SMART TRAFFIC MANAGEMENT

A PROJECT REPORT

Submitted by

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200510116004

In fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

INFORMATION TECHNOLOGY

ALPHA COLLEGE OF ENGINEERING AND TECHNOLOGY,

GANDHINAGAR

Gujarat Technological University, Ahmedabad

April – 2024

Alpha College of Engineering and Technology, Gandhinagar

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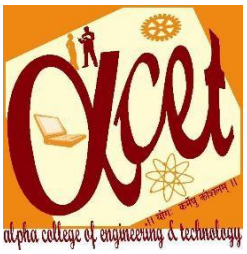
CERTIFICATE

This is to certify that the project report submitted along with the project entitled "**Smart Traffic Management"** been carried out by "**Patel Raj Alpeshkumar**" under my guidance in partial fulfillment for the degree of Bachelor of Engineering in **Department of Information Technology**, 8th Semester of Gujarat Technological University, Ahmedabad during the academic year 2023-24.

Prof. Vijay Prajapati
Internal Guide

Prof. Vijay Prajapati
Head of Department



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DECLARATION

We hereby declare that the Internship / Project report submitted along with the Internship / Project entitled **Smart Traffic Management** submitted in partial fulfillment for the degree of Bachelor of Engineering in **Information Technology** to Gujarat Technological University, Ahmedabad, is a bonafide record of original project work carried out by me at **Tusker AI** under the supervision of **Mr. Asit Pandit** and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

Name of the Student	Sign of Student
Raj Alpeshkumar Patel	_____

ACKNOWLEDGEMENT

I want to take a moment to express my gratitude to all the individuals and organizations who have contributed to this project. Without their kind support and cooperation, this project have not been possible.

I am particularly thankful to my mentor, **Mr. Asit Pandit** for their constant guidance and supervision, and for providing me with important project specifics. I also want to thank my friends and colleagues who started the conversation and contributed critical review input.

I am grateful to "**Alpha College of Engineering and Technology**" for providing me with all the resources I needed and a welcoming work environment. Additionally, I want to express my appreciation to the Head of the Department, **Prof. Vijay Prajapati** for their collaboration and support throughout my Endeavor.

With Sincere Regards

Raj Alpeshkumar Patel

ABSTRACT

Our project is based on traffic management. The current traffic control system in India are inefficient due to randomness in the traffic density pattern throughout the day. The traffic signal times have a fixed time period to switch traffic between different directions. Due to this, the vehicles have to wait for a long time even if the traffic density is less, so our project is on signal timer. If the traffic signal timer can be programmed to be manipulated with the continuously varying traffic density, the problem of traffic can be reduced to a lower level. The proposed system adapts the random traffic density using image processing technique. This model uses high resolution cameras to sense the changing traffic patterns.

Air pollution has a very negative impact on an individual's health and with the increasing vehicles; this problem is going to get worse. This reduction in time spent in the road will result in a decrease in the number of pollutants released by the cars and thus, reducing air pollution.

The system generally includes a network of cameras, sensors and other monitoring devices that capture real-time data on traffic conditions. This data is then analyzed using artificial intelligence algorithms to provide information on traffic flow, congestion, accidents etc. to traffic management authorities.

The system can also be used to implement real time traffic control measures such as dynamic traffic signal management, variable message signs to optimize traffic flow and reduce congestion.

Overall, a traffic management system provides valuable insights to transportation authorities to help them make informed decisions that improve safety, efficiency, and the overall transportation experience for commuters.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
AI-OPS	Artificial Intelligence for IT Operations
UI/UX	User Interface/User Experience
HTML	Hyper Text Markup Language
CSS	Cascading Style Sheet
YOLO	You Only Live Once
GUI	Graphical User Interface
WSGI	Web Server Gateway Interface
CCTV	Closed Circuit Television
XML	Extensible Markup Language
VOC	Visual Object Class Challenge
DBMS	Database Management System
VO	Value Object
DAO	Data Access Object
API	Application Programming Interface
OPENCV	Opensource Computer Vision Library

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CHAPTER 1 - OVERVIEW OF THE COMPANY

1.1 HISTORY

Tusker AI is an innovative web and mobile app Development Company since 2010 in India. We have specialization and expertise in developing Web and Mobile applications for organizations in various verticals Healthcare, Retail, Travel, Entertainment, Lifestyle, Social Networking and Education etc.

