design of Server

1.5 Identification/Reorganisation of Need

The amount of traffic in recent years has been steadily increasing due to the ever increasing number of vehicles. Everyday, millions of commuters take to their own personal vehicles in place of public transport systems .This leads to steady increase in vehicle traffic in developing countries. To control this traffic on the national highways the need for an automated toll plaza system is mandatory. It saves time and resources. As India is moving towards a cashless economy the need for a cashless transaction system for toll collection becomes mandatory.

1.6 Existing System

The existing system of toll collection used in India is the manual collection process. It has the following problems:

- **Corruption in money collection at toll booths**- On the tollbooth corruption is occurred at the time of paying the toll tax, the toll cashier collect the correct amount of money but not give the collected count of money to toll admin at that time mostly chances of corruption.

- **Increasing rate of stolen vehicle**:- In previous system, there is no any mechanism to detect the stolen vehicle which is pass through toll this increases the rate of stolen vehicle.
- **Vehicle congestion at toll booths**:- In the existing system, the owner pass the vehicle through the toll then the cashier was give the receipt to every owner and by this the existing system is got slow and by this lots of vehicles is get waiting in the queue and by this vehicle congestion is occur.
- **Toll deduction is time consuming**:- In the existing system, the payment of toll tax is as manual process, the toll payment is done by hand, giving cash due to the manual process the system is time consuming.
- **Manual system and Wastage of paper**:-The payment process of existing system is manual process not an automatic process and the user of the vehicle pay the toll tax by hand and the cashier provide the paper receipt as the payment acknowledgment to the user by this the paper waste is more.
- **Handling cash and carrying credit cards**:- The previous system is manual system and the payment of tax was the manual process hence a user always had to carry the cash or the credit cards for the payment of the tax.
- **Fuel consumption**:- In previous system the vehicle got congested in queues and waiting for the toll tax payment in that case many more users not turn off the vehicle by this the fuel got waste.

1.7 Proposed System

The proposed system is defined as automated toll collection technique where collection of tolls can be done automatically using image processing technique where we can detect the number plate of a vehicle and there by verify the amount paid by the driver at the start of the journey. If the database show that the toll has not been paid then the toll will have to be paid manually by the driver at the toll booth and then only the vehicle would be allowed to move.

1.8 Unique Features of the System

The features of the proposed system are as follows:

- Provides centralised data storage
- Provides complete supervision
- Easy operation
- Increases reliability and durability

Chapter 2 – Requirement Analysis and System Specification

2.1 Feasibility study

A feasibility study is an evaluation and analysis of the potential of the proposed project which is based on extensive investigation and research to give full comfort to the decision makers. Feasibility studies aim to objectively and rationally uncover the strengths and weakness of an existing business or proposed venture, opportunities and threats as presented by the environment, the resources required to carry through, and ultimately the prospects for success.

In its simplest terms, the two criteria to judge feasibility are the cost required and value to be attained. As such, a well-designed feasibility study should provide a historical background of the business or project, description of the product or service, accounting statements, details of the operation and management, marketing research and policies, financial data, legal requirements and tax obligations. Generally, feasibility studies precede technical development and project implementation.

When a new project is proposed, it normally goes through feasibility assessment. Feasibility study is carried out to determine whether the proposed system is possible to develop with available resources and what should be the cost consideration. Facts considered in the feasibility analysis were

- Technical feasibility
- Economic feasibility
- Operational feasibility

Technical feasibility:

Technical feasibility centres on the existing computer system (hardware/software) and to what extent it can support the proposed addition also the organization already has sufficient high end machines to serve the processing requirements of the proposed system.

The project is technically feasible as the technology involved in the project is easily available. This project is technical feasible because in this project add information, search result, all these things are technically feasible. In our project, if we want to add new data, then simply we click on add menu and store into database.

Economic feasibility:

Economic feasibility is the most frequently used method for evaluating the effectiveness of the candidate system. More commonly known as cost/benefit analysis, the procedure is to determine the benefits and savings that are expected from a candidate system and compare them with the costs. If benefits outweigh the costs, then the decision is made to design and implement the system. The project is economically feasible as the cost involved in building the system and establishing the cameras at the toll plazas would be very small as compared to the cost and resources saved. For the users to access the application, the only cost involved will be in getting access to the internet. This project is economical feasible. In this project we use the PHP and for data storage we use MYSQL. It is economical feasible because Glassfish Server and MySQL database are both available free of cost.

Operational feasibility:

Operational feasibility is evaluation is to determine whether system is operationally is acceptable. During this study it was determine whether the system will operate in the way that user wants or not.

This project is also operational feasible because in this project we provide the graphical user interface (GUI) which is easy to understand & operate. It also provides the user friendly interface. The user will easily use the system. In this project we use the buttons, text box, images which is easily understandable for end user.

The system will be used if it is developed well skill then be resistance for users that undetermined

1. No major training and new skills required as it is based on DBMS model.
2. It will help in the time saving and fast processing and applications.
3. New product will provide all the benefits of present system with better performance.
4. Improved information, better management and collection of the reports.

2.2 Software Requirement Specification Document

Data Requirements

- User personal information like email, phone number etc.
- Information of vehicles a person possesses.
- Government database of the registered vehicles and the owner's credentials.

Functional Requirements

- To build fully functional components of the system.

- To build a user friendly customer application
- To ensure the proper functioning of the number plate extraction module.

Performance Requirements

- To ensure system reliability.
- To ensure system accuracy.
- To ensure system flexibility.
- To ensure system maintainability.
- To improve the efficiency of system.

Maintainability Requirements

- To ensure that bug fixing in the system takes place properly.
- To ensure that the quality of the system doesn't degrade with time.
- To ensure that the system is easy to maintain and update.
- To provide ease of operations.
- To provide easy adaptability.

Security Requirements

- To maintain the integrity of system.
- To ensure system recovery in case of system crashes.

Look and Feel Requirements

- The application should be easy and understandable for the users.

2.3 Validation

The number plate is detected appropriately in most of the cases leading to correct license number extraction and hence leads to proper verification of user credentials. The system is reliable and efficient as it provides a one-time investment. It also reduces a large amount of human effort and time required. The system uses easily available softwares and technology and hence leads to cost reduction. The system provides a user friendly application that is easily understandable to an individual. The application built is easy to update and maintain.

2.4 Software Development Life Cycle

The software development life cycle of the system would consist of the planning, design, development, testing and deployment phase.

