VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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PROJECT REPORT

on

SMART TRAFFIC SIGNAL MANAGEMENT SYSTEM (STSMS)

Submitted in partial fulfillment of the requirement
for the award of the degree of

Bachelor of Engineering
in
Information Science and Engineering
by

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<u>2016 – 2017</u>

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ACKNOWLEDGEMENT

We consider it a privilege to express through the pages of this report, a few words of gratitude to all those distinguished personalities who guided and inspired us in the completion of the project.

We would like to thank **Shri. Narayan Rao R Maanay**, Secretary, BNMIT, Bangalore for providing excellent academic environment in college.

We would like to sincerely thank **Prof. T. J. Ramamurthy**, Director, BNMIT, Bangalore for having extended his support and encouragement during the course of work.

We would like to express my gratitude to **Dr. M. S. Suresh**, Dean, BNMIT, Bangalore for his relentless support, guidance and encouragement.

We would like to thank **Dr. Krishnamurthy G N,** Principal, BNMIT, Bangalore for his constant encouragement.

We would like to thank **Dr. Surabhi Narayan**, Professor and Head of The Department of Information Science and Engineering, BNMIT, Bangalore for her support and encouragement towards the completion of the project.

We would like to express our gratitude to our guide **Mrs. Christy Persya A**, Associate Professor, Department of Information Science and Engineering who has given us all the support and guidance in completing the project work successfully.

We would like to thank project coordinators **Dr. Saritha Chakrasali**, Professor and **Mrs. Christy Persya A**, Associate Professor, Department of Information Science and Engineering, BNMIT, for being the guiding force towards successful completion of the project.

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ABSTRACT

The project work is designed to develop a dynamic density based traffic signal system. The signal timing changes automatically on sensing the traffic density at the junction. Traffic congestion is a severe problem in many major cities across the world and it has become a nightmare for the commuters in these cities. Conventional traffic light system is based on fixed time concept allotted to each side of the junction, which cannot be varied as per varying traffic density. Junction timings allotted are fixed. Sometimes higher traffic density at one side of the junction demands longer green time as compared to standard allotted time. The image captured in the traffic signal is processed and converted into grayscale image then its threshold is generated, using which the area occupied by the vehicles present in the image is calculated. After calculating the area occupied by the vehicles, we will come to know in which lane the density is high, based on which the duration for green signals would be allotted for a particular lane.

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CHAPTER 1

INTRODUCTION

Nowadays, many countries suffer from the traffic congestion problems that affect the transportation system in cities and cause serious dilemma. In spite of replacing traffic officers and flagmen by automatic traffic systems, the optimization of the heavy traffic jam is still a major issue to be faced, especially with multiple junction nodes.

The rapid increase of the number of automobiles and the constantly rising number of road users are not accompanied with promoted infrastructures with sufficient resources. Partial solutions were offered by constructing new roads, implementing flyovers and bypass roads, creating rings, and performing roads rehabilitation.

However, the traffic problem is very complicated due to the involvement of diverse parameters such as [1]:

- The traffic flow depends on the time of the day where the traffic peak hours are generally in the morning and in the afternoon; on the days of the week where weekends reveal minimum load while Mondays and Fridays generally show dense traffic oriented from cities to their outskirts and in reverse direction respectively; and time of the year as holidays and summer.
- The current traffic light system is implemented with hard coded delays where the lights transition time slots are fixed regularly and do not depend on real time traffic flow
- The third point is concerned with the state of one light at an intersection that influences the flow of traffic at adjacent intersections

Fast transportation systems and rapid transit systems are nerves of economic developments for any nation. Mismanagement and traffic congestion results in long waiting times, loss of fuel and money. It is therefore utmost necessary to have a fast, economical and efficient traffic control system for national development. The monitoring and control of city traffic is becoming a major problem in many countries. With the ever increasing number of vehicles on the road, the Traffic Monitoring Authority has to find new methods of overcoming such a problem. One way to improve traffic flow and safety of the current transportation system is to apply automation and intelligent control methods [2].

A traffic light system is an electronic device that assigns right of way at an intersection or crossing or street crossing by means of displaying the standard red, yellow and green colored indications. An addition, it also works in conjunction with pedestrian displays to assign pedestrian crossing right of way. A traffic light, also known as traffic signal, stop light, stop-and-go lights, is a signaling device positioned at a road intersection, pedestrian crossing, or other location in order to indicate when it is safe to drive, ride, or walk using a universal color code (and a precise sequence, for that are colors blind). Nowadays, a red light meant traffic in all directions had to stop. A yellow light meant cross-town traffic would have to slow and a green light would to go or proceed.

1.1 OBJECTIVE

- To develop a smart traffic light control system that automatically scans the density of traffic and manages the traffic light accordingly
- To optimize efficiency and to expand the benefits in environmental sector
- To overcome burden of manual traffic control
- To reduce severe traffic congestion, traffic volume, waiting time

1.2 RELEVANCE

The system developed has relevance with respect to both society and environment which has been inferred from the paper [3].

1.2.1 Society:

The Smart Traffic Control System provides several benefits to the society. They include:

- To reduce the amount of time motorists spend on the road
- To allow for more efficient use of road capacity by increasing throughput of vehicles through intersections.
- Reduced vehicular emissions from stationary vehicles on roads.

The absence of traffic lights at intersections with significant traffic congestion add to the pollution of the atmosphere as stationary exhaust fumes from stationary cars introduce nitrous oxides and carbon dioxide, air pollutants into the atmosphere, serving as a significant contributor to climate change. Thus, the use of Smart Traffic Control System helps in mitigating traffic congestion and vehicular emission.

1.2.2 Environment:

It also provides a different set of benefits to both roads users and other interested groups including a reduction in traffic congestion and air pollution emissions including greenhouse emissions and particulate matter emissions. Also facilitates an improved vehicular flow and road usage patterns, allowing for more efficient use of road capacity by increasing throughput of vehicles through intersections and reduction in greenhouse gas.

1.3 SCOPE OF WORK

Traffic light control systems are widely used to monitor and control the flow of automobiles through the junction of many roads. They aim to realize smooth motion of cars in the transportation routes. The scope of the proposed system is to provide a smart traffic light control system that automatically scans the density of traffic and manages the traffic light accordingly.

1.4 MOTIVATION

- To guarantee fast and smooth traffic flow that utilize new and versatile technologies
- The traffic lights that are in widespread use today do not do much intricate reasoning when deciding when to change the lights for the various road users waiting in different lanes
- Most of the traffic control systems are timer based
- These timer-based systems does not handle the variable flow of vehicles approaching the junction

1.5 PROBLEM STATEMENT

The aim of STSMS project is to analyze the volume of the traffic at each lane by incorporating image-processing techniques. Based on the analysis, the traffic signal duration can be extended or reduced, which will greatly reduce the waiting time and transportation problems occurring every day.

This chapter ends with a brief introduction to the proposed system, motivation behind implementing this work, scope and relevance of the system with regards to the society and environment, and the problem statement of the system.

CHAPTER 2

LITERATURE SURVEY

The literature survey contains a brief background to the traffic light system, existing systems and its limitations, the proposed system and its advantages.

2.1. BACKGROUND

Before the traffic lights, traffic police controlled the flow of traffic. The main reason for the traffic light was that there was an overflow of horse-drawn traffic over Westminster Bridge which forced thousands of pedestrians to walk next to the Houses of Parliament. The design combined three semaphore arms with red and green gas lamps for night-time use, on a pillar, operated by a police constable. The gas lantern was manually turned by a traffic police officer, with a lever at its base so that the appropriate light faced traffic. The signal was 22 feet high. The light was called the semaphore and had arms that would extend horizontally that commanded drivers to "Stop" and then the arms would lower to a 45 degrees angle to tell drivers to proceed with "Caution". At night a red light would command "Stop" and a green light would mean use "Caution".