Company follows standard software development process. We are well known for on time delivery of high quality and secure products. We implement standard security protocols for software development.

Tusker AI is an innovative web and mobile app development company in India and USA that has specialization and expertise in developing Web and Mobile app for the organization in various verticals such as Retail, Travel, Construction and Entertainment Lifestyle, Social Networking and Education.

1.2 SCOPE OF WORK

We accelerate business verticals with agile vision at a global scale and deliver unprecedented milestones of results. We are a leading innovation-driven company providing diverse solutions in Healthcare, SMART-HOME, E-commerce, Offline app development, Voice-Solutions Construction & logistics, and much more.

Tusker AI is mix of skills and technologies that modify the world around us. The main motivation of our team is to develop applications those impress people for quality, convenience and functionalities in order to make them essential for their users.

1.3 ORGANIZATION CHART

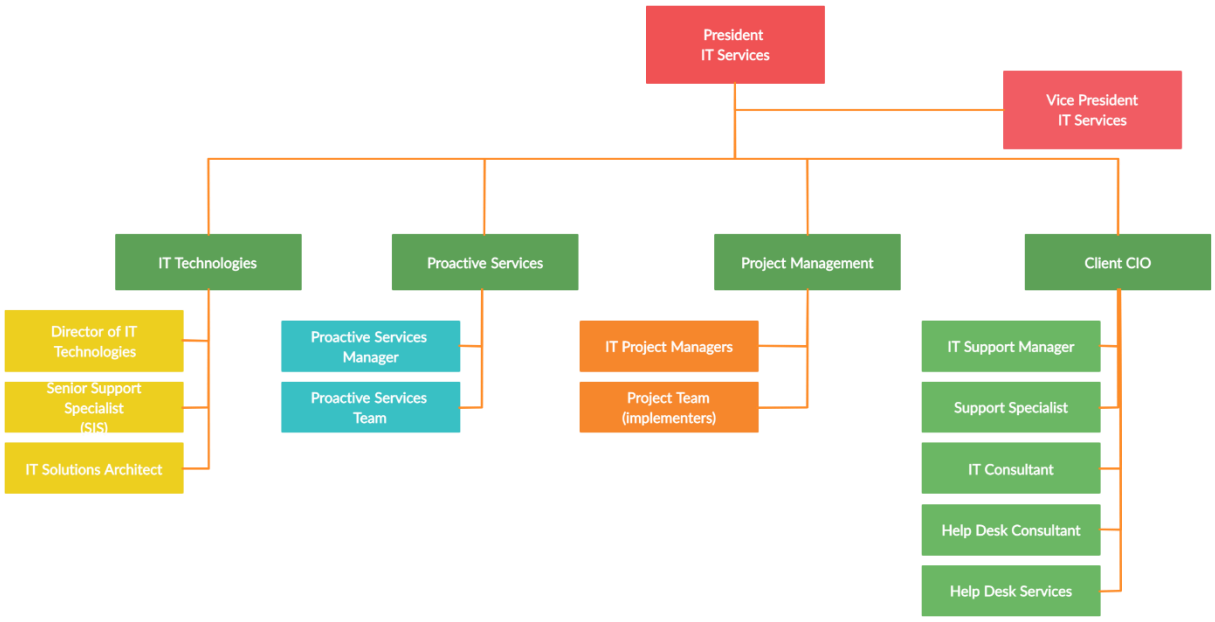


Fig 1.1 Organization Chart

1.4 Capacity Of Plant

Tusker AI that has been in business in software development for the past 10 years headquartered in Ahmedabad, Gujarat, INDIA, our network of offices are in India with around 50 experts of mobile app developers, web app developers and Internet marketer's. Tusker AI have launched 50+ Web Apps in iOS, Android, Windows and Cross platform mobile app.