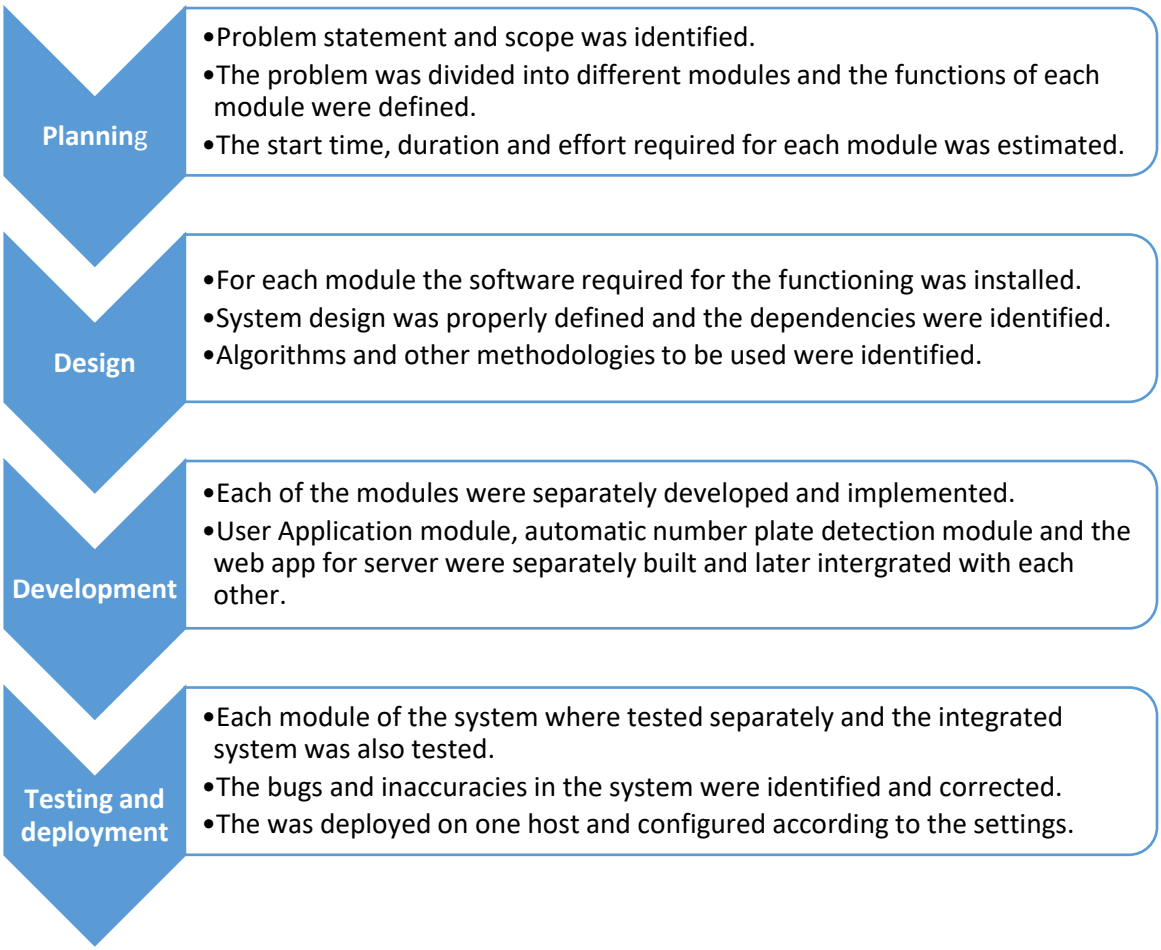


Fig: SDLC of the proposed system

Chapter 3- System Design

3.1 Design Approach

The purpose of this system is to create a real time application of number plate detection and tagging can be made for car parking systems, Toll collection System, Octroi, etc. The system is based on regular PC's controlling Video Cameras, Barricade, Alarming Systems, database and toll Processing. The video camera catch video frames which include a visible car license plate , extracting the number and it will be checked with database for verification and the type of vehicle is identification. The toll amount for particular vehicle is collected through credit card or bank account. In case of any crime about a vehicle it also will be recorded in a database so that we can enhance the security and it will be more helpful for the identification of stolen vehicle. This system consists both automated and manual way for collection of toll. For using automated toll collection system, registration is made by giving the details like user personal details , vehicle details and account details for payment at registration centres before availing the facility .The most obvious advantage of this technology is the opportunity to eliminate traffic congestion in toll booths.

3.2 Detail Design and Methodology.

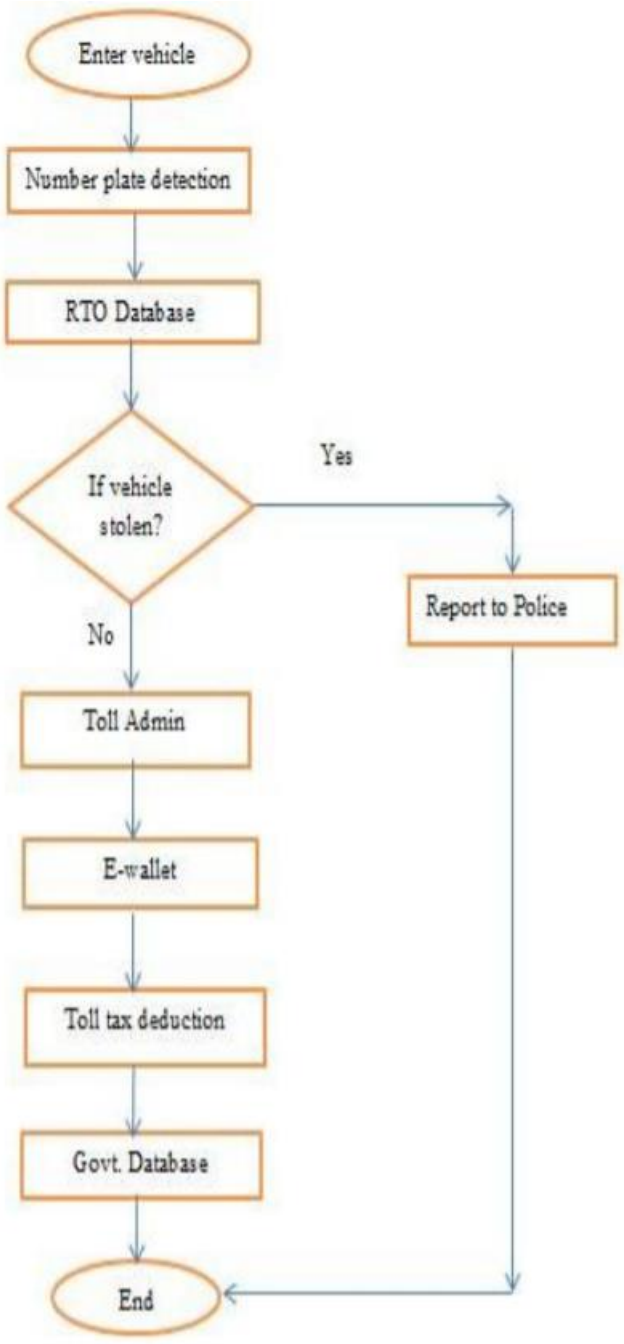
The process starts when a sensor detects the presence of a vehicle and signals the system camera to record an image of the passing vehicle. The image is passed on to a computer where software running, on the computer extracts the license plate number from the image. LPN (License plate number) can then be verified in a central database. If number valid for this system then LPN recorded in a database with other information such as vehicle number, time, balance, personal details. License plate numbers can also be further processed and be used to control other systems such as raising a gate.

These toll systems are generally composed of four main components

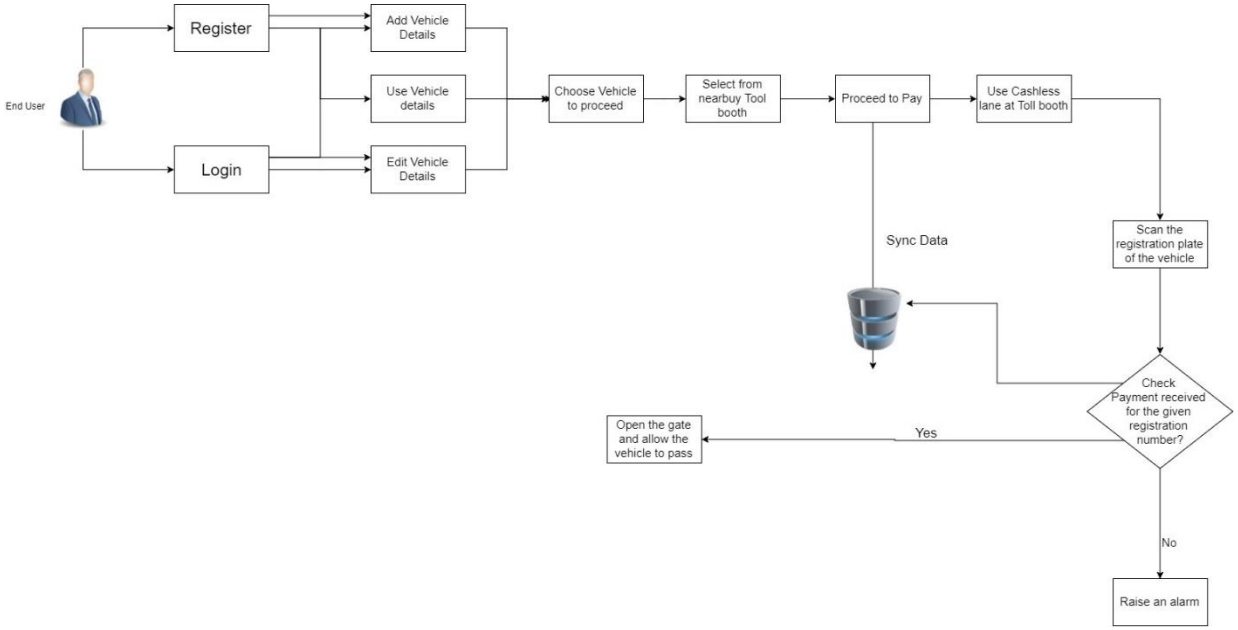
- ✓ Sensor used for vehicle detection.
- ✓ LPR Camera for capturing images
- ✓ Computer with TOLL Image processing software.
- ✓ Gate controlled system.