2.1.1 The First Traffic Signal

Although the purpose of a traffic signal is to regulate the flow of automobiles, traffic signals came into existence long before automobiles were invented. The idea for developing traffic signals began in the 1800's, and on December 10, 1868, the first gas-lit traffic lights were installed outside the Houses of Parliament in London. This model shown in figure 2.1.1 was proposed by a British railway engineer, J.P Knight. It was implemented to control the traffic of horse carriages in the area, and to allow pedestrians to safely cross the roads. The gas-fuelled lights needed to be manually controlled by a police officer using semaphore arms. During the daytime, the semaphore arms would be raised or lowered by the police officer, signalling vehicles whether they should proceed or stop. At night, instead of arms, gas-lit red and green lights were used. Red signalled carriages to stop, and green meant proceed. Red was used to stop, as it represented danger or caution, whereas green was determined to be a more reassuring colour in most cultures and also has a strong emotional correspondence with safety [5].

Figure 2.1.1 First traffic signal

2.1.2 The First Electric Traffic Lights

In the early 1900's, the world was developing at a very rapid pace, and with the growth of industrialization, cities became more crowded. Furthermore, with the invention of automobiles, the traffic on the roads increased significantly, so there was a need for a better traffic system.

At that time, it was said that this invention would revolutionize the handling of traffic in congested cities. As it turned out, the modern traffic system still works on the same principle as Wire's original system. The momentous occasion of the first electric traffic light turning 101 years old on August 5, 2015 was celebrated by Google Doodle.

The first electric traffic light had only red and green lights; it did not have a yellow light like modern-day traffic signals. Instead of a yellow light, it had a buzzer sound that was used to indicate that the signal would be changing soon [5].

2.1.3 The First Four-way and Three-colour Traffic Lights

In the year 1920, a police officer named William Potts in Detroit, Michigan invented the first four-way and three-colored traffic lights as shown in Figure 2.1.3.

Figure. 2.1.3 First Four-way and Three-colour Traffic Lights

Apart from red and green, a third color – amber (or yellow) – was introduced. Detroit became the first city to implement the four-way and three-colored traffic lights. In the 1920's, several automated traffic signals were installed in major cities around the world. The modern traffic light still uses this famous T-shaped model with three different colors.

2.2 EXISTING SYSTEMS

Traffic lights, developed since 1912, are signaling devices that are conceived to control the traffic flows at road intersections, pedestrian crossings, rail trains, and other locations. Traffic lights consist of three universal colored lights: the green light allows traffic to proceed in the indicated direction, the yellow light warns vehicles to prepare for short stop, and the red signal prohibits any traffic from proceeding.

The conventional traffic system needs to be upgraded to solve the severe traffic congestion, alleviate transportation troubles, reduce traffic volume and waiting time, minimize overall travel time, optimize cars safety and efficiency, and expand the benefits in health, economic, and environmental sectors.

2.2.1 COUNTDOWN TIMER :

The countdown timer shown in Figure 2.2.1 was introduced to traffic lights in the 1990's. The countdown timer helps pedestrians know whether they have enough time to cross the road before the signal changes color.

Figure.2.2.1 Countdown Timer Traffic Signal

2.2.2 LIMITATIONS OF EXISTING SYSTEM [2]

- Heavy Traffic Jams with increasing number of vehicles on road, heavy traffic congestion has substantially increased in major cities. This happened usually at the main junctions commonly in the morning, before office hour and in the evening, after office hours. The main effect of this matter is increased time wasting of the people on the road
- No traffic, but still need to wait: In certain junctions, sometimes even if there is no traffic, people have to wait. Because the traffic light remains red for the preset time period, the road users should wait until the light turn to green. If they run the red.
- Manual traffic control is causing a lot of burden in managing traffic congestion
- Conventional traffic system does not provide solution to traffic congestion
- Manual traffic control is timer based as opposed to STSMS, which scans traffic density to determine the traffic signal duration
- IR sensors, spot sensors, pneumatic sensors have limited coverage of area

2.3 PROPOSED SYSTEM

The design of intelligent traffic control system is an active research topic. Researchers around the world are inventing newer approaches and innovative systems to solve this stressful problem. Models based on mathematical equations are applied to estimate the car waiting time at a junction, the number of cars in the waiting queue, the extension of the waiting cars along the lane, the optimal timing slots for green, yellow, and red lights that best fit the real and veritable situation and the efficient combination of routing. In fact, the mutual dependencies between nearby intersections lead to a complicated formulation with cumbersome parameters. These parameters are accidental, hazardous, dependent, and the worse point is the variance of these parameters with time. Thus, finding a dynamic, consistent, and convenient solution is quite impossible. Researchers from different disciplines are collaborating to explore feasible solutions that reduce traffic congestion. Therefore, various methodologies are constantly proposed in the literature and many techniques are implemented profiting from the technological advances of microcomputers, recent manufactured devices and sensors, and innovative algorithms modeling, as much as possible, the complication of traffic lights. We propose a smart traffic light control system that automatically scans the density of traffic and manages the traffic light accordingly [6].

2.4 ADVANTAGES OF PROPOSED SYSTEM

The advantages of building Intelligent Traffic Control System which reduce congestion; reduce operational costs; provide alternate routes to travelers, increases capacity of infrastructure. Problem of severe traffic congestion, alleviate transportation troubles, reduce traffic volume and waiting time, minimize overall travel time, optimize cars safety and efficiency, and expand the benefits in health, economic, and environmental sectors are solved. [7]

2.5 TECHNOLOGY, TOOLS, LANGUAGES USED IN THE PROJECT

This project has been implemented using Java Development Kit (JDK), Eclipse JEE Oxygen, Apache Tomcat Server and MySQL Database.

2.5.1 Java Development Kit

The Java Development Kit (JDK) is an implementation of either one of the Java Platform, Standard Edition; Java Platform, Enterprise Edition or Java Platform, Micro Edition platforms[1] released by Oracle Corporation in the form of a binary product aimed at Java developers on Solaris, Linux, MacOS or Windows. The JDK includes a private JVM and a few other resources to finish the development of a Java Application. Since the introduction of the Java platform, it has been by far the most widely used Software Development Kit (SDK). On 17 November 2006, Sun announced that they would release it under the GNU General Public License (GPL), thus making it free software. This happened in large part on 8 May 2007, when Sun contributed the source code to the OpenJDK. The JDK has as its primary components a collection of programming tools.

2.5.2 Eclipse

Eclipse is an integrated development environment (IDE) used in computer programming, and is the most widely used Java IDE. It contains a base workspace and an extensible plug-in system for customizing the environment. Eclipse is written mostly in Java and its primary use is for developing Java applications, but it may also be used to develop applications in other programming languages.

Eclipse supports development for Tomcat, GlassFish and many other servers and is often capable of installing the required server (for development) directly from the IDE. It supports remote debugging, allowing a user to watch variables and step through the code of an application that is running on the attached server.

The Eclipse Web Tools Platform (WTP) project is an extension of the Eclipse platform with tools for developing Web and Java EE applications. It includes source and graphical editors for a variety of languages, wizards and built-in applications to simplify development, and tools and APIs to support deploying, running, and testing apps.

2.5.3 Apache Tomcat Server

Apache Tomcat (or simply Tomcat, formerly also Jakarta Tomcat) is an open source web server and servlet container developed by the Apache Software Foundation

(ASF). Tomcat implements the Java Servlet and the Java Server Pages (JSP) specifications from

Sun Microsystems, and provides a "pure Java" HTTP web server environment for Java code to run.

