Automated Traffic Control Signal

Submitted in partial fulfillment of the requirements
of the degree of

BACHELOR OF ENGINEERING

in

INFORMATION TECHNOLOGY

by

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University of Mumbai
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CERTIFICATE

This is to certify that the BE PROJECT entitled **"Automated Traffic Control Signal"** is a bonafide work of

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Submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **"BACHELOR of ENGINEERING"** in **"INFORMATION TECHNOLOGY"**.

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BE Project Report Approval

BE Project report entitled Automated Traffic Control Signal by

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Examiners

1.----------

2.----------

3.----------

Date:

Place: Mumbai

Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Date:

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Chapter 1
INTRODUCTION

Vehicular traffic density has always been a matter of care for administrative concern in many modern cities around the world. Several attempts have been made to design efficient automated systems to solve this problem. Most of the present systems use predetermined timing circuits to operate traffic signals, which are not very efficient because they do not operate according to the current volume of traffic at the crossing. To avoid this problem societies, use hardware sensors to monitor traffic status. These tools function well however, they have some limitations. One of these limitations is the high maintenance costs of these tools.

Google maps is a mapping service developed by Google that provides satellite imagery and real time traffic conditions (Google Traffic) that works by analysing the GPS-determined locations transmitted to Google by a large number of mobile phone users. By calculating the speed of users along a length of the road, Google is able to generate a live traffic map. Google processes the incoming raw data about mobile phone device locations, and then excludes anomalies such as postal vehicles which make frequent stops. When a threshold of users in a particular area is noted, the overlay along roads and highways on the Google map changes colour. The principle aim of this project is to design and develop an autonomous traffic control system. Real time traffic information is important for avoiding traffic congestion spots. It is often seen in today's automated traffic control systems that vehicles have to wait at a road crossing even though there is little or no traffic in the other direction. There are other problems as well, such as ambulances getting caught up by a red traffic signal and wasting valuable time. Congestion is often translated into lost time, missed opportunities, lost worker productivity, delivery delay, and a general increased cost.

It eliminates the need of a traffic police standing at the junction to control the traffic manually and relaying information to the next signal officer over radio. This automated system has more vision compared to the human traffic police officer to route traffic and can be easily updated real time over a large span of area.

1.1 Problem Statement

Traffic congestion is a main problem with foremost cities. In India the traffic lights are founded on a timing system i.e. whether the vehicles are present or not the timing will remain constant which makes people wait unnecessarily for a longer time. The key characteristic of the traffic in cities particularly for developing the geographies is that even if the geographies are explicitly mentioned/marked on the roads it doesn't move through the lanes. The lanes with more traffic tolerate more waiting time [2]. The lanes with less traffic often get the green signal. We here propose a density based traffic signal scheduling algorithm. The system is designed to manage traffic signal timings based on the density of traffic on its corresponding road. The system represents the traffic strength of a road graphically using traffic judgments. By measuring the traffic lined up on a particular road the signal timings are adjusted to let that particular way clear out and then the next populated one. The entire system works according to an algorithm that allows for smooth and efficient traffic flow across all four ways. It also consists of an emergency override that allows traffic authorities to remotely let go a particular signal in case an ambulance or important vehicle arrives on that way [3].

1.2 Aims and Objectives

The principle aim of this project is to design and develop an autonomous traffic control system. Real time traffic information is important for avoiding traffic congestion spots.

The existing studies based on Internet Traffic Analysis Concepts that use machine learning to route the internet traffic have shown greater efficiency and better management when paralleled to the real time application to vehicle traffic management and automation.[1]

Objectives:

- Automation of current traffic control signals and make the traffic signal timings dynamic instead of being a fixed static value for different routes.

- Ensure efficient routing of traffic to minimize congestion and time wasted by vehicles at the respective traffic signal junctions.

- Provide better routing to emergency services like ambulance and fire brigade which usually cannot reach the destination at the right time due to vehicle congestion.

- Classify the routes based on the colour scheme given by Google Traffic and determine the time period for every traffic signal to be green or red allowing or stopping traffic (respectively).

- Provide the option of manually re-routing traffic by administrator for emergency services or government use.

- The system determines whether manual rerouting is feasible and implements it if true.

1.3 Scope

The Project Scope pertains to the work necessary to deliver a product. The main goal of the project is to stop the unnecessary delays caused by the static traffic signals which are causing enormous amounts of fuel and result in poor management of real time traffic.

In our project, we will be using satellite maps to know the traffic status on a road. The traffic signals on the roads will dynamically change instead of having a fixed timer, road junction signals that have less or no traffic will become red and the traffic signals on the roads with more traffic will be turned to green dynamically, depending on the present vehicle density of that route.