CHAPTER 2 - OVERVIEW OF PROCESS BEING CARRIED OUT IN COMPANY

2.1 It includes the details about the work being carried out in each department.

Project Management Department : This department is responsible for planning and coordinating the overall development of the system. They set project goals, timelines, budgets, and manage the resources needed for the project.

Design Department : This department is responsible for designing the user interface and experience of the system. They create wireframes, mockups, and prototypes of the system and work closely with the development team to ensure that the design is feasible.

Development Department : This department is responsible for the actual coding of the system. They work with Python and Django frameworks to develop the various modules and features of the system, such as the dashboard module , website module , product purchase module.

Deployment Department: This department is responsible for deploying the system on the production server. They ensure that the system is running smoothly and troubleshoot any issues that arise during the deployment process.

Support Department: This department is responsible for providing technical support to users of the system. They troubleshoot any issues that users may encounter and provide guidance on how to use the system.

Overall, the development of a Glow Gadget System with different departments to ensure that the system is functional, reliable, and user- friendly.

2.2 List the technical specifications of major equipment used in each department.

Project Management Department :

- Project Management Software
- Communication Tools

Design Department :

- Design Software

Development Department :

- Programming Language
- Frameworks
- Version Control
- Integrated Development Environment (IDE)

Deployment Department :

- Cloud Infrastructure
- Containerization

Support Department :

- Help Desk Software
- Remote Access Software

2.3 Prepare schematic layout which shows the sequence of operation for manufacturing of end product.

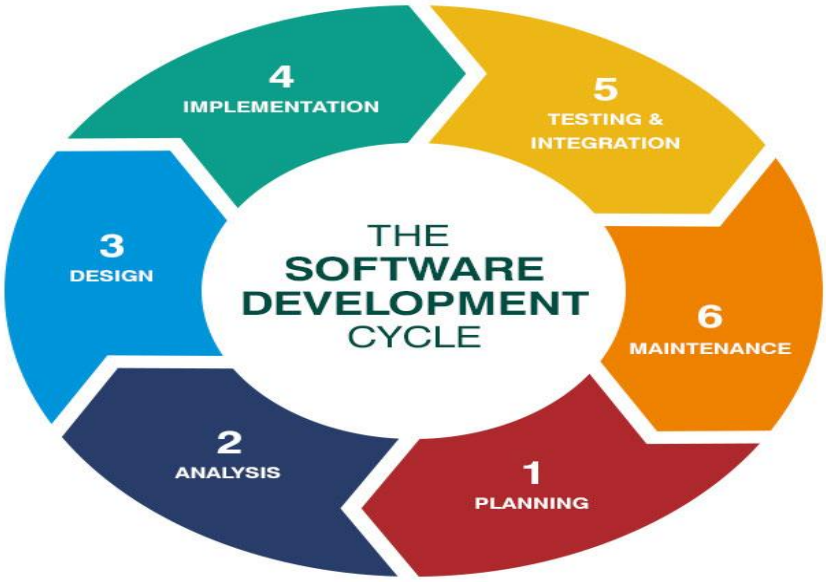


Fig 2.3 Software Development Life Cycle

2.4 Explain in detail about each stage of production.

Requirements Gathering :

Fig 2.4.1 Requirements Gathering

This is the first stage of production where the requirements for the system are gathered from stakeholders, users, and other sources. The goal of this stage is to identify the features and functionality that the system needs to have to meet the needs of the users. The requirements are documented in a software requirement specification (SRS) document, which serves as a blueprint for the development of the system.

System Analysis :

Fig 2.4.2 System Analysis

Once the requirements are gathered, the next stage is system analysis. In this stage, the system is analyzed to determine the feasibility of the project. This involves identifying the technical, economic, and operational feasibility of the project. The goal of this stage is to identify any potential issues or risks that may impact the development of the system.

System Design :

Fig 2.4.3 System Design

Once the feasibility of the project is determined, the next stage is system design. In this stage, the system architecture is designed, and the components of the system are identified. The goal of this stage is to create a design that meets the requirements of the users while being scalable, maintainable, and secure.