Apache Tomcat includes tools for configuration and management, but can also be configured by editing XML configuration files.

2.5.4 MySQL Database.

MySQL officially, but also called /maɪ ˈsiːkwəl/ "My Sequel") is (as of 2008) the world's most widely used open source relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases. It is named after co-founder Michael Widenius' daughter, My. The SQL phrase stands for Structured Query Language.

The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL was owned and sponsored by a single for-profit firm, the Swedish company MySQL AB, now owned by Oracle Corporation.

MySQL is a popular choice of database for use in web applications, and is a central component of the widely used LAMP open source web application software stack (and other 'AMP' stacks). LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python." Free-software-open source projects that require a full-featured database management system often use MySQL.

For commercial use, several paid editions are available, and offer additional functionality. Applications which use MySQL databases include: TYPO3, Joomla, WordPress, phpBB, MyBB, Drupal and other software. MySQL is also used in many high-profile, large-scale World Wide Web products, including Wikipedia, Google (though not for searches), Facebook, Twitter, Flickr, Nokia.com, and YouTube.

In this chapter, we explained about background of traffic system and the way it came into existence also explained about current existing traffic system and its drawbacks. Proposed system and its advantages has been explained. Also the technology and tools used have been described.

CHAPTER 3

SYSTEM REQUIREMENTS SPECIFICATION

All computer software needs certain hardware components or other software resources to be present on a computer for efficient use. These prerequisites are known as (computer) system requirements and are often used as a guideline as opposed to an absolute rule. Most software defines two sets of system requirements: minimum and recommended. System requirements play major roles in systems engineering, as they:

- Form the basis of system architecture and design activities
- Form the basis of system integration and verification activities

3.1 USER REQUIREMENTS

The goal of requirement analysis is to understand the requirement of the system that is developed. It involves getting the needs from the people or users who are going to use the system. Requirement definitions for actually client-oriented descriptions of what the application should look like and how different functionalities are required to be performed.

3.2 SOFTWARE REQUIREMENTS

- Operating System: Windows XP or higher
- JDK 1.7
- Any latest Applications server like Apache Tomcat
- Eclipse
- Open CV and Java CV

3.3 HARDWARE REQUIREMENTS

- Processor: Intel Pentium 4 or higher
- RAM: Min 512MB
- Hard Disk: 40GB

3.4 FUNCTIONAL REQUIREMENTS

The proposed system must be able to provide the following functionalities:

- The algorithm should categorize each road into appropriate density ranges by executing image segmentation algorithm.
- The duration of green light should be based on the configuration parameter values entered by the admin.
- Detecting the motion in a video source, trimming it off, and storing it in a separate file in the file system whose path will be provided by the end users.

3.5 NON FUNCTIONAL REQUIREMENTS

Economic analysis is the most frequently used method for evaluating the effectiveness of a system. More commonly known as cost/ benefit analysis, the procedure is to determine the benefits and savings that are expected from a system and compare them with costs. If the benefits outweigh costs, then the decision is made to design and implement the system. Otherwise, further justification or alterations in the proposed system will have to be made if it is to have a chance of being approved. This ongoing effort improves in accuracy at each phase of the system lifecycle.

- Behavioral feasibility

People are inherently resistant to change, and computers have been known to facilitate change. It is understandable that the introduction of a system requires special effort to educate and sell the software.

- Reliability

This software does not have any interface problems and it is more reliable. The system must provide highest possible accuracy.

- Portability

The software shall work on windows based platforms such as windows 7, windows 8.1 and above.

All tools that are used here are cost free and open source with open standard.

- Should be easier to access it from the various browsers available
- Response time of the applications should reflect the real time observations

- The algorithm should never fail in any of the test cases
- Should provide an efficient UI for the customers

This chapter discusses the various requirements of STSMS. The user requirements, software requirements, hardware requirements, along with the functional and non-functional requirements are enumerated.

CHAPTER 4

COST ESTIMATION

The tool used for cost estimation of the proposed system is Program Evaluation and Review Technique (PERT).

4.1 Description of the tool/method used for cost estimation of the project

PERT is a statistical tool, and these days is widely used in projects where usually no historical records are available to be reviewed. PERT methodology is used mainly on very large and complex project where time is a more important factor than the cost. PERT is mainly used in research type projects where you cannot predict the time duration of any activity accurately; therefore, you have to plan your work based on the milestones.

The critical path method is a deterministic model where you use a fixed time estimate for activities. CPM helps you run the project efficiently if the time estimates are definitive; however, if there is a variation in time estimate, it may affect your project badly. The solution to this drawback of CPM method is built into the PERT methodology, which helps you complete project successfully with less cost and time.

Since there is an uncertainty in the duration of an activity, you will use three estimates to determine the PERT estimate for an activity so that the uncertainty in the activity completion time can be reduced. These three estimates are as follows:

- Most Likely Estimate
- Optimistic Estimate
- Pessimistic Estimate

Most Likely Estimate (T_m)

This is the time duration where there is a high probability of completing the task within the given time duration.

Optimistic Estimate (T_o)

In this scenario, the estimate is determined considering all favorable conditions; i.e. it is a best case scenario. In other words, you can say that this is the shortest time in which you may complete the task.

Pessimistic Estimate (T_p)

Here, estimate is determined considering all un-favorable conditions; i.e. worst case scenario. In other words, this is the longest time the activity might require to complete itself.

The formula to calculate the PERT is as follows:

PERT Estimate = $(T_o + 4T_m + T_p)/6$ ---(1)

and,

Standard Deviation = $(T_p – T_o)/6$ ---(2)

The two formulas above are very important from a PMP Exam point of view, as you may see few questions based on these formulas.

4.2 Cost Estimation

To determine the PERT estimate, we need Optimistic Time, Pessimistic Time and Most Likely Time for the activity.

In the proposed system it is most likely that the task can be completed in 50 days, hence: Most Likely Time = 50 days

It further says that in the worst case it may take 60 days, hence: Pessimistic Time = 60 days

It also says that if all conditions are favourable, it will take 40 days to complete the task.

Hence:
Optimistic Time = 40 days

Now,

PERT Estimate = [Optimistic Time + 4X(Most Likely Time) + Pessimistic Time]/6

= [40 + 4X50 + 60]/6

= [40 + 200 + 60]/6

= 300/6

= 50 days

Hence, PERT estimate for this activity is 50 days.

Standard Deviation = (Pessimistic Time – Optimistic Optimistic)/6

= (60 – 40)/6

= 20/6

= 3.33 days

Hence, the Standard Deviation is 3.33 days.

The overall cost estimation and the total number of days required to carry out the proposed work has been discussed in detail this chapter.

CHAPTER 5

SYSTEM DESIGN AND DEVELOPMENT

In this chapter, the overall architectural design of STSMS followed by detailed design discussion and the sequence diagrams developed are discussed.

5.1 ARCHITECTURAL DESIGN

A general block diagram describing the activities performed by this project is shown in figure 5.1. The entire architecture diagram can be divided into following divisions as shown in figure 5.1.