This automated system can also be used by administrators to control and redirect the traffic as needed if considered feasible by the system.

Chapter 2
LITERATURE SURVEY

Traffic congestion is a main problem with foremost cities. In India the traffic lights are founded on a timing system i.e. whether the vehicles are present or not the timing will remain constant which makes people wait unnecessarily for longer time. The key characteristic of the traffic in cities particularly for developing the geographies is that even if the geographies are explicitly mentioned/marked on the roads it doesn't move through the lanes. The lanes with more traffic tolerate more waiting time [2]. The lanes with less traffic often get the green signal. We here propose a density-based traffic signal scheduling algorithm.

The system is designed to manage traffic signal timings based on the density of traffic on its corresponding road. The system represents the traffic strength of a road graphically using traffic judgments. By measuring the traffic lined up on a particular road the signal timings are adjusted to let that particular way clear out and then the next populated one. The entire system works according to an algorithm that allows for smooth and efficient traffic flow across all four ways. It also consists of an emergency override that allows traffic authorities to remotely let go a particular signal in case an ambulance or important vehicle arrives on that way [3].

2.1 Existing Solution

In India, no such solution has yet been implemented. But there are some similar implementations around the world.

For example, let's take the case of the traffic systems in the United Kingdom developed and installed by ***"Auto Mate Systems Limited"***

Sr no.	Parameter	UK based system	Our system
1	MAPS	The system in UK uses cameras instead of MAPS to know the traffic status	Google maps are used to know the status of traffic on different routes
2	Supervision	Not supervised	Supervised
3	Recovery	In case of a system failure, the traffic signals stops working resulting in unsupervised traffic across the road	In case of a system failure, the supervisor can control the traffic signal in order to maintain the conduct of the traffic properly
4	Accuracy	Not very accurate because in cameras, the two wheelers are not visible properly and thus the system cannot detect them	As google maps uses the number of active mobile phones to detect the traffic in any area, the system is more accurate than the existing system

5	Time Allotted	As cameras are involved, the time allotted to each route will not be accurate or according to the traffic as it is difficult to detect the amount of traffic.	Because of the google maps, the exact amount of traffic is detected using satellite imagery and the time is allotted according to the algorithm which uses the percentage traffic per kilometre to allot the time to different routes.
6	Employment options	Due to completely unsupervised traffic systems, people are provided with less employment option	As the system is partially supervised, the employment options are open for people.

Table 2.2 Comparison of project model to existing solutions

These are a few points in which our system is different from the traffic systems in the UK.
This system was proposed in UK by a private firm named AUTOMATE SYSTEMS
The system was installed in different cities in UK.[4]

2.2 Domain Explanation

Data Extraction from Google Traffic API

Extracting data from the Google Traffic API is another module of this system which solely involves getting real traffic information for the Machine Learning module to train on and determine the time period for each traffic signal dynamically.

Google Traffic changes continuously with time based on the satellite imagery making it accurate and reliable information to determine the traffic density given at a particular time of the day, hence ensuring the traffic management automation is accurate and rational in deciding where to route the traffic.

Using satellite imagery for automation of traffic signals is a relatively new emerging research area. Most of the present systems use predetermined timing circuits to operate traffic signals, which are not very efficient because they do not operate according to the current volume of traffic at the crossing. To avoid this problem urban societies use hardware sensors like cameras, inductive loops and radars to monitor traffic status. These tools function well however, they have some limitations. One of these limitations is the high maintenance costs of these tools. [3]

On the other hand Google Traffic provides real time traffic status and is highly accurate to represent the current vehicle density on a particular route.