3.3 System Design using various Structured analysis and design tools:

Flowchart:

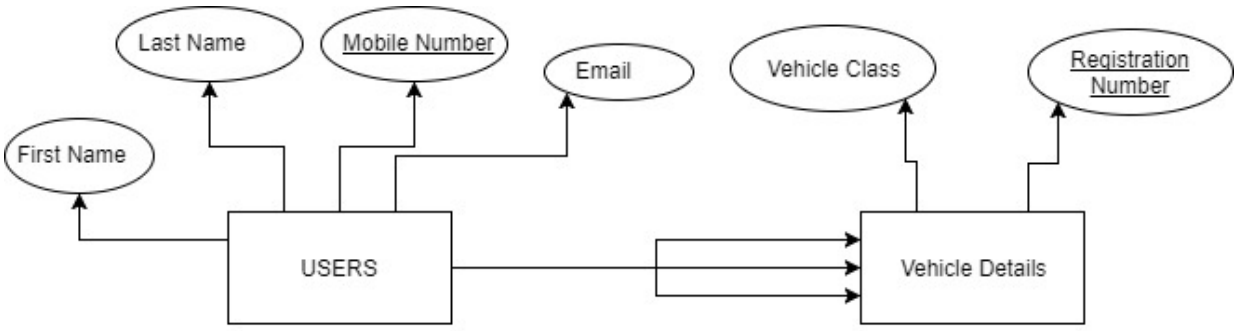


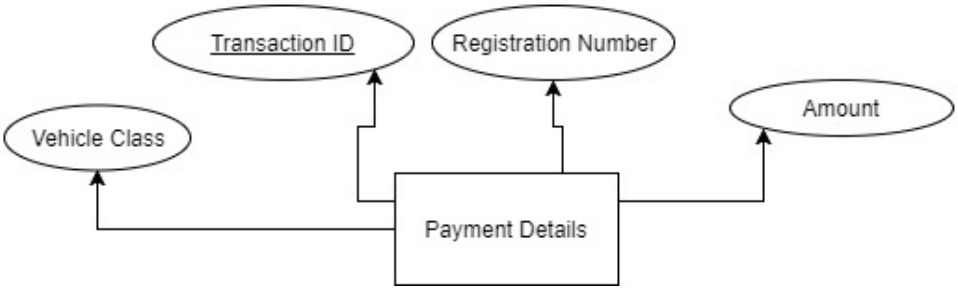
UML Diagram:



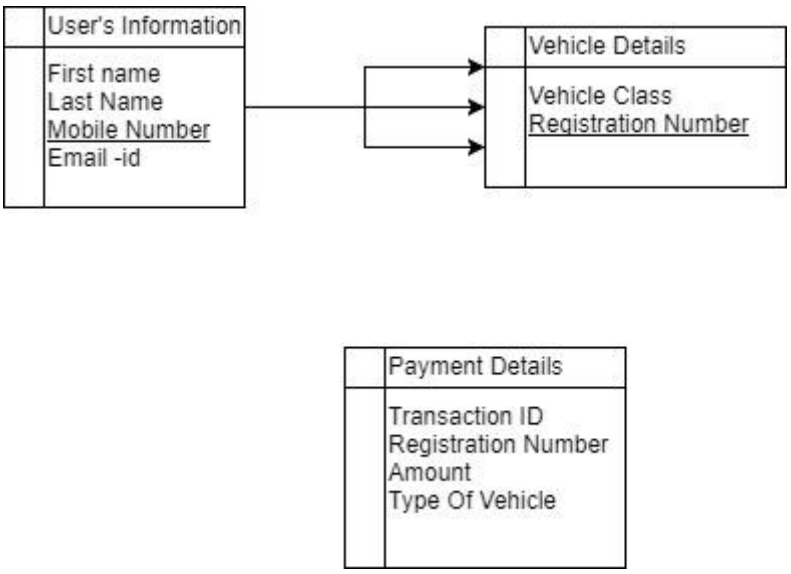
3.5 Database Design

3.5.1 ER Diagrams





3.5.2 Database Manipulation



3.5.3 Database Connection Controls and Strings

- **Android**

```
String data = "";
try {
    data = URLEncoder.encode("City", "UTF-8")
            + "=" + URLEncoder.encode(city , "UTF-8") + "&" +
URLEncoder.encode("District", "UTF-8")
            + "=" + URLEncoder.encode(district , "UTF-8") ;
} catch (UnsupportedEncodingException e) {
    //
}
BufferedReader reader = null;

// Send data

    // Define URL where to send data
    // https://bsby.000webhostapp.com/fix_appointment.php
    URL url = new URL("https://bsby.000webhostapp.com/hos_detail.php")
;

    // Send POST data request
    URLConnection conn = url.openConnection();
    conn.setDoOutput(true);
    OutputStreamWriter wr = new
OutputStreamWriter(conn.getOutputStream());
    wr.write(data);
    wr.flush();

    // Get the server response
    reader = new BufferedReader(new
InputStreamReader(conn.getInputStream()));
    int fetchedData = reader.read();
```

- **PHP mysql connection**

```
<?php
   $servername = "localhost";
   $username = "id1098019_bsby";
   $password = "pass123";
   $dbname = "id1098019_bsby";

   // Create connection
   $conn = new mysqli($servername, $username, $password, $dbname);
   // Check connection
   if ($conn->connect_error) {
      die("Connection failed: " . $conn->connect_error);
   }
?>
```

3.6 Methodology.

For using the best methodology or algorithms in the proposed system following study and survey is done as follows:-

1) **Automated toll booth system:-** The automated toll booth system uses an algorithm i.e. Template matching algorithm from this The Indian number plates following the new format can be off lengths 8, 9 or 10.
   Format of the number plate is as shown below.

   AA 11 BB 1111

   Where AA is the two letter state code; 11 is the two digit district code; 1111 is unique license plate number and BB are the optional alphabets if the 9999 numbers are used up.

2) **Number plate detection** with application to electronic toll collection system. The above system uses the template matching algorithm and the gray scale image representation technique.

   - **Template matching algorithm**: The templates of all characters will be defined with some test points. The character will compare to that templates. The template with the maximum match point will be characterized as an image. The system is capable to recognize vehicle plate number automatically. After recognition the plate number will be compared with the list of number plate in database. If the number plate is in the database of numbers plate, then the system will allow further processing.

   - **Gray scale Method**: m pixel x n pixel image can be represented as matrix. Value(m, n) represent the gray scale intensity in the form of either 0 or 1 with 0=black and 1=white. C. True color RGB: In this method image can be represented as the 3 dimensional double matrixes. Each pixel is having a red, green and blue component along with the third dimension with value (0, 1).