Implementation :

Fig 2.4.4 Implementation

Once the system design is completed, the next stage is Implementation. In this stage, the code is written in Python and using the Django framework to create the web application. This involves creating models, views, and templates, implementing business logic, and integrating external libraries and APIs as needed. This stage may also involve testing and debugging of the code.

Testing :

Fig 2.4.5 Testing

Once the implementation is complete, the next stage is testing. In this stage, the system is tested to ensure that it meets the requirements of the users and is free of defects. This involves creating test cases, running tests, and identifying and fixing any issues found during testing.

Deployment :

Fig 2.4.6 Deployment

Once the testing is complete, the next stage is deployment. In this stage, the system is deployed to the production environment, and it becomes available to users. This involves configuring the system, setting up servers and databases, and ensuring that the system is available and accessible to users.

Maintenance and Support :

Fig 2.4.7 Maintenance and Support

Once the system is deployed, the final stage is maintenance and support. In this stage, the system is monitored for issues, and updates and fixes are applied as needed. This stage also involves providing support to users, addressing any issues that arise, and ensuring that the system continues to meet the needs of the users over time

CHAPTER 3 - INTRODUCTION TO INTERNSHIP AND PROJECT

3.1 Project / Internship Summary

In today's cut throat competitive world, enhancing basic aptitude skills such as analytical, logical, verbal and reasoning has become a necessity. These skills are considered the building blocks of a student's life.

Therefore, the company I interned with aimed to develop an Automated Systems using an Artificial Intelligence so that it improves the current system and work becomes much easy to do. My company aims to developan Artificial Intelligence based Traffic Management system, which is basically used for monitoring and handling the traffic, which is increasing day by day and generates problems. This is the system which works on video management cameras, sensors, and algorithms that can analyze movement of traffic in real time from different perspectives.

As an intern, I was given the task to work on this project from the scratch, which involved AI technology as backend, integrating it with the real time cameras and incorporating technologies such AI and Machine Learning. I was also involved in developing the admin panel, which made the use of the html and CSS along with some bootstrap, which helped to keep the track of different modules.

During the internship, I first gained the knowledge about the language, framework and technologies used in the project. After getting trained on these technologies the development phase started. All first started with the requirements gathering phase and Analysis of the data and real time environment. Then after, creating paper forms and defining the user interface, the coding began for the project.

Overall, the traffic management system can help improve the traffic safety,reduce congestion and enhance the traffic system. However, use of these system raises concerns about privacy and civil liberties and adequate safeguards and regulations must be implemented to ensure proper use.

Throughout the course of the internship, the consistent feedback and guidance provided by my supervisor proved to be an instrumental in not only enhancing my skills and knowledge, but also significantly improving the project.

3.2 Purpose

The purpose of undertaking this project was to apply the acquired knowledge during the internship to real world scenarios. In today's constantly evolving and emerging world, the use of the vehicles is been constantly increasing, which now cannot be handled manually and so it requires some automated system. The integration of AI based technologyfacilitates the automated system with accuracy and friendliness to the vehicle users.

The main purpose of this system is that people can travel with less amount of time to wait at the signals, which specially helps in summer, along with the optimizing traffic flow and supporting transportation planning which leads us to better urban development in countries like India where the density of vehicles is much more on the roads. And it also helps in improving the public safety on the roads.

3.3 Objective

The project has several goals aimed to developing a useful system which will be customized to meet the specific requirements, needed for managing the traffic, thereby saving time of vehicle drivers.

The primary objective of the traffic management is to identify and analyzepatterns of the traffic conditions in real time and to monitor it. This can include identifying the number of vehicles over the traffic signals, detectingthe flow of the traffic and predicting the density of vehicles over a particular area. The purpose of this system can vary depending on the specific application. For an instance, over the traffic signals, it can be usedto predict the signal timings on basis of the density of vehicles. It can also be used for managing the lane driving to avoid crashing of vehicles and accidents so that traffic moves smoothly. It can also help with the parking management, so that management team can know according to traffic prediction about the parking without creating congestion.

The main objective of management system is to automatically analyze videos or live data captured using CCTV cameras at the cross roads or signals, to determine the number of vehicles on that particular signal so that next signal timer gets the appropriate time for vehicles based on density. So, by using this system over signals it helps to give the signal timeraccording to the number of vehicles present so that in the next round appropriate time can be provided.