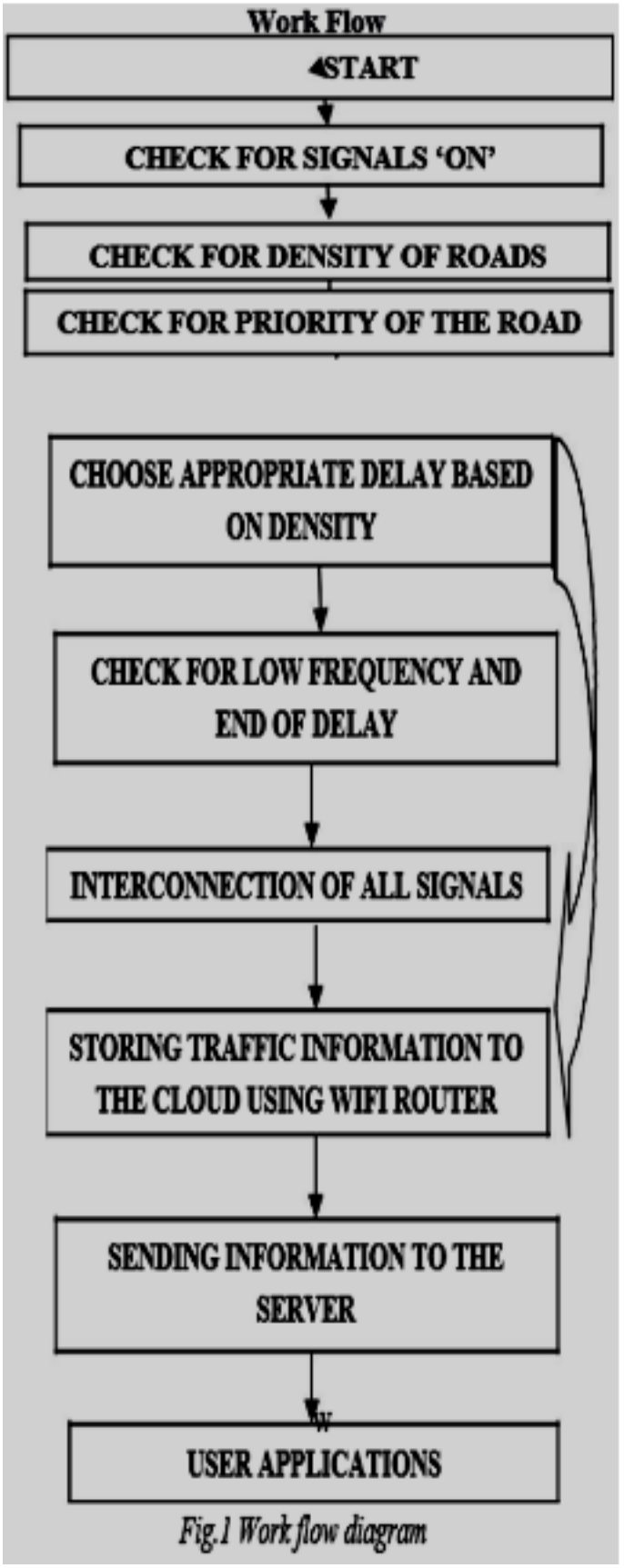


Figure 1. Workflow Diagram

2.3 Proposed Methodology

• Considering the anomalies in the existing system computerization of the whole activity is being suggested after initial analysis.

• The android application is developed using Android Studio with JAVA as a programming language.

• Proposed system is accessed by two entities namely, Admin and User.

• Admin need to login with their valid login credentials first in order to access the android application.

• After successful login, admin can access all the modules and manage each task accurately.

• Admin can perform tasks such as adding new lanes, delete unwanted lanes and update the existing lane.

• Admin will set the Default Timings for Signals, Number of Cars Manipulation on each lane and in emergency admin can control traffic signals manually.

• Users can check the traffic signal and traffic on google map.

The system is divided into 4 subsystems:

- Google Traffic Data Extraction
- User Android APP to view live traffic signal automation for every route
- Admin Android APP to manipulate live traffic signal automation
- Traffic Automation Module

User Android APP to view live traffic signal automation for every route

This subsystem is dealing with the front-end GUI of the project and displays the sample manually inputted information regarding the automation and management done by the Traffic Automation Module.

Admin Android APP to manipulate live traffic signal automation

This subsystem is dealing with the front-end GUI of the project and displays the Traffic Automation information regarding every lane and allows manipulation of the data for Manual control or fine tuning.

Traffic Automation Module

This consists of a module co-ordinating with the various APIs used in the project to store, analyse and process the traffic data from a SQL database. This module is split across the USER as well as the ADMIN android app.