3) Hardware Setup

- **Webcam**: The hardware setup part consist of Web Camera, Barricade , LCD Display and Infrared Sensors. It is used to capture the images of the vehicles for the detection of number plates.

- **Barricade**: For proper traffic management, a barricade is used. It also ensures toll collection from every vehicle that passes through the toll booth.

- **LCD Display**: A LCD display is used here to give the output amount and transaction details. A liquid crystal display (LCD) is a thin, flat panel used for displaying [4] information such as text, images, and moving pictures.

- **Infrared Schemes**: An infrared sensor is used for detecting the vehicles exiting and processing inside the toll booth. In this system two Infrared sensors are used. First infrared sensor is used for detecting vehicle inside the toll and other infrared sensor is used for detecting the vehicle exiting the toll. First infrared sensor also triggers the camera for capturing the images of the vehicle for detection and processing the number plate.

- **Alarming System**: An alarming system ,an amplifier and an alarming speaker is also integrated with the system for detecting any problems with Toll processing ,security issues and notifications. They are used for handling control to the manual controller and security systems.

Chapter 4 - Implementation, Testing, and Maintenance

4.1 Introduction to Languages, IDE's, Tools and Technologies and standards used for Implementation

I. PHP

PHP started out as a small open source project that evolved as more and more people found out how useful it was. Rasmus Lerdorf unleashed the first version of PHP way back in 1994.

- PHP is a recursive acronym for "PHP: Hypertext Preprocessor".
- PHP is a server side scripting language that is embedded in HTML. It is used to manage dynamic content, databases, session tracking, even build entire e-commerce sites.
- It is integrated with a number of popular databases, including MySQL, PostgreSQL, Oracle, Sybase, Informix, and Microsoft SQL Server.
- PHP is pleasingly zippy in its execution, especially when compiled as an Apache module on the Unix side. The MySQL server, once started, executes even very complex queries with huge result sets in record-setting time.
- PHP supports a large number of major protocols such as POP3, IMAP, and LDAP. PHP4 added support for Java and distributed object architectures (COM and CORBA), making n-tier development a possibility for the first time.
- PHP is forgiving: PHP language tries to be as forgiving as possible.
- PHP Syntax is C-Like.

Common uses of PHP

- PHP performs system functions, i.e. from files on a system it can create, open, read, write, and close them.
- PHP can handle forms, i.e. gather data from files, save data to a file, through email you can send data, return data to the user.
- You add, delete, modify elements within your database through PHP.
- Access cookies variables and set cookies.
- Using PHP, you can restrict users to access some pages of your website.
- It can encrypt data.

Characteristics of PHP

Five important characteristics make PHP's practical nature possible −

- Simplicity
- Efficiency
- Security
- Flexibility
- Familiarity

"Hello World" Script in PHP

To get a feel for PHP, first start with simple PHP scripts. Since "Hello, World!" is an essential example, first we will create a friendly little "Hello, World!" script.

As mentioned earlier, PHP is embedded in HTML. That means that in amongst your normal HTML (or XHTML if you're cutting-edge) you'll have PHP statements like this −

Live Demo

```
<html>

  <head>
    <title>Hello World</title>
  </head>

  <body>
    <?php echo "Hello, World!";?>
  </body>

</html>
```

It will produce following result −

```
Hello, World!
```

II. JAVA/XML

XML (Extensible Markup Language) is a very popular simple text-based language that can be used as a mode of communication between different applications. It is considered as a standard means to transport and store data.

JAVA provides excellent support and a rich set of libraries to parse, modify or inquire XML documents.

XML is a simple text-based language which was designed to store and transport data in plain text format. It stands for Extensible Markup Language. Following are some of the salient features of XML.

- ✓ XML is a markup language.
- ✓ XML is a tag based language like HTML.
- ✓ XML tags are not predefined like HTML.
- ✓ You can define your own tags which is why it is called extensible language.
- ✓ XML tags are designed to be self-descriptive.
- ✓ XML is W3C Recommendation for data storage and data transfer.

Example

```
<?xml version = "1.0"?>

<Class>

   <Name>First</Name>

   <Sections>

      <Section>

         <Name>A</Name>

         <Students>

            <Student>Rohan</Student>

            <Student>Mohan</Student>

            <Student>Sohan</Student>

            <Student>Lalit</Student>

            <Student>Vinay</Student>

         </Students>

      </Section>
```

```
      <Section>
         <Name>B</Name>
         <Students>
            <Student>Robert</Student>
            <Student>Julie</Student>
            <Student>Kalie</Student>
            <Student>Michael</Student>
         </Students>
      </Section>
   </Sections>
</Class>
```

Advantages

Following are the advantages that XML provides −

- ✓ Technology agnostic − Being plain text, XML is technology independent. It can be used by any technology for data storage and data transfer purpose.
- ✓ Human readable − XML uses simple text format. It is human readable and understandable.
- ✓ Extensible − In XML, custom tags can be created and used very easily.
- ✓ Allow Validation − Using XSD, DTD and XML structures can be validated easily.

III. Android

Android is an open source and Linux-based operating system for mobile devices such as smartphones and tablet computers. Android was developed by the Open Handset Alliance, led by Google, and other companies.

The source code for Android is available under free and open source software licenses. Google publishes most of the code under the Apache License version 2.0 and the rest, Linux kernel changes, under the GNU General Public License version 2.

Features of Android

Android is a powerful operating system competing with Apple 4GS and supports great features. Few of them are listed below −

Sr.No.	Feature & Description
1	**Beautiful UI** Android OS basic screen provides a beautiful and intuitive user interface.
2	**Connectivity** GSM/EDGE, IDEN, CDMA, EV-DO, UMTS, Bluetooth, Wi-Fi, LTE, NFC and WiMAX.
3	**Storage** SQLite, a lightweight relational database, is used for data storage purposes.
4	**Media support** H.263, H.264, MPEG-4 SP, AMR, AMR-WB, AAC, HE-AAC, AAC 5.1, MP3, MIDI, Ogg Vorbis, WAV, JPEG, PNG, GIF, and BMP.
5	**Messaging** SMS and MMS
6	**Web browser** Based on the open-source WebKit layout engine, coupled with Chrome's V8 JavaScript engine supporting HTML5 and CSS3.
7	**Multi-touch** Android has native support for multi-touch which was initially made available in handsets such as the HTC Hero.

Application components are the essential building blocks of an Android application. These components are loosely coupled by the application manifest file AndroidManifest.xml that describes each component of the application and how they interact.

There are following four main components that can be used within an Android application −

Sr.No	Components & Description
1	**Activities** They dictate the UI and handle the user interaction to the smart phone screen.
2	**Services** They handle background processing associated with an application.
3	**Broadcast Receivers** They handle communication between Android OS and applications.
4	**Content Providers** They handle data and database management issues.

Activities

An activity represents a single screen with a user interface,in-short Activity performs actions on the screen. For example, an email application might have one activity that shows a list of new emails, another activity to compose an email, and another activity for reading emails. If an application has more than one activity, then one of them should be marked as the activity that is presented when the application is launched.

An activity is implemented as a subclass of Activity class as follows −

```
public class MainActivity extends Activity {

}
```

Services

A service is a component that runs in the background to perform long-running operations. For example, a service might play music in the background while the user is in a different

application, or it might fetch data over the network without blocking user interaction with an activity.

A service is implemented as a subclass of Service class as follows −

```
public class MyService extends Service {

}
```

Broadcast Receivers

Broadcast Receivers simply respond to broadcast messages from other applications or from the system. For example, applications can also initiate broadcasts to let other applications know that some data has been downloaded to the device and is available for them to use, so this is broadcast receiver who will intercept this communication and will initiate appropriate action.