The secondary objective of traffic management system is to get extra additional information like density of vehicles at particular day time, whenis more and when is less, also we can know about how much traffic pass over there and patterns along with about type of vehicles. This system also helps enhancing public safety by identifying accidents and giving alerts about the emergency services and reducing response time. It also helps infrastructure designing so that road and highways can be made broader as per traffic flow. Also, in today's time it helps in sustainable development, which reduces fuel consumption and vehicle emission and helping environment by optimizing traffic.

3.4 Scope

The scope of a traffic management system is vast and covers a range of activities related to monitoring and managing traffic conditions on roads. The scope of a traffic management system can also vary depending on thelevel of integration with other transportation systems and technologies. For an instance, the system can be integrated with intelligent transportation system, connected vehicles and smart cities to provide a more comprehensive view of traffic conditions and optimize transportationsystem.

It also provides ease to the emergency services like fire safety vehicles, health care and also the police system for an emergency. It gives insights and real time information for enhancement of current system. Additionally, the system complies with the Government's guidelines, termsof service and privacy policies and rules & regulations.

3.5 Technology And Literature Review

Traffic Management System is an interdisciplinary field that combinescomputer vision, machine learning and image-video processing techniquesto automatically analyze images or videos and detect the traffic. Over the years, various approaches and techniques have been developed to improve the accuracy and efficiency of traffic systems. A traffic management system uses a combination of technologies to collect, analyze and manage trafficdata.

Technology:

HTML and CSS :

- The project's admin panel was designed using HTML and CSS, which work together to create a web-based interface for managing project content. HTML provides the structure and content of the pages, while CSS defines their layout and presentation,resulting in a customizable and visually appealing admin panel accessible through a web browser.

BOOTSTRAP :

- Bootstrap is a popular front-end development framework that was also used to design the project's admin panel. It provides a collection of pre-built HTML, CSS, and JavaScript components that developers can use to create responsive web pages and applications. Boot-strap simplifies the design process by providing a set of standardized components, such as navigation bars, buttons, forms, and grids, that can be customized and combined to create a consistent and professional-looking interface.

COMPUTER VISION :

- Computer Vision (OPENCV LIBRARY) techniques are used to analyze the visual data and detect the vehicles.Some popular computer vision techniques used in system includefeature and class extraction, object detection and backgroundsubtraction.

MACHINE LEARNING :

- Machine learning algorithms are used totrain vehicle detection models using a large dataset of images and videos. Some of the popular machine learning algorithms used are Support Vector Machine (SVM), Random Forest, and Convolutional Neural Networks (CNN).

IMAGE PROCESSING :

- Image processing techniques are used to preprocess the visual data and enhance the features that are relevantto vehicle detection. Some popular image processing techniques usedin vehicle detection are filtering, edge detection and segmentation.

PYTHON :

- Python is used for creating dashboard in which AI is integrated in it, to give the user a hassle-free experience to interact with AI.

FLASK :

- Flask is microframework for developers, designed to enable them to create and scale web page quickly and simply. Flask depends on Jinja Template engine and the Werkzeug WSGI Toolkit.

SQLYOG :

- SQLyog was utilized in the project to manage and store various types of data, including Login information, user information, data analysis history. SQLyog is a popular graphical user interface (GUI)database management tool that enables developers to interact with databases using a simple and intuitive interface. It simplifies tasks suchas database design, creation, management, and optimization.

Literature :

Density Based Traffic Analysis :

- One of the popular approaches in traffic analysis is density-based vehicle detection, which relies on analyzing the density of vehicles for a given signal. This approach has been used in various applications, such as public safety, transportation, and infrastructure management.

Behavior Based Traffic Analysis :

- Another approach in traffic analysis is behavior-based vehicle detection, which analyzes the movement and behavior of vehicles on road to identify potential safety risks. This approach has been used in various applications, such as traffic control, incident management, on road emergency services etc.