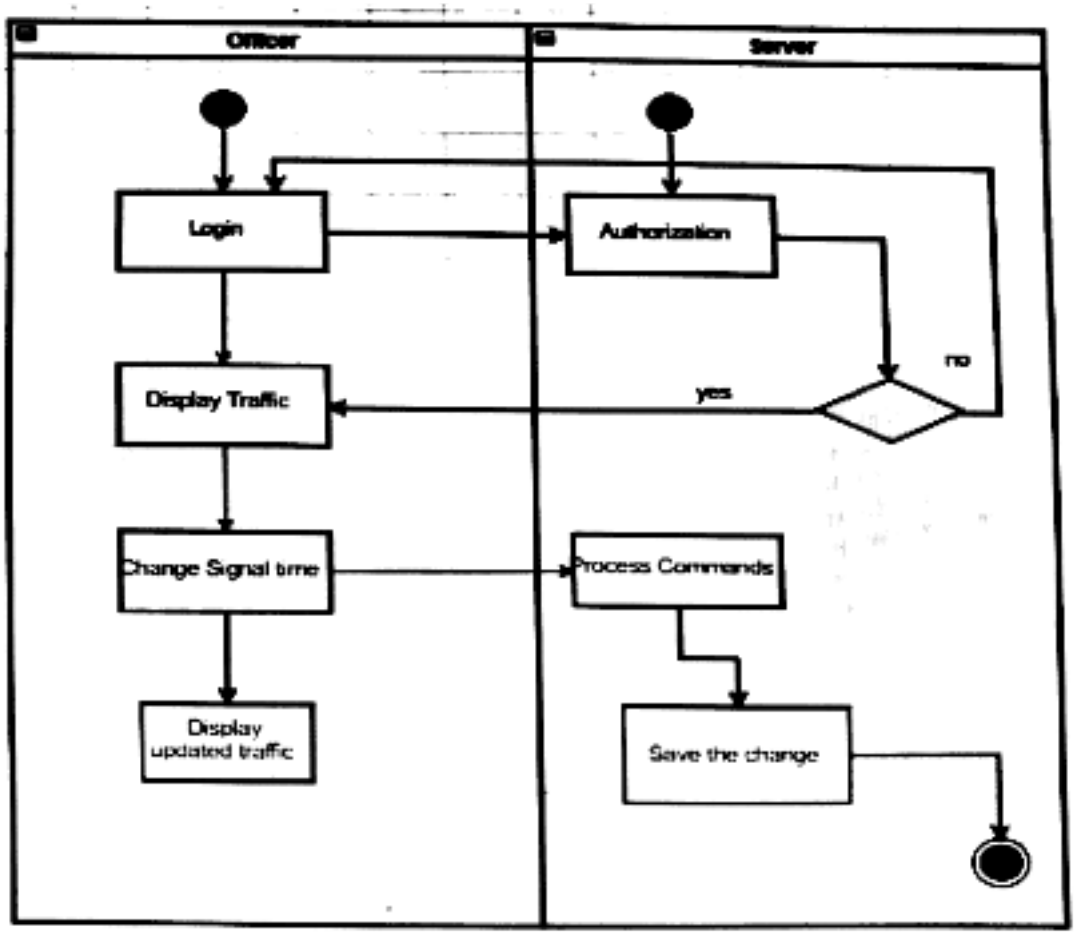


Figure 2. Activity Diagram (officer/admin giving inputs to system)

2.4 Hardware and Software Requirements

2.4.1. Recommended Hardware requirements

- Disk space: 200MB
- Android Device
- Internet Connection (min. 100KBps)

2.4.2. Recommended Software Requirements

- MySQL database system
- Android v5.0 or Higher

Chapter 3

DESIGN AND IMPLEMENTATION

3.1 Design Consideration

1. Android Studio

Android Studio is the official Integrated Development Environment (IDE) for Android app development, based on IntelliJ IDEA. On top of IntelliJ's powerful code editor and developer tools, Android Studio offers even more features that enhance your productivity when building Android apps.

2. Google Map API

The Maps JavaScript API lets you customize maps with your own content and imagery for display on web pages and mobile devices. The Maps JavaScript API features four basic map types (roadmap, satellite, hybrid, and terrain) which you can modify using layers and styles, controls and events, and various services and libraries.

3. XML

XML is a part of Android as Layouts for the application itself also XML makes it easier to express metadata in a portable, reusable format.

4. RESTful API

A RESTful API is an application program interface (API) that uses HTTP requests to GET, PUT, POST and DELETE data.

REST technology is generally preferred to the more robust Simple Object Access Protocol (SOAP) technology because REST leverages less bandwidth, making it more suitable for internet usage. An API for a website is code that allows two software programs to communicate with each other. The API spells out the proper way for a developer to write a program requesting services from an operating system or other application.

In Android you cannot directly connect to a Database which is on Server. You need a backend to support the Database calls. So here is a technique that we use called RESTFUL Services or RESTFUL API or Web Services.