A broadcast receiver is implemented as a subclass of BroadcastReceiverclass and each message is broadcaster as an Intent object.

```
public class MyReceiver  extends  BroadcastReceiver {

   public void onReceive(context,intent){}

}
```

Content Providers

A content provider component supplies data from one application to others on request. Such requests are handled by the methods of the ContentResolverclass. The data may be stored in the file system, the database or somewhere else entirely.

A content provider is implemented as a subclass of ContentProvider class and must implement a standard set of APIs that enable other applications to perform transactions.

```
public class MyContentProvider extends  ContentProvider {

   public void onCreate(){}

}
```

Additional Components

There are additional components which will be used in the construction of above mentioned entities, their logic, and wiring between them. These components are –

S.No	Components & Description
1	**Fragments** Represents a portion of user interface in an Activity.
2	**Views** UI elements that are drawn on-screen including buttons, lists forms etc.
3	**Layouts** View hierarchies that control screen format and appearance of the views.
4	**Intents** Messages wiring components together.
5	**Resources** External elements, such as strings, constants and drawable pictures.
6	**Manifest** Configuration file for the application.

IV. MATLAB

MATLAB is a programming language developed by MathWorks. It started out as a matrix programming language where linear algebra programming was simple. It can be run both under interactive sessions and as a batch job.

MATLAB (matrix laboratory) is a fourth-generation high-level programming language and interactive environment for numerical computation, visualization and programming.

It allows matrix manipulations; plotting of functions and data; implementation of algorithms; creation of user interfaces; interfacing with programs written in other languages, including C, C++, Java, and FORTRAN; analyze data; develop algorithms; and create models and applications.

It has numerous built-in commands and math functions that help you in mathematical calculations, generating plots, and performing numerical methods.

MATLAB's Power of Computational Mathematics

MATLAB is used in every facet of computational mathematics. Following are some commonly used mathematical calculations where it is used most commonly −

- Dealing with Matrices and Arrays
- 2-D and 3-D Plotting and graphics
- Linear Algebra
- Algebraic Equations
- Non-linear Functions
- Statistics
- Data Analysis
- Calculus and Differential Equations
- Numerical Calculations
- Integration
- Transforms
- Curve Fitting
- Various other special functions

Features of MATLAB

Following are the basic features of MATLAB −

- It is a high-level language for numerical computation, visualization and application development.
- It also provides an interactive environment for iterative exploration, design and problem solving.
- It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.
- It provides built-in graphics for visualizing data and tools for creating custom plots.
- MATLAB's programming interface gives development tools for improving code quality maintainability and maximizing performance.
- It provides tools for building applications with custom graphical interfaces.
- It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and Microsoft Excel.

Uses of MATLAB

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams. It is used in a range of applications including −

- Signal Processing and Communications
- Image and Video Processing
- Control Systems
- Test and Measurement
- Computational Finance
- Computational Biology

V. MySQL

MySQL is the most popular Open Source Relational SQL Database Management System. MySQL is one of the best RDBMS being used for developing various web-based software applications. MySQL is developed, marketed and supported by MySQL AB, which is a Swedish company.

A database is a separate application that stores a collection of data. Each database has one or more distinct APIs for creating, accessing, managing, searching and replicating the data it holds. Other kinds of data stores can also be used, such as files on the file system or large hash tables in memory but data fetching and writing would not be so fast and easy with those type of systems.

Nowadays, we use relational database management systems (RDBMS) to store and manage huge volume of data. This is called relational database because all the data is stored into different tables and relations are established using primary keys or other keys known as Foreign Keys.

A **Relational DataBase Management System (RDBMS)** is a software that −

- Enables you to implement a database with tables, columns and indexes.
- Guarantees the Referential Integrity between rows of various tables.
- Updates the indexes automatically.
- Interprets an SQL query and combines information from various tables.

RDBMS Terminology

Before we proceed to explain the MySQL database system, let us revise a few definitions related to the database.

- **Database** − A database is a collection of tables, with related data.
- **Table** − A table is a matrix with data. A table in a database looks like a simple spreadsheet.
- **Column** − One column (data element) contains data of one and the same kind, for example the column postcode.
- **Row** − A row (= tuple, entry or record) is a group of related data, for example the data of one subscription.
- **Redundancy** − Storing data twice, redundantly to make the system faster.

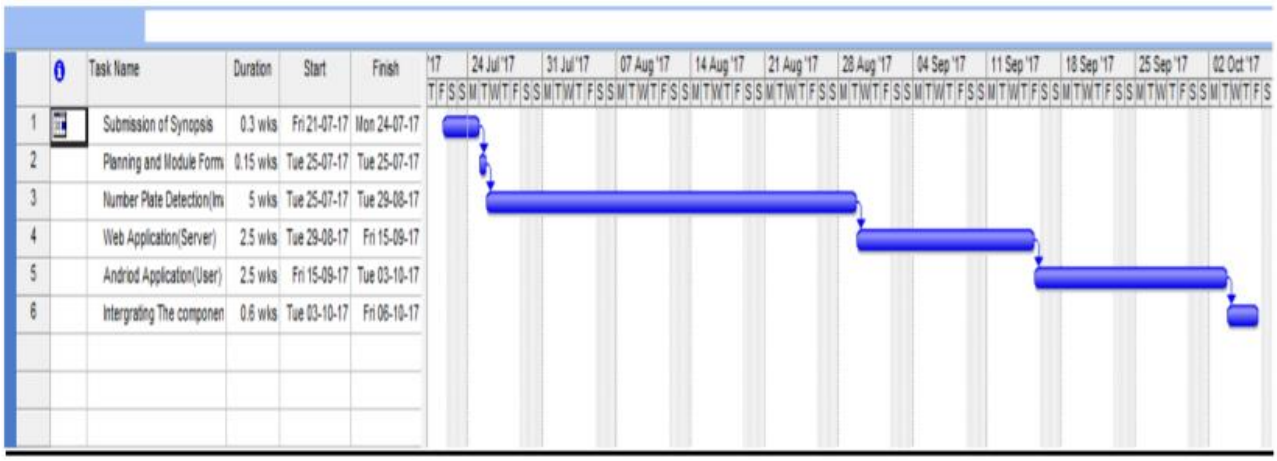
- **Primary Key** − A primary key is unique. A key value can not occur twice in one table. With a key, you can only find one row.
- **Foreign Key** − A foreign key is the linking pin between two tables.
- **Compound Key** − A compound key (composite key) is a key that consists of multiple columns, because one column is not sufficiently unique.
- **Index** − An index in a database resembles an index at the back of a book.
- **Referential Integrity** − Referential Integrity makes sure that a foreign key value always points to an existing row.

MySQL Database

MySQL is a fast, easy-to-use RDBMS being used for many small and big businesses. MySQL is developed, marketed and supported by MySQL AB, which is a Swedish company. MySQL is becoming so popular because of many good reasons −

- MySQL is released under an open-source license. So you have nothing to pay to use it.
- MySQL is a very powerful program in its own right. It handles a large subset of the functionality of the most expensive and powerful database packages.
- MySQL uses a standard form of the well-known SQL data language.
- MySQL works on many operating systems and with many languages including PHP, PERL, C, C++, JAVA, etc.
- MySQL works very quickly and works well even with large data sets.
- MySQL is very friendly to PHP, the most appreciated language for web development.
- MySQL supports large databases, up to 50 million rows or more in a table. The default file size limit for a table is 4GB, but you can increase this (if your operating system can handle it) to a theoretical limit of 8 million terabytes (TB).
- MySQL is customizable. The open-source GPL license allows programmers to modify the MySQL software to fit their own specific environments.