1. Data Access Layer
2. Account Operations
3. Control Center
4. Configuration center
5. Refresh System

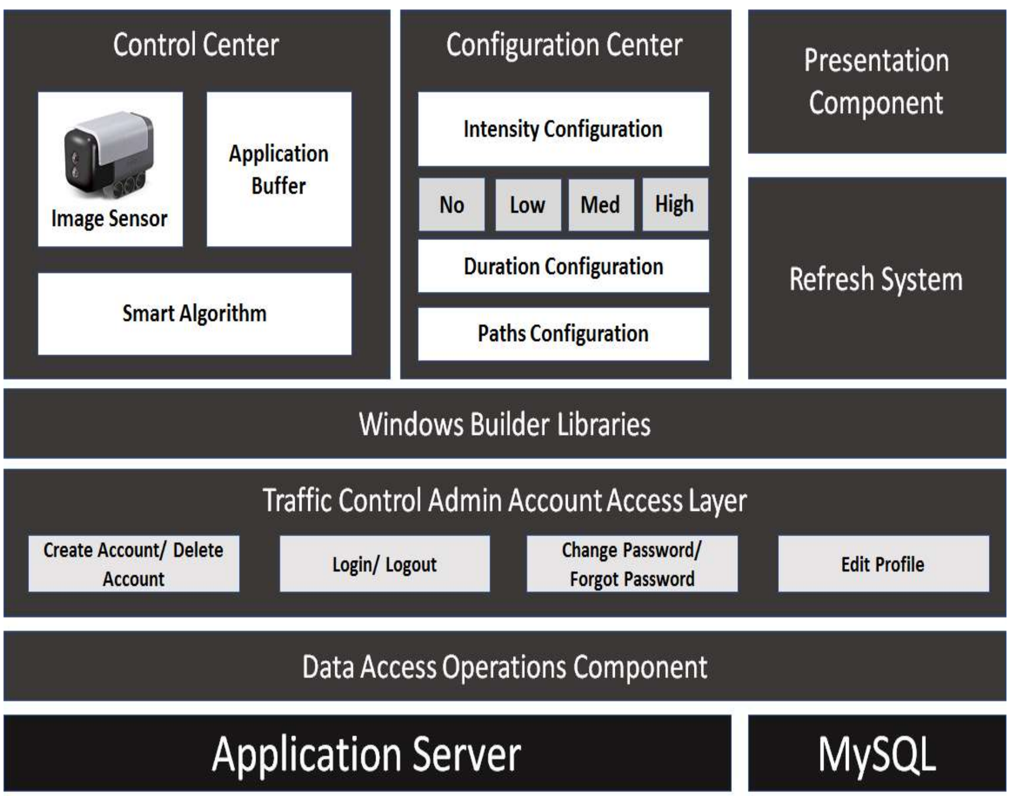

Figure 5.1 Architectural design of entire system

5.2 SEQUENCE DIAGRAM

A sequence diagram in a Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It shows the participants in an interaction and the sequence of messages among them, each participant is assigned a column in a table.

This system involves user as an actor as shown in the fig.5.2 who can access the account in order to edit, modify or delete an account. When the user enters the login credentials, the DAO layer verifies the entered credentials with the account details stored in the database. After successful login user will run control system, which takes image from the application buffer of roads. It then validates the images and runs the smart algorithm to give the density of each lane. The user specifies the range for each lane based on the obtained densities. The duration will be decided based on the range of path configuration. This process continues again in the refresh system.

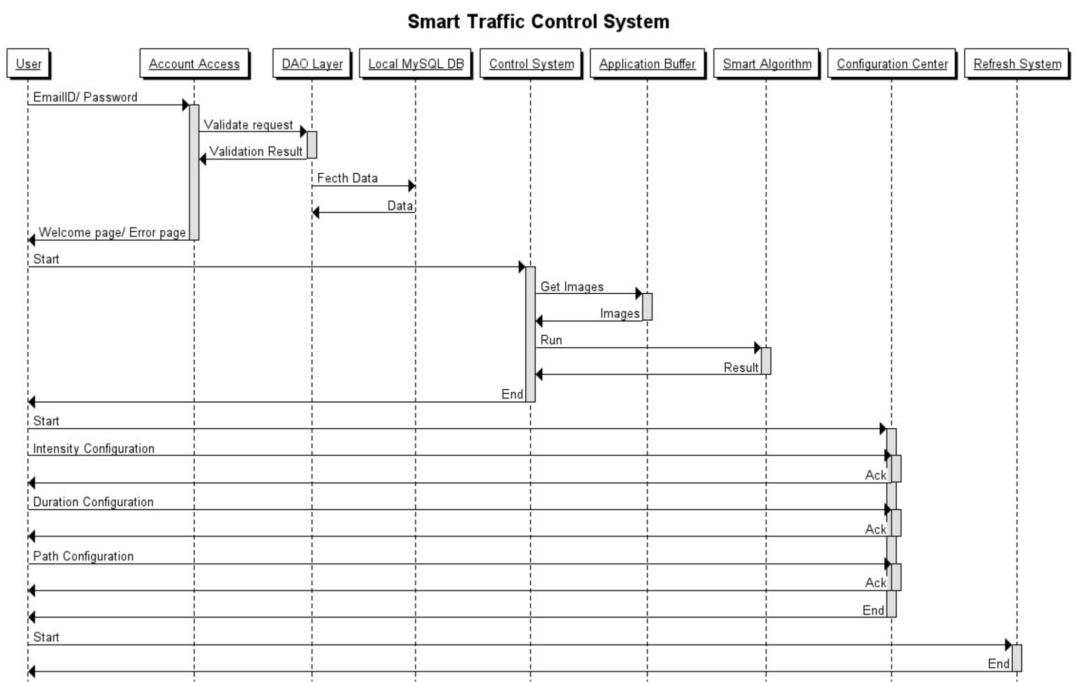

Figure 5.2 Sequence Diagram

6.3 DATA FLOW DIAGRAM

A data flow diagram is the graphical representation of the flow of data through an information system. DFD is very useful in understanding a system and can be efficiently used during analysis.

A DFD shows the flow of data through a system. It views a system as a function that transforms the inputs into desired outputs. Any complex systems will not perform this transformation in a single step and a data will typically undergo a series of transformations before it becomes the output.

With a data flow diagram, users are able to visualize how the system will operate that the system will accomplish and how the system will be implemented, old system data flow diagrams can be drawn up and compared with a new systems data flow diagram to draw comparisons to implement a more efficient systems. Data flow diagrams can be used to provide the end user with a physical idea of where the data they input, ultimately as an effect upon the structure of the whole system.

Level 0 DFD:

DFD Level 0 is also called a Context Diagram as shown in Figure 5.3. It's a basic overview of the whole system or process being analyzed or modelled. The user input the data into the user interface which is the image of a lane for which the intensity value has to be calculated. The green signal duration for the input image is assigned based on the calculated intensity value.

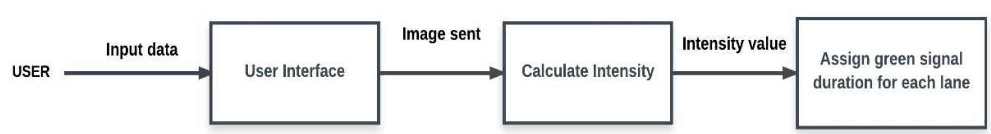

Figure 5.3 Level 0 DFD

Level 1 DFD:

The level 1 DFD highlights the functions carried out in calculating the intensity. The input image is first converted into a grey scale image the same image is the converted into a threshold image for appropriate threshold values. The number of black pixels will be the value of intensity.