3.2 Activity Diagram

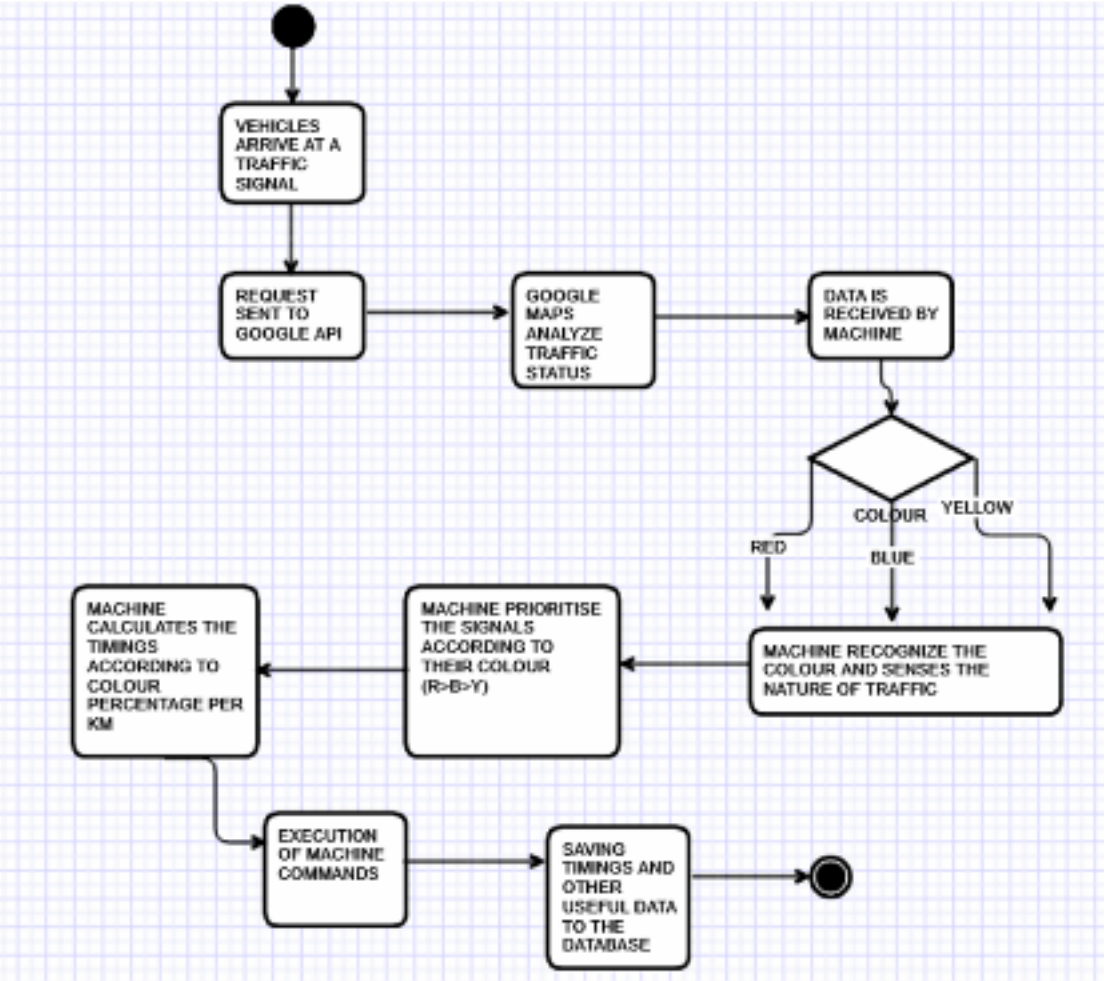


Figure 3. Activity Diagram of Entire System

Activity diagram: It represents the workflow of stepwise activities and action with support for choice. The diagram represents overall system activity flow from login activity up to the solution activity.

3.3 Implementation

Traffic Automation Module

Early versions of Google Maps relied only on data from traffic sensors, most of which were installed by government transportation agencies or private companies that specialize in compiling traffic data. Using radar, active infrared or laser radar technology, the sensors are able to detect the size and speed of passing vehicles and then wirelessly transmit that information to a server.

But here we are simply going to classify congestion on the road based on the number of cars in that congestion. The application will identify type of congestion (Red, Orange & Blue) using a classification algorithm.

In this basic classification Algorithm, we are going to classify congestion based on the number of cars in that congestion.