4.2 Gantt Chart (Project Schedule)



	Task Name	Duration	Start	Finish
1	Submission of Synopsis	0.3 wks	Fri 21-07-17	Mon 24-07-17
2	Planning and Module Form	0.15 wks	Tue 25-07-17	Tue 25-07-17
3	Number Plate Detection(Im	5 wks	Tue 25-07-17	Tue 29-08-17
4	Web Application(Server)	2.5 wks	Tue 29-08-17	Fri 15-09-17
5	Andriod Application(User)	2.5 wks	Fri 15-09-17	Tue 03-10-17
6	Intergrating The componen	0.6 wks	Tue 03-10-17	Fri 06-10-17

4.3 Testing

System Testing

Software testing is a crucial element of software quality and represents the ultimate review of specialization design and coding. No program or design is perfect, communication between the user and the designers not always complete or clear, and time is usually short, this result is errors. The number and nature of error in a new design depend on several features:

- Communication between the user and the designer.
- The programmer's ability to generate a code that reflects exactly the system specifications.
- The time frame for the design.

Testing is vital to the success of the system. System testing makes a logical assumption that if all parts of the system are correct, the goal will be successfully achieved. Inadequate testing or non-testing leads to error, that may not appear until months later but it can be fatal in future. This creates two problems:

- The time lag between the cause and the appearance of the problem.
- The effect of the system errors on files and records within the system.

Effective testing early in the process translates directly into long-term cost saving from the reduced number of errors.

Some major types of testing methods are:

1. White box testing
2. Black box testing
3. Stress testing

4. Performance testing

White box testing:

White box sometimes called “glass box testing” is a test case design uses the control structure of the procedural design to derive test case.

Using white box testing methods, the following tests were made on the system.

A) All independent paths within a module have been exercised once. In our system, ensuring that case was selected and executed checked all case structures. The bugs that were prevailing in some part of the code where fixed.
B) All logical decisions were checked for the truth and falsity of the values.

Black box testing:

Black box testing focuses on the functional requirements of the software. This is black box testing enables the software engineering to derive a set of input conditions that will fully exercise all functional requirements for a program. Black box testing is not an alternative to white box testing rather it is complementary approach that is likely to uncover a different class of errors that white box methods like..

1) Interface errors
2) Performance in data structure
3) Performance errors
4) Initializing and termination errors

Stress testing:

In this type of testing, we test under various critical conditions. In the various stress options we test our project whether it will work properly or not. In all the critical conditions we check each and every module. If number of entities exceed to our limit how it will behave.

Performance testing:

In this type of testing, we check for the performance of our project. Performance testing is the major part of our testing. In this type of testing all the modules performance is checked out, how it behave under various conditions. In this overall performance of the system is checked out and it gives variances, if any, so the developer can take the appropriate action in response to the variances.

Chapter 5 - Results and Discussions

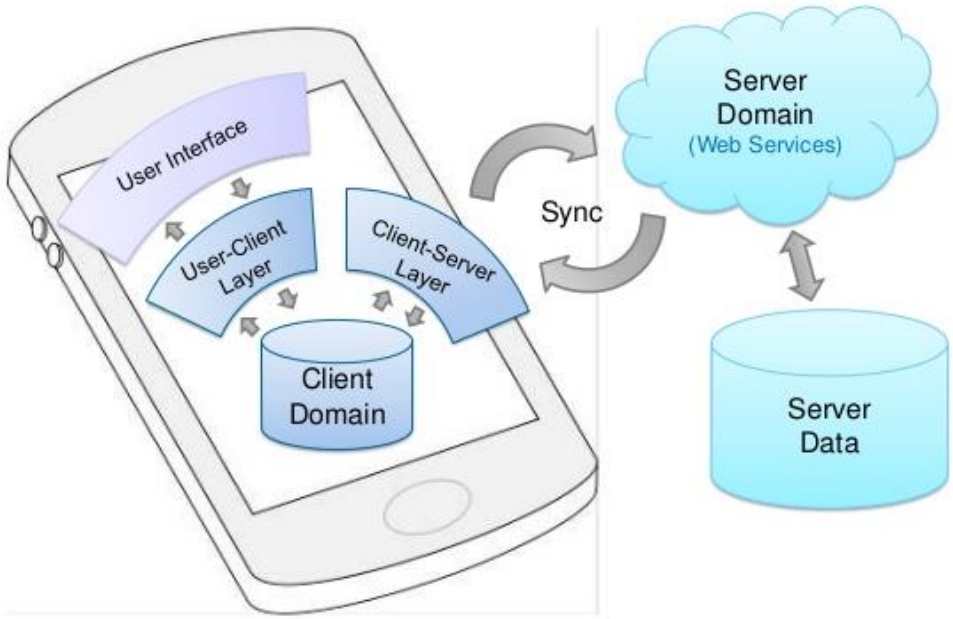
5.1 User Interface Representation

5.1.1 Brief Description of Various Modules of the system

- **Mobile Application:** Majorly the User Interface is surrounded by the android application which is provided at the user end to facilitate the users. The application is flexible to use with no complexities. A user can commence its desired operations with the application and successfully make payments across the toll plazas.

- **Image Processing:** Vehicle number Plate detection is carried out through MATLAB. So all the GUI features of MATLAB are used in the application making it easier for the programmer or application developer to use the in built features of the MATLAB IDE and perform the number plate detection in a robust manner.

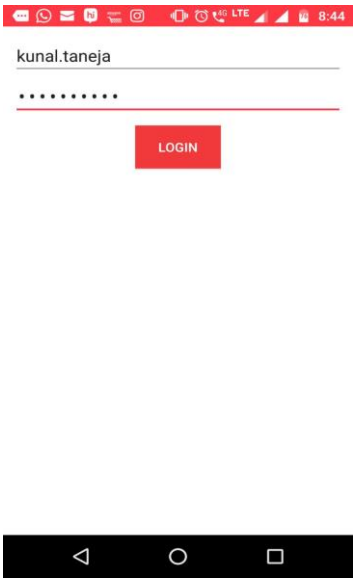
- **Server:** Server of this system is hosted free dedicated server named 000webhost.com which in turn has a great user interface and properly placed menus to assist the officials to carry out server tasks in an unambiguous way. Moreover the data residing over the server can be accessed and visualised in an efficient way without any bottlenecks.



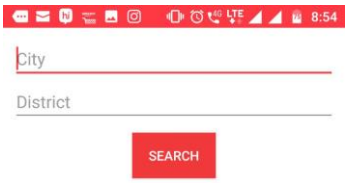
5.2 Snapshots of system with brief detail of each

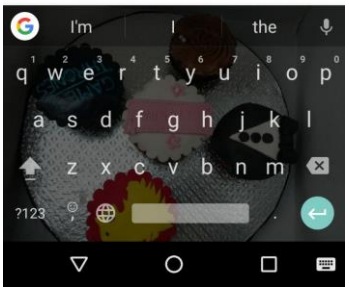
5.2.1 Android Application

- **Index page or the first activity** of the application when it is executed is the login activity where the app asks the user to login into the system. The user specifies its login credentials. These credentials are verified from the server in the database and in case of valid user the login is made successful.



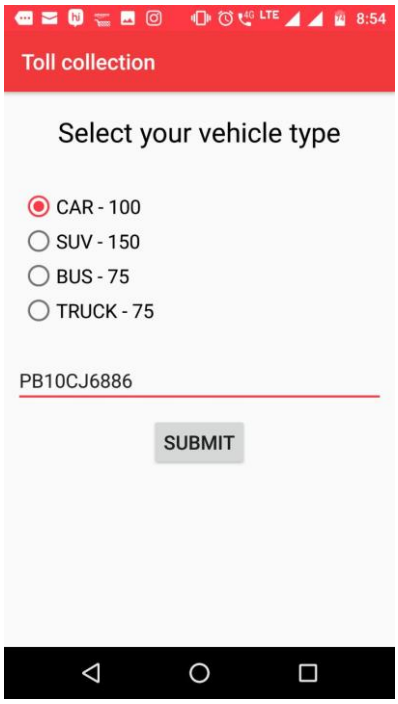
- After the user logs in he is prompted for the location details for which he wants to make the toll payment. In this option city name and district name are gathered from the users and on its basis the database is fetched for the respective toll plazas lying in that region or city.