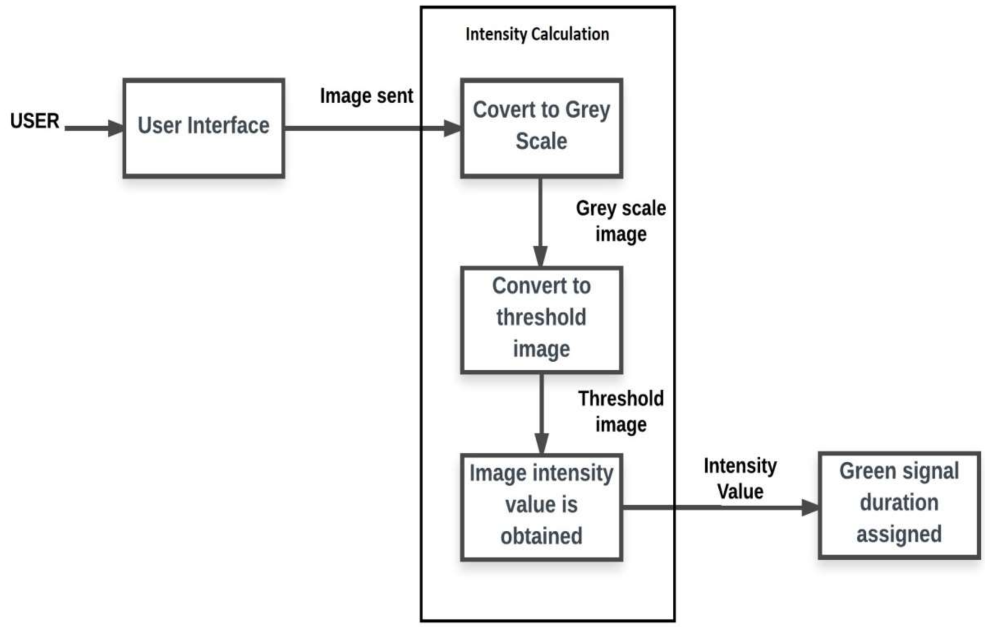

Figure 5.4 Level 1 DFD

5.4 USE CASE DIAGRAM

The external objects that interact directly with the system are called ***actors.*** Actors include humans, external devices and other software systems. The important thing about actors is that they are not under control of the application. In this project, user of the system is the actor.

In reference to the use case given in fig.6.5, the various actors involved are: Users and System. With reference to the users, the use cases are:

- The user first needs to create an account. This includes mainly creating a new account or deleting an existing account or editing an account. After creating the account, the user can login or logout.
- User can access the Control Center, in which he has to upload images of four different roads.
- In the Configuration center, traffic control admin is allowed to configure various parameters like intensity configuration and green light duration configuration.
- User has access to refresh system where he can refresh the system to update the change in traffic.

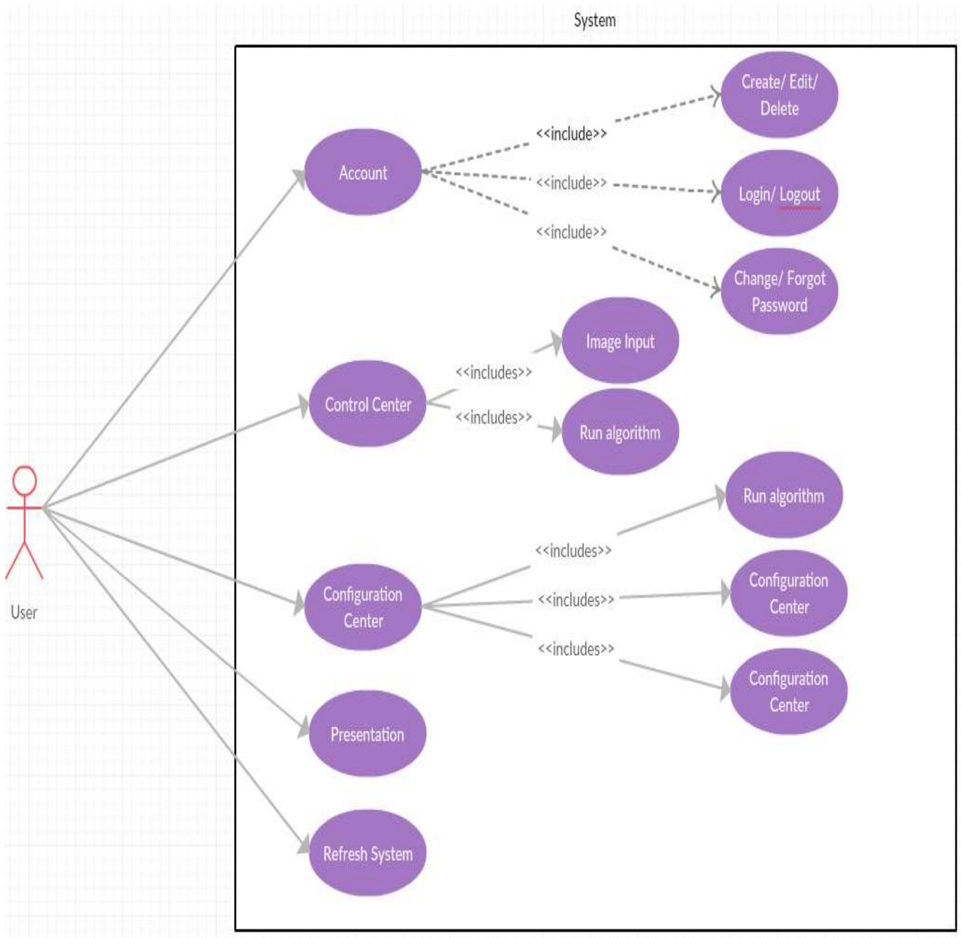

Figure 5.5 Use Case Diagram

CHAPTER 6

IMPLEMENTATION

The process of putting the plan into effect is called Implementation. The project has been implemented by dividing the entire project into three modules.

6.1 LIST OF MODULES

1. Account Operations
2. Control Center
3. Configuration center
4. Refresh System

6.2 MODULE DESCRIPTION

The description of the various modules used in the implementation of the smart traffic control system has been explained here.

6.2.1 Account Operations

This module provides the following functionalities to the end users of our project.

- Register a new admin account
- Login to an existing account
- Logout from the session
- Edit the existing Profile
- Change Password for security issues
- Forgot Password and receive the current password over an email
- Delete an existing Account

Account operations module will be re-using the DAO layer to provide the above functionalities.

6.2.2 DAO Layer

The DAO layer is the service layer which provides database CRUD (create, update, read, and delete) services to the other layers.

It will contain the POJO classes to map the database tables into java object. It will also contain the until classes to manage the database connections.

DAO is the access layer to DB tables. The Java Data Access Object (Java DAO) is an important component in business applications. Business applications almost always need access to data from relational or object databases and the Java platform offers many techniques for accessing this data.

Data in the database is meant to be accessed by any of the component within the application. So if you have N number of application components which would require database access, previously we would have written the logic to access the data in each of these components, thus ending up duplicating the data.

DAO layer comes as solution to this problem by providing the layer which can be used by any component within the application for accessing the database. Accessing the database technically meant to read, write, update and delete the data.

Thus, we can define the DAO layer formally as the data access layer which provides the data from the database to the outside world, and injects the data from outside world to the database.

For each table in the database, we need to create three java source files. One being the Java Bean for the table which is nothing but the mapping from database table to the java class, another being the interface file which provides the access functions, and the last one will be the implementation file which defines the access functions.

6.2.3 Control Center

Here, the user can launch the control center which will contain two sub components: Application Buffer and the Smart Algorithm. The application buffer will contain the traffic images from all the roads. Typically, these images will be provided by the image sensors deployed on to the roads. The smart algorithm will contain the implementation of the image segmentation algorithm to find out the density of the traffic on each of the images inputted into the application buffers by the image sensors. Because of the limitations in the hardware, we are going to provide the image input into the application buffer manually from our local disks.