Blue Congestion – 0 to 10 cars

Orange Congestion – 11 to 20 cars

Red Congestion – 21 & above

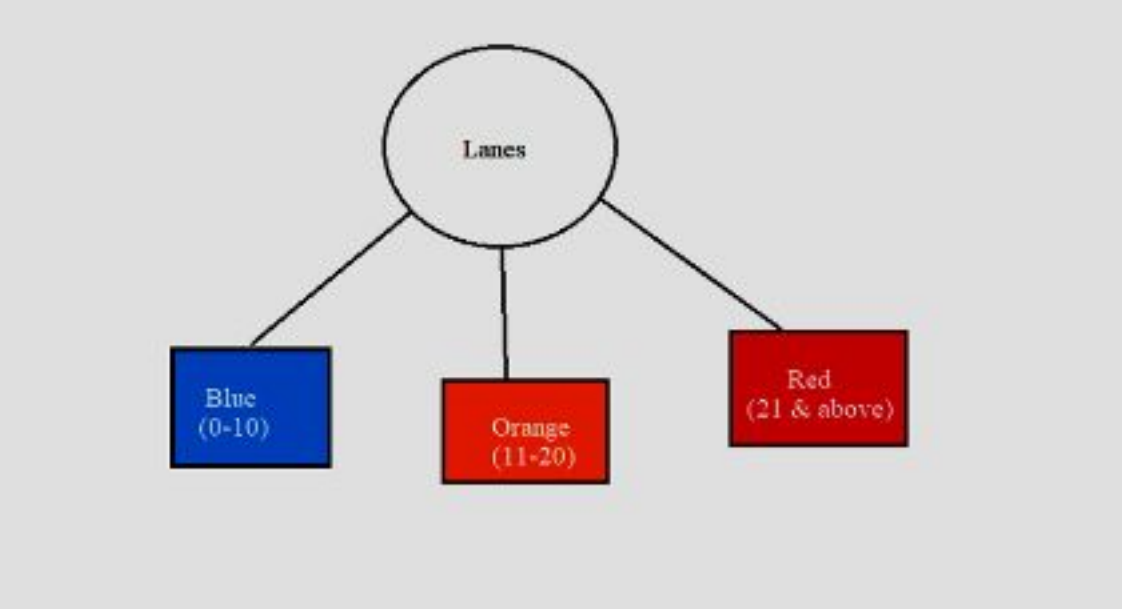


Figure 4. Traffic Layer Colour-Traffic Classification

Now the task is to convert the red lane into orange. We already know that the red lane has 21+ cars according to classifications. To convert it into orange lane, we need to reduce the number of cars below 21. To perform such action, we need to first assume that time taken by each car

to pass a signal is 5 seconds. Let ‘a’ be the variable that denotes a number of cars. Let ‘Ci’ be the current time of signal on that particular lane ‘Li’

Rule.

If (a>20)

Then do

B=a - 20

Break

*C= B*5;*

Cd= C - Ci;

Ci=Ci + Cd;

End

Example.

Let’s say lane L1 (Red lane) has 35 cars and C1=30sec

I.e. a=35.

Our goal is to convert that red lane into Orange.

Applying the Rule

B=35-20=15

So

C=15*5=75

Cd= C-C1=75-30= 45

C1= C1+Cd= 30 +45;

As the number of cars reduces to 20, the lane will become orange by increasing the traffic timings by 45 seconds.

For the priority of the lanes to open we have used Bubble Sort.

Bubble sort, sometimes referred to as **sinking sort**, is a simple sorting algorithm that repeatedly steps through the list, compares adjacent elements and swaps them if they are in the wrong order. The pass through the list is repeated until the list is sorted. The algorithm, which is a comparison sort, is named for the way smaller or larger elements "bubble" to the top of the list.

If the given array has to be sorted in ascending order, then bubble sort will start by comparing the first element of the array with the second element, if the first element is greater than the

second element, it will **swap** both the elements, and then move on to compare the second and the third element, and so on.

If we have total n elements, then we need to repeat this process for n-1 times.

Similarly, n is the number of lanes. The algorithm will run n-1 times. Depending on the number of cars inputted by the admin, the lanes will open and start releasing the cars.

The lane with the maximum number of cars will open first and so on and so forth. We have assumed each car will take 4 seconds to move out of the lane, so depending on the density of the lane, the signal will prioritise and open using Bubble sort.

Chapter 4

RESULTS AND EVALUATION

4.1 Feasibility Report

Feasibility Study is a high-level capsule version of the entire process intended to answer a number of questions like: What is the problem? Is there any feasible solution to the given problem? Is the problem even worth solving? Feasibility study is conducted once the problem is clearly understood. Feasibility study is necessary to determine that the proposed system is Feasible by considering the technical, Operational, and Economical factors. By having a detailed feasibility study the management will have a clear-cut view of the proposed system.
The following feasibilities are considered for the project in order to ensure that the project is variable and it does not have any major obstructions. Feasibility study encompasses the following things:

- Technical Feasibility
- Economic Feasibility
- Operational Feasibility

In this phase, we study the feasibility of all proposed systems, and pick the best feasible solution for the problem. The feasibility is studied based on three main factors as follows.

4.1.1 Technical Feasibility

In this step, we verify whether the proposed systems are technically feasible or not. i.e., all the technologies required to develop the system are available readily or not.