Multi-Camera Traffic Analysis :

- Multi-camera traffic analysis involves using multiple cameras to monitor a large area and detect the presence of a vehicles. This approach has been used in various applications, such as trafficmonitoring, public safety, and parking management.

Deep Learning-Based Traffic Analysis :

- Deep learning-based traffic analysis uses deep neural networks to detect the presence of a vehicle in an image or video. This approachhas been shown to be highly accurate and efficient, and has been used in various applications, such as vehicle counting, vehicle density estimation, and vehicle tracking.

3.6 Internship / Project Planning

3.6.1 Internship / Project Development Approach and Justification :

The Agile technique will be used to create the project, with a focus on incremental development and continuous testing. The task will be broken up into sprints that each last for two weeks. The project team will performa sprint review at the conclusion of each sprint to assess the results and pinpoint any areas that still need to be improved. In order to make sure that everyone is on the same page and that any concerns are immediatelyresolved, the project team will also hold daily stand-up meetings.

Agile SDLC model is a combination of iterative and incremental process models with a focus on process adaptability and customer satisfaction by rapid delivery of working software products. Agile Methods break the product into small incremental builds. These builds are provided in iterations. Each iteration typically lasts from about one to three weeks. Every iteration involves cross-functional teams working simultaneously onvarious areas like –

- Planning
- Requirement and analysis
- Design
- Coding
- Testing

We undertook the Incremental model for the development of our project.The incremental model relies on specifying and implementing individual parts of the software, rather than attempting to start with full specificationrequirements. Once a rough product is created within an iteration, it is then reviewed and improved in the next iteration and so on, and so this wayproduct is being developed step by step.

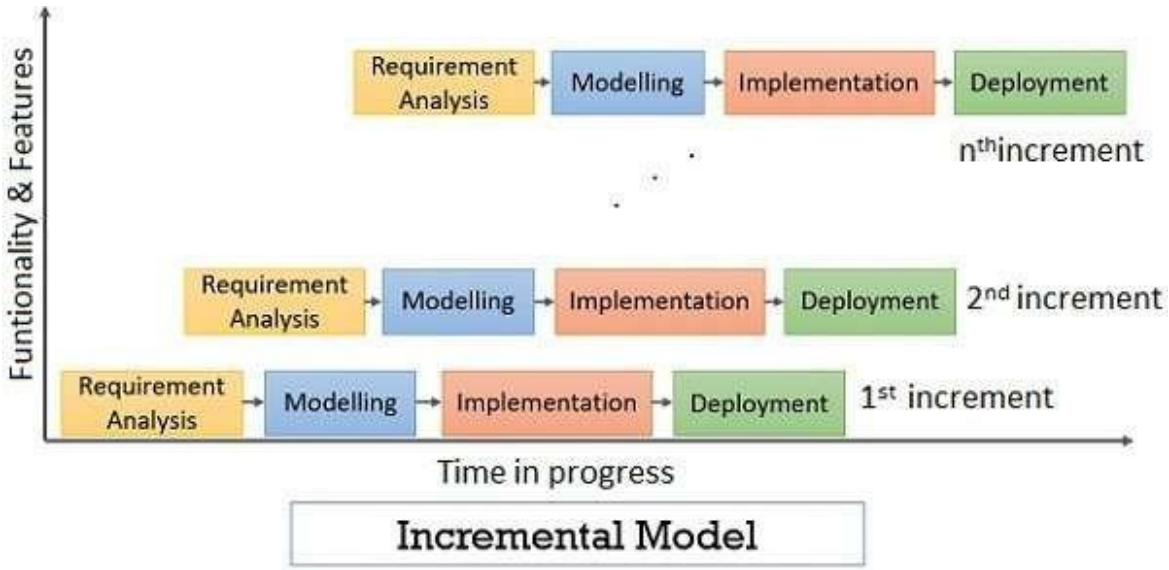


Fig 3.6.1: Incremental Model

Advantages :

- Errors are easy to be recognized
- Easier to test and debug
- Very realistic approach to software development
- Functionality can be developed rapidly and demonstrated
- Suitable for changing requirements
- Client get important functionality early
- Simple to manage risk because it is handled during its iteration

Disadvantages :

- Not suitable for handling complex dependencies.
- Need for good planning
- Total cost is high
- Well defined module interfaces are needed.