6.2.4 Configuration center

The configuration center of this project allows the traffic control admin to configure various parameters that will be used in our algorithm. Various configurable parameters in this project are as follows: Intensity configuration and Green light duration configuration. Through the intensity configuration, the admin of this project can define the intensity ranges for low, high, and medium categories. Through the Green light duration configuration, the admin of this project can define the duration of green light for low, medium, high, and no intensity traffic roads.

Pseudocode to calculate the intensity

The table 6.1 gives the Pseudo code for calculating the intensity value for an input 32 bit image.

Table 6.1 Pseudocode for intensity calculation

Algorithm for Image segmentation

Input: 32 bit image

Output: Intensity value

Step 1: Capture Image and get width and height

Step 2: Create a temporary image with the same dimensions of captured Image

Step 3: Extract the values of Red, Green & Blue separately for each pixel.

Step 4: Convert image to grayscale using Equation

int y = (int) ((0.299*red) + (0.587*green) + (0.114*blue));

Step 5: If the new RGB value is greater than 50 and Less than 220 change the RGB value to White

Else

change the RGB value to Black

Step 6: Store and save the information in a temporary image

Step 7: If the adjacent pixel of any black pixel is white,

then, change it to white

Else

Retain

Step 8: Save the image

Step 9: Count Intensity based on number of black pixels in the image.

6.2.5 Refresh System

This module will be helpful particularly when the intensity of the traffic roads keeps changing drastically. Through this module, the admin of the project can re-run the smart algorithm, thus re-assigning the traffic roads into new intensity category and thereby dynamically updating the duration of green light for each of the roads.

In this chapter, all the modules of the project and working of those modules has been explained briefly.

CHAPTER 7

TESTING AND VALIDATION

Testing is a very important phase of development. Testing is a process used to identify the correctness, completeness and quality of developed computer software. The purpose of testing is to discover errors. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the software system meets its requirements and user expectations and does not fail in an unacceptable manner. The system has been verified and validated by running the test data and live data.

7.1 TESTING PROCESS

Software testing is critical element of software quality assurance and represents the ultimate review of the design and coding in a software development project. Errors can be introduced at any stage during the development. After checking and correcting the errors at every stage there may still be some errors left, these errors will be reflected in the code. The code is often the only product that can be executed and whose actual behavior can be observed. Hence testing performs a critical role for quality assurance and ensuring the reliability of the software.

During testing the program to be tested is executed with a set of test cases and the output of the program is evaluated to determine, if the program is performing as expected. For testing the objective should be to design a test that systematically uncovers different classes of errors and to do so with minimum amount of time and effort. Testing is carried out during the implementation phase to verify that the software behaves as intended by its designer and after implementation phase is complete. This later testing phase checks confirmation with the requirements access the reliability of the system. The types of testing that can be used are:

- **Unit testing** that involves the design test cases that validate that the internal program logic is functioning properly, it is testing of individual component
- **Integration testing** is designed to test integrated software components to determine if actually the program runs as one

- **Functional testing** provides systematic demonstrations that functions tested are available as specified by the technical requirements, system documentation and users manuals.
- **System test** ensures that the entire integrated software system meets requirements.
- **White box testing** is a testing in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose.
- **Black box testing** is testing the software without any knowledge of inner workings, structure or language of the module being tested

because the isolation of errors is complicated by vast expanse of the entire program.

7.2 TEST CASES AND VALIDATION

The test various cases for the Smart Traffic Signal Management system is as shown in the Table 7.1

Table 7.1 Test Cases

Test Case No.	Description	Input	Output	Status
1.	Intensity of the input images is calculated and is compared with the intensity of the other lanes and then given preference.	 **Lane A=High**  **Lane B=Medium**	Image A is given more preference because it has the highest intensity among A, B, C, D so the signal changes to green for A.	Green Signal for image A

		 **Lane C=Low**  **Lane D=No**		
2.	Intensity of the input images is calculated and is compared with the intensity of the other lanes and then given preference.	 **Lane A=High**  **Lane B=High**	If two images have the same intensity then the first image is given more preference.	Green light for the first image A

		 **Lane C=Medium**  **Lane D=Low**		
3.	Intensity of the input images is calculated and is compared with the intensity of the other lanes and then given preference.	 **Lane A=No**  **Lane B=No**	If there are no vehicles in any of the lanes then the intensity is zero. So a default value of 10s is assigned	Each lane gets green light for 10s.

		 **Lane C=No**  **Lane D=No**		

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		 **Lane C=Low**  **Lane D=No**		
2.	Intensity of the input images is calculated and is compared with the intensity of the other lanes and then given preference.	 **Lane A=High**  **Lane B=High**	If two images have the same intensity then the first image is given more preference.	Green light for the first image A

		 **Lane C=Medium**  **Lane D=Low**		
3.	Intensity of the input images is calculated and is compared with the intensity of the other lanes and then given preference.	 **Lane A=No**  **Lane B=No**	If there are no vehicles in any of the lanes then the intensity is zero. So a default value of 10s is assigned	Each lane gets green light for 10s.

		 **Lane C=No**  **Lane D=No**		

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		 **Lane C=Low**  **Lane D=No**		
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		 **Lane C=Medium**  **Lane D=Low**		
3.	Intensity of the input images is calculated and is compared with the intensity of the other lanes and then given preference.	 **Lane A=No**  **Lane B=No**	If there are no vehicles in any of the lanes then the intensity is zero. So a default value of 10s is assigned	Each lane gets green light for 10s.

		 **Lane C=No**  **Lane D=No**		

7.3 DIFFERENT TYPES OF TEST DONE

The different types of testing carried out are unit testing and integration testing.

7.3.1 Unit testing

Here each module that comprises the overall system is tested individually. Unit testing focuses testing focuses verification efforts even in the smallest unit of design in each module. This is also known as Module Testing. The modules of the system are tested separately. This testing is carried out in programming style itself. Unit testing exercises specific paths in the module's control structure to ensure complete coverage and maximum error detection. This test focuses on each module individually, ensuring that it functions properly as a unit. Hence, it is named as Unit Testing.

7.3.2 Integration testing

Data can be lost across interface. One module can have an adverse effect on another. Sub functions when combined, should not reduce the desired major function. Integration testing is a systematic technique for constructing the program structure. It addresses the issues associated with the dual problems of verification and program structure. The main objective of this testing process is to test the unit-tested modules and build a program structure that has been dictated by design. After the software has been integrate, a set of high order tests are conducted. All the modules are combined and tested as a whole.

This chapter describes the different levels of testing and the types of tests done. It also contains the various test cases carried out for validating the proposed system.

CHAPTER 8

RESULTS AND DISCUSSIONS

The results of the SMARF system and the observations made from it are discussed in this chapter.

8.1 SNAPSHOTS OF STSMS APPLICATION AND DESCRIPTION

8.1.1 Home page

The first screen is the Home page of the Smart Traffic Signal Management System which is as shown in figure 8.1.