Technical Feasibility determines whether the organization has the technology and skills necessary to carry out the project and how this should be obtained. The system can be feasible because of the following grounds:

- Must determine whether it is worthwhile to process with the entire project or whether the benefits obtained from the new system are not worth the costs. Financial benefits must be equal or exceed the costs. In this issue, we should consider:
- The cost to necessary technology exists to develop the system.
    - This system is too flexible and it can be expanded further.
    - This system can give guarantees of accuracy, ease of use, reliability and data security.
    - This system can give instant responses to inquire.
    - Our project is technically feasible because all the technology needed for our project is readily available.
    - Operating System : Android v5.0 or Higher (For Android Devices)
    - Languages : JAVA, XML
    - Other tools : Android Studio, Google Maps API
    - Database System : MS-SQL Server
    - Documentation Tool : MS – Word

4.1.2 Economic Feasibility

Economically, this project is completely feasible because it requires no extra financial investment and with respect to time, it's completely possible to complete this project in 6 months.

- In this step, we verify which proposal is more economical. We compare the financial benefits of the new system with the investment. The new system is economically feasible only when the financial benefits are more than the investments and expenditure.
- Economic Feasibility determines whether the project goal can be within the resource limits allocated to it or not. It uct a full system investigation.
- The cost of h/w and s/w for the class of application being considered.
- The development tools.
- The cost of maintenance etc...
- Our project is economically feasible because the cost of development is very minimal when compared to financial benefits of the application.

4.1.3 Operational Feasibility

In this step, we verify different operational factors of the proposed systems like man-power, time etc., whichever solution uses less operational resources, is the best operationally feasible solution. The solution should also be operationally possible to implement. Operational Feasibility determines if the proposed system satisfied user objectives could be fitted into the current system operation.

- The methods of processing and presentation are completely accepted by the clients since they can meet all user requirements.
- The clients have been involved in the planning and development of the system.
- The proposed system will not cause any problem under any circumstances.
- Our project is operationally feasible because the time requirements and personnel requirements are satisfied. We are a team of four members and we worked on this project for three working months.

4.2 Working App GUI Screenshots

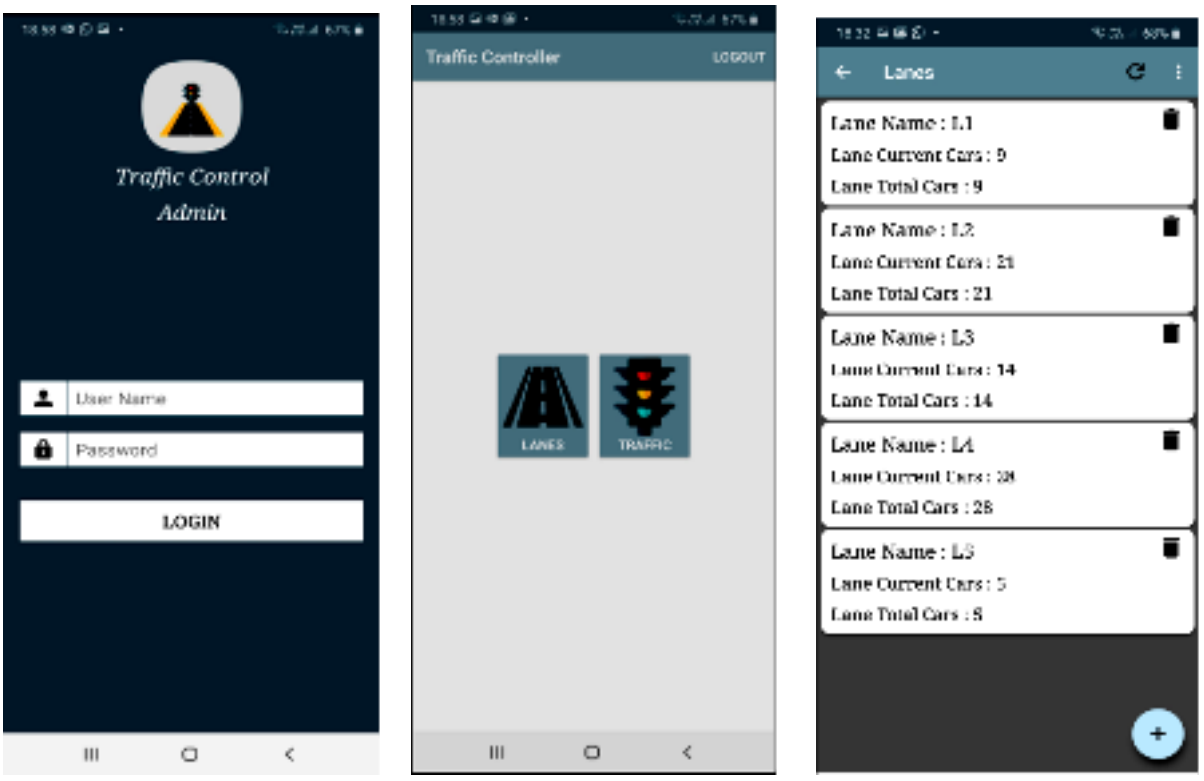
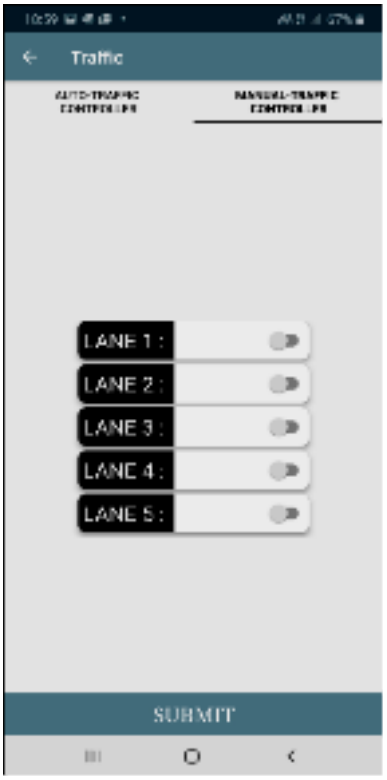
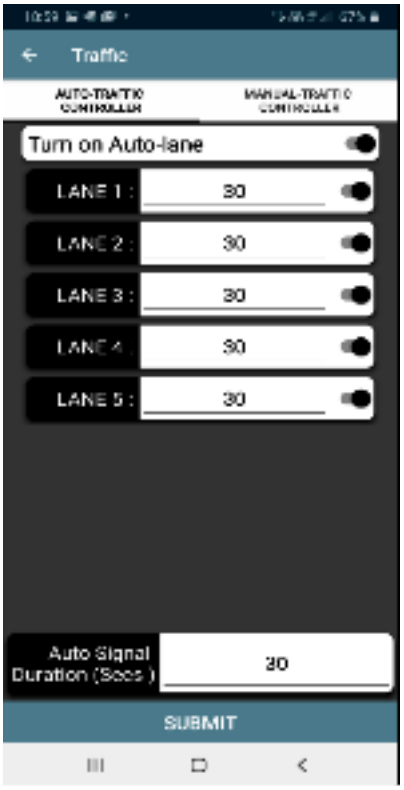