3.6.2 Project Effort and Time, Cost Estimation

Time Estimation :

Table 3.6.2: Time Estimation Table

Activity	Estimated Duration
Project Initiation	**1 week**
Initial Proposal	**2 weeks**
Building a Project Plan	**1 week**
Literature Review	**5 days**
Methodology	**1 week**
System Analysis	**1 weeks**
Project Design	**1 week and 6 days**
Project Development	**6 days**
Testing	**6 days**
Critical Analysis	**4 days**
Evaluation	**1 day**
Report Writing	**1 week**
Total Effort	**12 weeks (Approx. 3 months)**

Cost Estimation:

Development cost: This includes the cost of the development team, including salaries, bonuses, benefits, and training costs.

Infrastructure cost: This includes the cost of hardware, software, and other tools required for the development, testing, and deployment of the system.

Project management cost: This includes the cost of project managers, project management tools, and other expenses related to managing the project.

Quality assurance and testing cost: This includes the cost of testing tools, the QA team, and the cost of fixing bugs and issues found during testing.

Maintenance and support cost: This includes the cost of maintaining and supporting the system after deployment, including ongoing updates, bug fixes, and user support.

Contingency cost: This includes the cost of unexpected events, such as delays, scope changes, or other issues that may arise during the development process

3.6.3 ROLES AND RESPONSIBILITIES

My Roles and Responsibilities throughout the course of internship were:

- Communication
- Requirement Gathering
- Live and Real-Time data gathering
- Database Connectivity
- Coding
- Testing of developed System Reporting to the Supervisor

3.6.4 GROUP DEPENDENCIES

We were a group of 2 members in a team who worked together throughout the project's various stages. Our collective efforts were aimed at successfully implementing and refining the project, and we collaboratedclosely during the design, coding, and testing phases to achieve our objectives on time.

3.7 INTERNSHIP SCHEDULING

Internship Scheduling is the planning phase of the overall internship program, which describes about the overall internship program about the task we are going to perform, timelines of the particular task, deadline of the particular task and basic activities we are going to perform during internship with its tentative dates. One of the most popular scheduling technique, we can use is Gantt Chart.

Gantt Charts are useful for planning and scheduling projects and overall timings for it. They help you assess how long a project should take, determine the resources needed, and plan the order in

which you will complete tasks. They are also helpful for managing the dependencies between tasks.