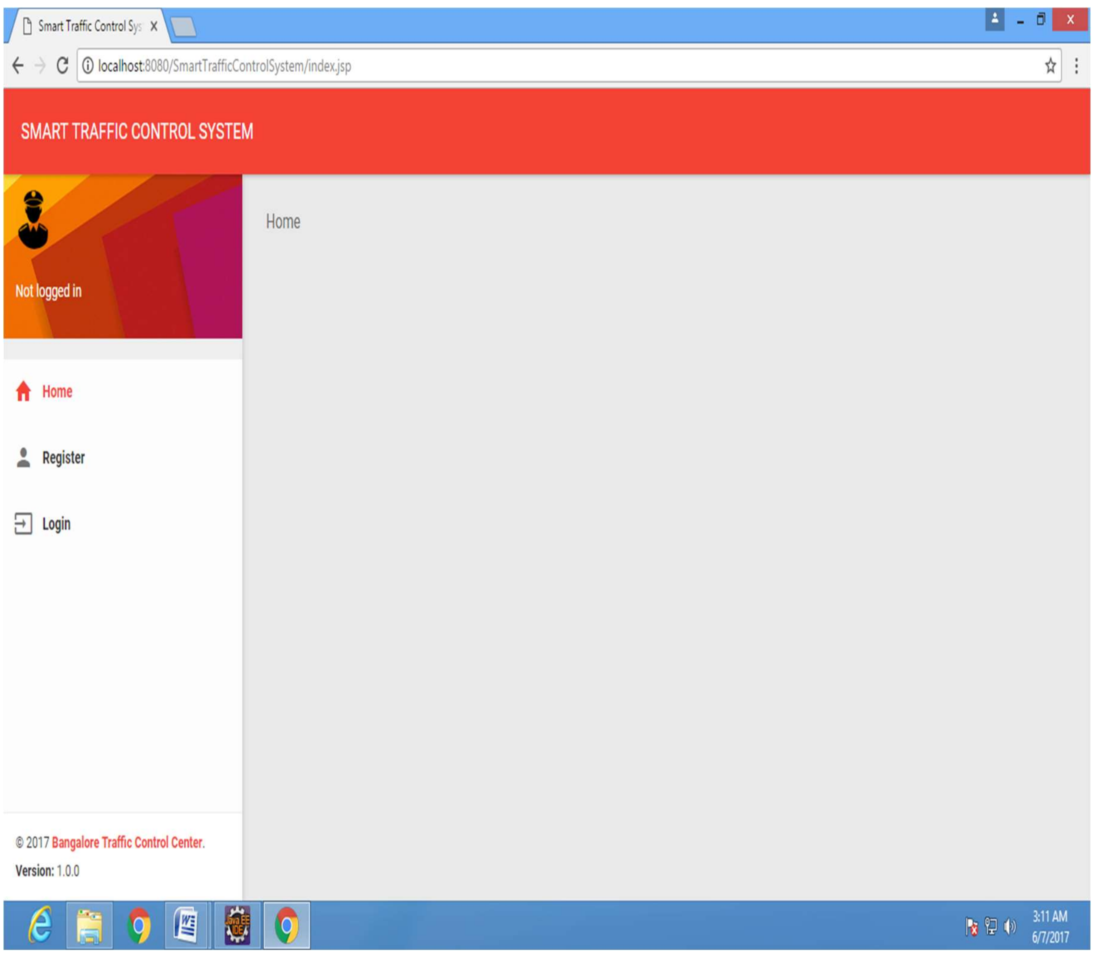

Figure 8.1.1. Home page

8.1.2 Register Interface

The next screen is the registration interface which requires the user to enter his/her personal details such as first name, last name, email ID, address mobile number and password in order to register successfully.

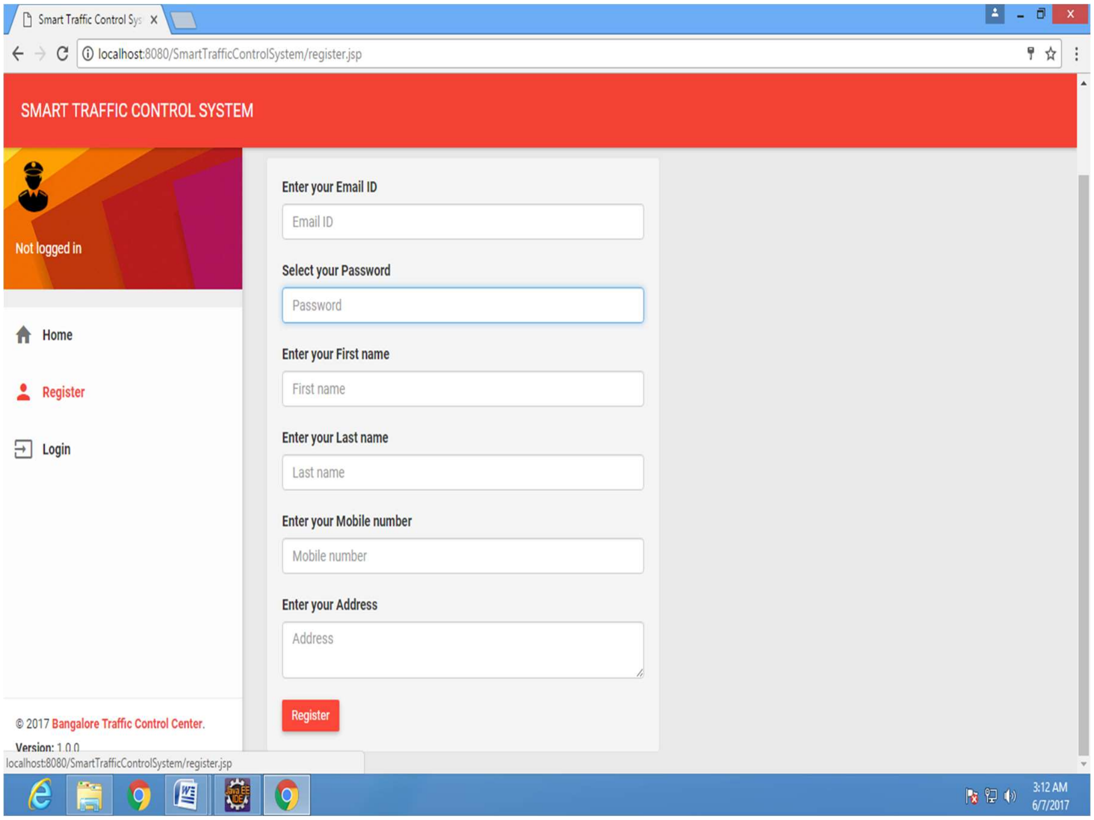

Figure 8.1.2. Register Page

8.1.3 Login Interface

After successful registration the user logins in using the registered email ID and password.

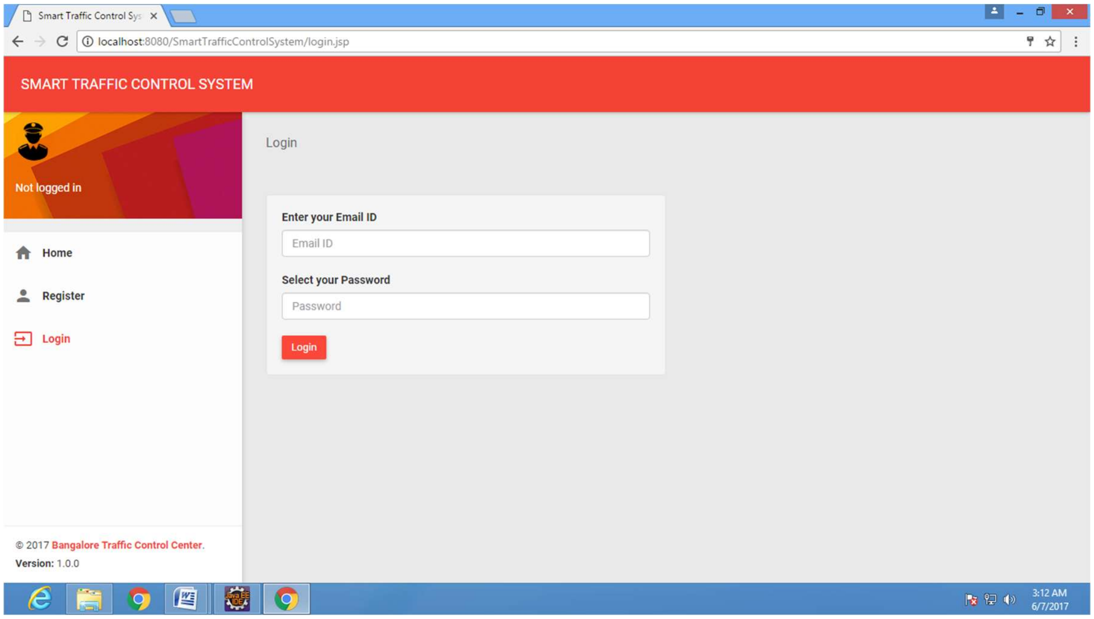

Figure 8.1.3. Login Page

8.1.4 Control Center Interface

The Control Center Interface is the main interface of the Smart Traffic Signal Management System where the user uploads the image of each lane for which the intensity value is calculated by the system. The user can also decide what intensity value determine the ranges of intensity- LOW, MID, HIGH and the duration of green signal to be assigned to each of the intensity range.