Figure 5 : Screenshots


ADD LANE
Name :
L1
No of Car :
Number Of Cars
SUBMIT
1
2
3
4
5
6
Done
7
8
9
.-
0
.


Traffic
LANE 1 :
LANE 2 :
LANE 3 :
LANE 4 :
LANE 5 :
SUBMIT


Traffic
Turn on Auto-lane
LANE 1 :
30
LANE 2 :
30
LANE 3 :
30
LANE 4 :
30
LANE 5 :
30
Auto Signal Duration (Secs) :
30
SUBMIT


Map
Lane Name : L4
No Of Cars : 28
Time(Sec) : 58
Type : Auto


Map
Lane Name : L2
No Of Cars : 21
Time(Sec) : 31
Type : Auto


Map
Lane Name : L4
No Of Cars : 18
Time(Sec) : 19
Type : Auto


Map
Lane Name : L3
No Of Cars : 14
Time(Sec) : 27
Type : Auto


Map
Lane Name : L4
No Of Cars : 13
Time(Sec) : 20
Type : Auto


Map
Lane Name : L2
No Of Cars : 13
Time(Sec) : 28
Type : Auto

Chapter 5

FUTURE SCOPE

With more access clearance to google maps API and GPS image data we can scale the project to a larger area coverage and also have more accurate data for input.

With the help of the Indian government this project can control and automate the traffic signals in real time with sensor inputs and dynamic traffic control could be established truly.

Also, this project if given more time to develop can be expanded to other services such as provision of optimal routes across two points on the map for example ambulances or fire brigades.

More data sets from the google API with unrestricted access would mean we could use it to make the signal automation more accurate without any assumptions of the car density.

Have more concurrency control measures to ensure that data across devices is consistent.

With more time and access to street layout from google maps and the government of India we could map more routes in our application and add more signals and expand the area considered.

Special situation cases like the ambulance stuck in heavy traffic can be solved.

An accident in the middle of a junction can act as another special case.

Chapter 6

CONCLUSION

In this report, we have presented a traffic system using machine learning. The system is built using Android Studio, JAVA, RESTful API, Google Map API and XML.

It is capable of fetching the traffic status directly from google maps, analysing the traffic status and providing a pass to the routes where the traffic is more.

The system is supervised by traffic police at every time to keep an eye on emergency cases which cannot be recognized by Google maps like an ambulance passing or a fire brigade truck passing the signal. Thus, the signal can be changed manually also.

The important data about the timings of the signal and traffic density is saved on the database.

We have integrated all this technology to present the traffic system using an Android Application.

Chapter 7

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