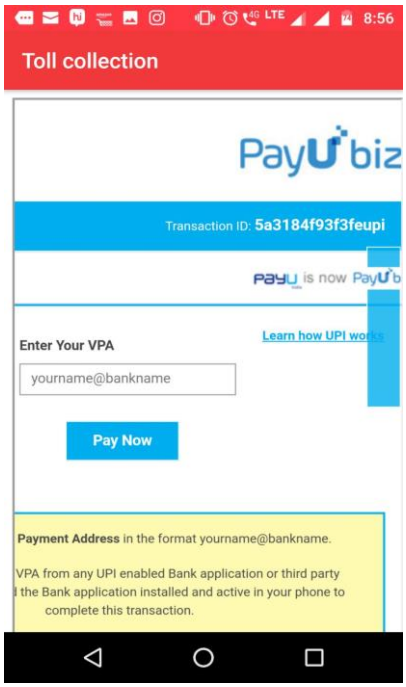


The Fetched results for example for the city “JAIPUR” is shown below.

- On selecting the Toll Plaza Against which the payment is to be made. The user is presented with a form which gathers information such as vehicle number, vehicle type from the user and it also displays the fare associated with the vehicle type.



- Finally, the user is redirected to the payment page where he can pay for his services through UPI (United Payment Interface) and as soon as the user pays his toll the entry corresponding his receipt is recorded in the server so that whenever the user passes the toll. The details and vehicle number from this entry can be used for the authentication of the user.



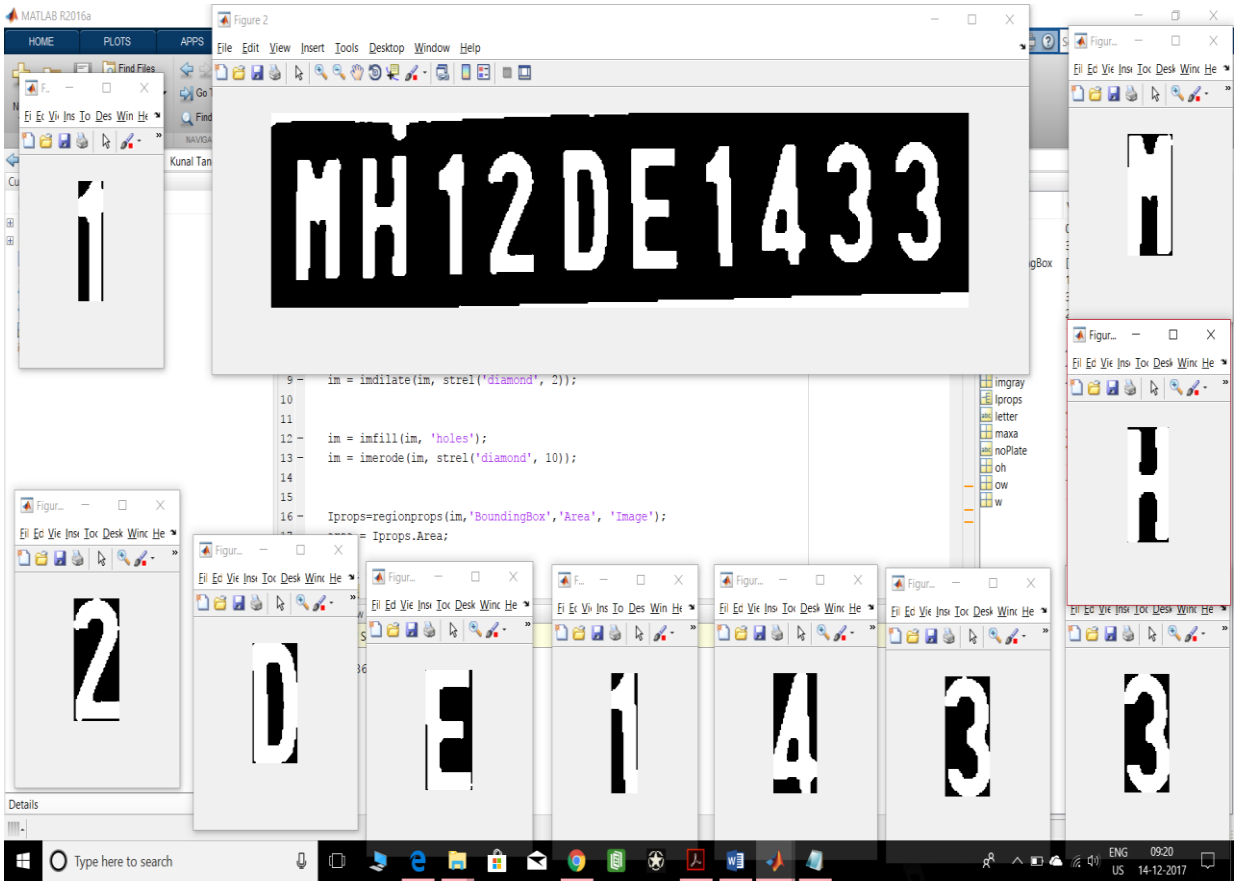
5.2.2 MATLAB Application

- In the application the image of the vehicle plate number to be detected is fed and the appropriate image processing techniques are applied over it and then the portion of the number plate is cropped from the entire picture so as to fetch individual characters out of the number plate.

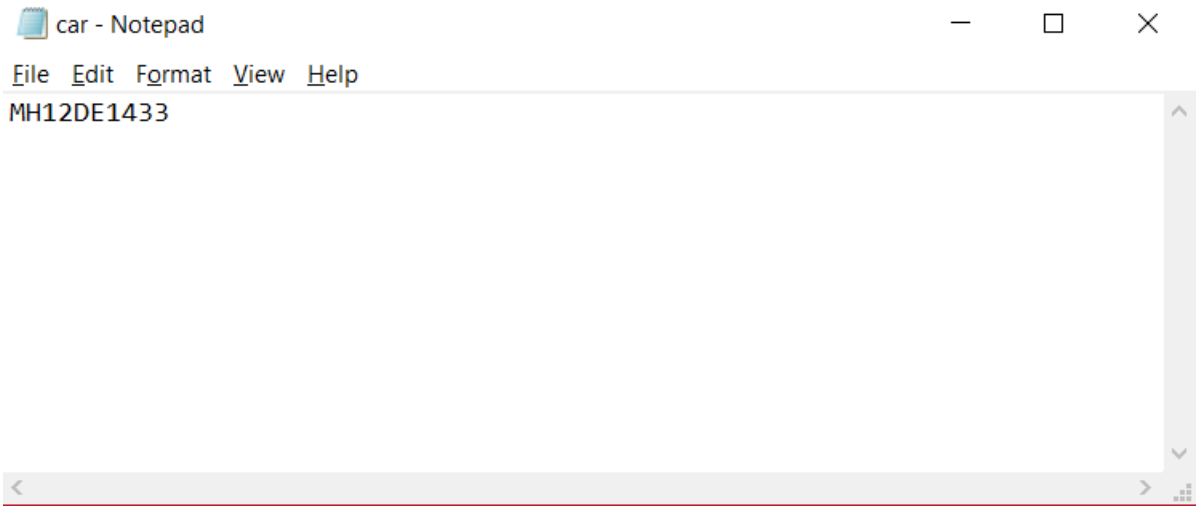
The following figure shows the original image passed and the results of the image processing applied over it.