Figure 8.1.4. Control Center

8.1.5 Input Images

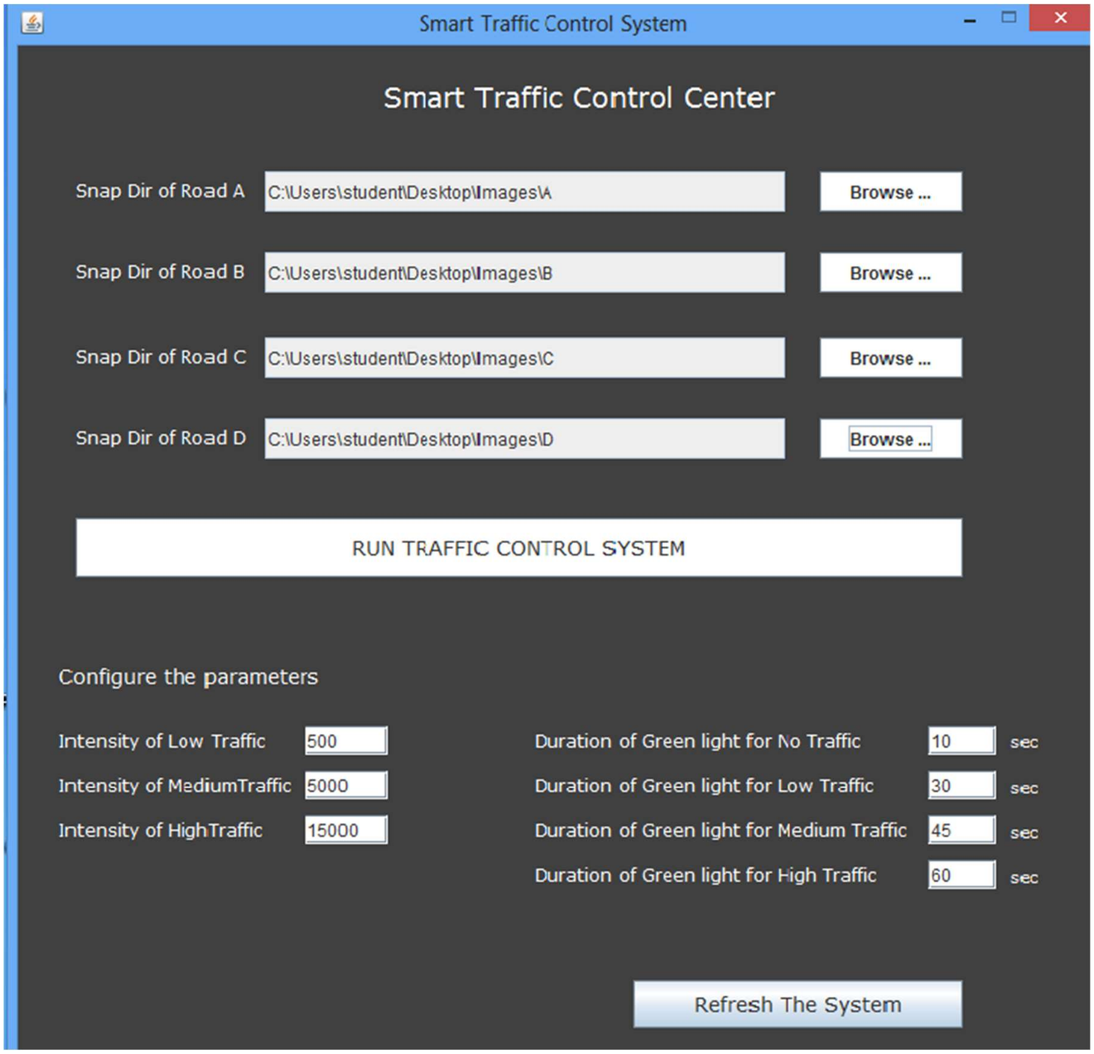

Figure 8.1.5. Input Images

8.1.6 Simulation Windows

Figure 8.1.6 Simulation Windows

Once the "Run Traffic Control System" button is pressed in the configuration center UI, four windows pop up representing each lane. The working of the project could be visualized in these screens.

CHAPTER 9

CONCLUSION AND FUTURE ENHANCEMENT

The proposed system adapts the traffic signal timer according to the random traffic density using image-processing techniques. This model uses high-resolution cameras to sense the changing traffic patterns around the traffic signal and manipulates the signal timer accordingly by triggering the signals to the timer control system. The increase and decrease in traffic congestion directly depends upon the control on the flow of traffic, and hence, on the traffic signal timer.

Eventually, traffic signals will not have to predict traffic flow at all. Instead, they will be able query the cars where they are going, and change plans accordingly. So-called vehicle-to-vehicle (V2V) communication uses dedicated short-range communication technology that lets cars "talk" to each other and to traffic signals.

A V2V-compatible signal could relieve congestion by prioritizing emergency vehicles, large groups of concertgoers, or a behind-schedule bus that is loaded with riders. It could also let drivers know which roads have the most green lights. According to the Department of Transportation, V2V compatibility could be standard on all new cars.

BIBLIOGRAPHY

[1] Mohammad Shahab Uddin Ayon Kumar Das, Md. Abu Taleb, “”Real-time Area Based Traffic Density Estimation by Image Processing for Traffic Signal Control System”, 2nd Int'l Conf. on Electrical Engineering and Information & Communication Technology (ICEEICT) 2015 Jahangirnagar University, Dhaka-1342, Bangladesh, 21-23 May 2015.

[2] Omkar Ramdas Gaikwad, Anil Vishwasrao, Prof. Kanchan Pujari, Tejas Talathi, ” Image Processing Based Traffic Light Control” , International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 4, 2014.

[3] Dr. Deborah D. Stine and Dr. Enes Hosgor , ”Smart Traffic Light”, May 2014.

[4] K.Vidhya, A.Bazila Banu, “Density Based Traffic Signal System”, International Journal of Innovaive Research in Science, Engineering and Technology ,Volume 3, Special Issue 3, March 2014.

[5] scienceabc.com- The History and Evolution Of Traffic Lights.

[6] W.Wen, Department of Information Management, “A dynamic and automatic traffic light control expert system solving the road congestion problem” ,Lang Hwa university of Science and Technology.

[7] Prashant Jadhav, Pratiksha Kelkar, Kunal Patil, Snehal Thorat,” Smart Traffic Control System using Image Processing”, International Research journal of Engineering and Technology (IRJET) Volume: 03 Issue: 03 | Mar-2016