Original Image:

Result after Applying image processing:



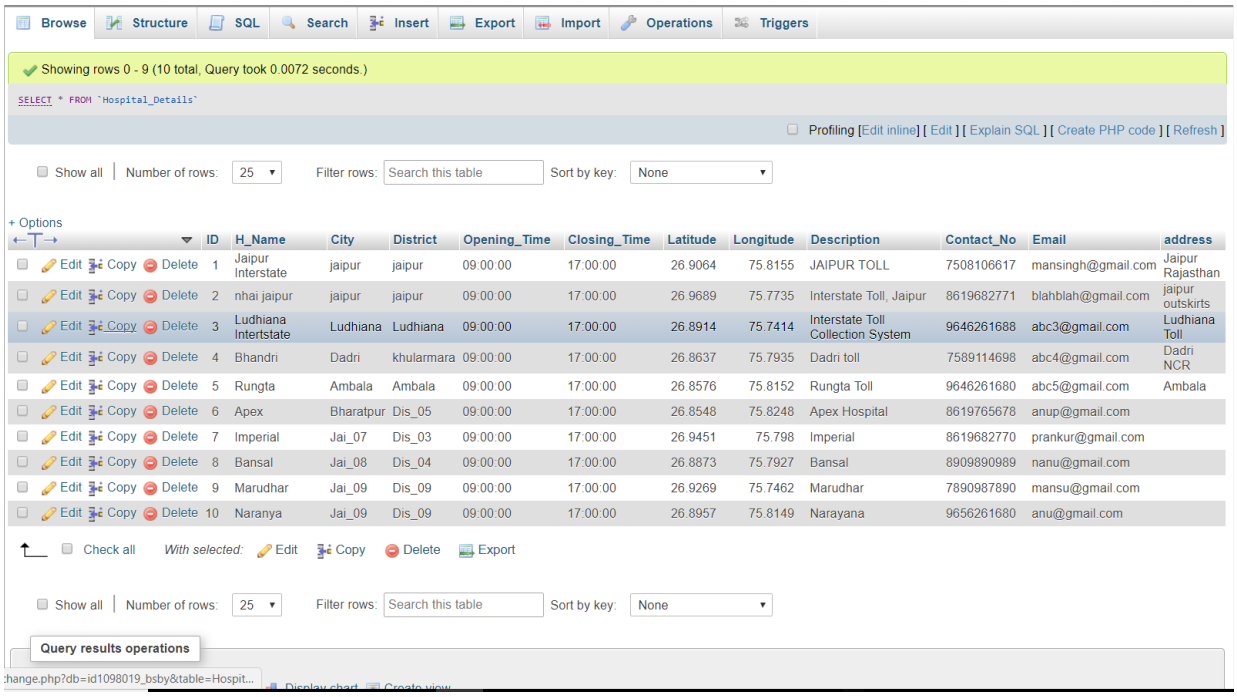
- After the number plate is successfully detected the contents of the number plate are made to be written in a text file so that this text file can be uploaded on the server and accessed during authentication mechanism of the identity of the vehicle.



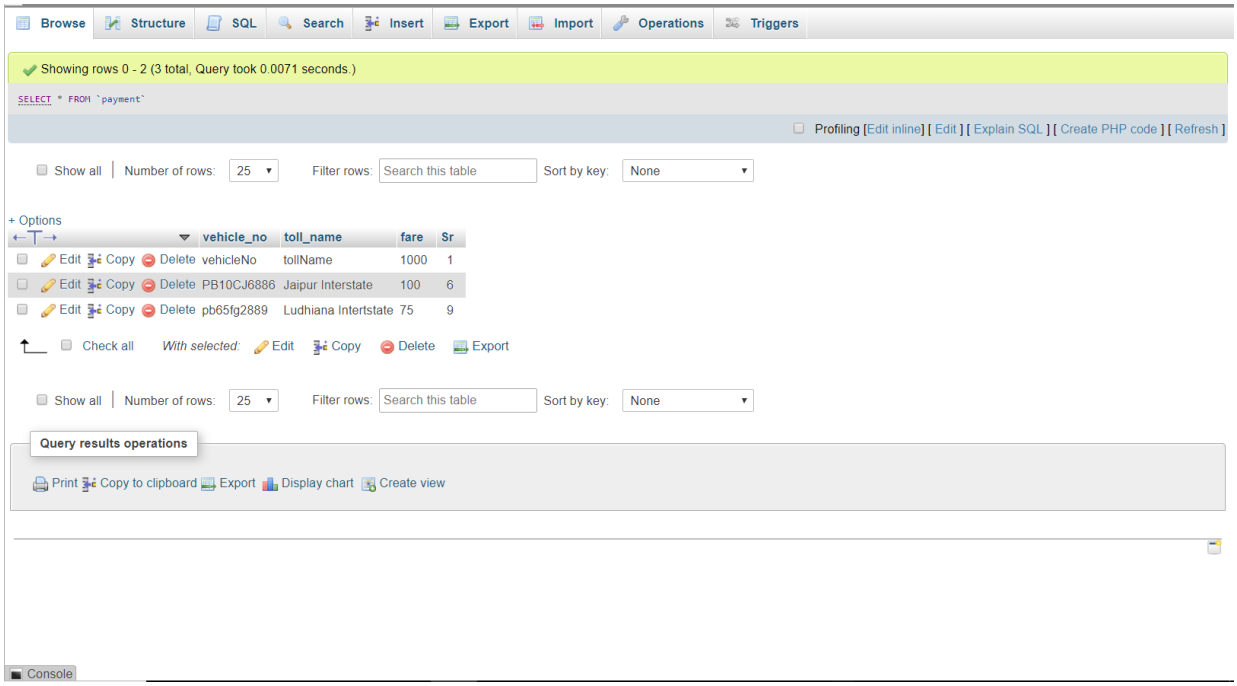
5.3 Back Ends Representation (Database to be used)

5.3.1 Snapshots of Database Tables with brief description

- Database corresponding to the toll locations and its information.



- Database corresponding to the payment details made against different toll plazas.



Chapter 6- Conclusion and future scope

In a populated country like India implementing new techniques is extremely difficult and this technique can be easily implemented without much change to the current toll system and also with least expense. It provides the tracking system for theft vehicle which is secured and highly reliable. E-toll system can help to achieve proper traffic management, appropriate toll collection and improves security. Thus a system used as an Automated Toll collection booth, based on image processing saves the time at toll booth, minimizes the fuel consumption during the ideal condition of the vehicle. It can be used to overcome all drawbacks with the current system such as time and human efforts.

Certain enhancements can be applied to the project in future are:

- The vehicle would not have to stop at all the toll plaza. To develop a system that provides immediate response. For now the vehicles would have to stop for a few seconds at the toll plaza for capturing the image of the number plate.
- Map info will be added directly to the application in future so that user can use navigation process to cross through every Toll Plaza.
- To enhance the user view of the application
- To make the payment procedure more efficient and secure.

References:

1. Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins, Digital Image Processing using MATLAB
2. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing Second Edition.
3. C. N. E. Anagnostopoulos and I. E. Anagnostopoulos, A License Plate Recognition Algorithm for Intelligent Transportation System, Applications, *IEEE Transaction on Intelligent Transportation System, Vol. 7, No. 3, 2006, pp. 377-392.*
4. -Hsun Lee , Shian-Shyong Tseng , and Ching-Hung Wang, “design and implement of electronic toll collection system based on vehicle positioning system techniques,”vol. 31, 2008,pp. 2925–2933.
5. F.Don,"Electronic Toll Collection: An Introduction and Brief Look at Potential Vulnerabilities," in SANS Institute infoSec Reading Room, 1.4b ed. 2004.