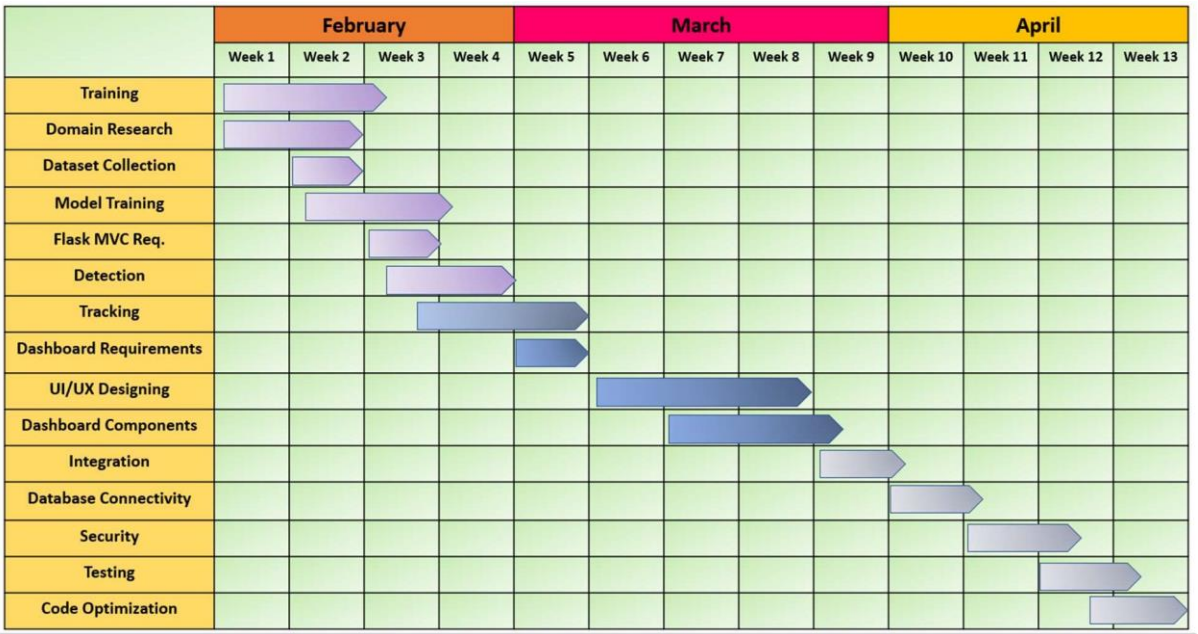


Table 3.7: Internship Scheduling Table

CHAPTER 4 – SYSTEM ANALYSIS

4.1 STUDY OF CURRENT SYSTEM

When I started with my internship, I was assigned to observe the differentsystems that is currently in operation for traffic management, but researchsays that there is the system present which works manually and handles traffic manually, which sometimes becomes chaos and doesn't work effectively. Currently the system is handled by the operators in which theyneed to keep an eye on system 24x7 because everything is done manually.

The system that is in use right now has the signal timer on basis of factors like, for an instance timer is more at the peak times even though it isn't works effectively and sometimes at the day time when the density of vehicles is more or less small, then also timer is normal, that means in current system for every situation the signal works same in every conditiondue to which traffic management is not done effectively, and also due to which time is wasted of the vehicle users.

So as per observation, we can say that manually done management is not effective for traffic management and due to which traffic flow is notsmooth and traffic issues increases.

4.2 PROBLEMS AND WEAKNESS OF CURRENT SYSTEM

- Current traffic management is done manually at the signals, due to which every signal doesn't get appropriate wait time for vehicles to move.
- Due to current traffic light system, heavy traffic jams occur at signals.
- For the sake of going early and fast, there sometimes occur violationof traffic rules, something which is very common in India.
- Due to the inappropriate wait time at signal for every lane, thereoccurs a wastage of man hours daily.
- Due to traffic jam at signals, increase pollution in that particular area
- Green Light for an empty road
- No traffic, but pedestrians have to wait till signal turns off.
- Loss of fuel and non-sustainable.

4.3 REQUIREMENTS OF NEW SYSTEM

We seek to create a system by integrating with the Artificial Intelligence, asthe current system doesn't have the ability to manage the traffic effectively.We need more of a user-friendly system so that no highly skilled employeeis required to operate the system for traffic lights. Looking at the current system's problems and weakness, we surely need to develop a new system.

USER REQUIREMENTS:

It describes the type of user which will be dealing with the new system for managing traffic. This application has only one type of user that is Administrator.

- Administrator: Responsibility of the administrator is to handle the Artificial Intelligence (AI) part of the system i.e. detection of vehicles.
- Responsibility of administrator is to manage the database of the system which has the information about the particular signal.
- User who uses this system should know how the run the system.

HARDWARE REQUIREMENTS:

- HD Cameras – High-Definition Quality cameras are needed to detect the vehicles properly. If needed number of cameras canbe installed to overcome the problem of congestion.
- CPU – CPU with the dual core processor is required for processing the videos that is taken as input, captured by cameras overhead and for real-time processing.
- Display – High resolution display is required to display the video captured. Recommended id 1024 x 768.

SOFTWARE REQUIREMENTS:

- Editor Required: JetBrains PyCharm 2023
- Database Server: SQLYog for Database
- Flask Framework for the Web Development and Integration Windows 10 or above

FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS

A Functional Requirement defines the specific services that a software system or its components must provide. These services areessentially the inputs, behavior, and outputs of the software system.Functional requirements are product features which developer needto implement. Whereas, non-functional requirements are theconstraints the software must comply with according to the project.It usually deals with issues like usability, portability, security, and flexibility – to name a few, which define how the system should perform.

FUNCTIONAL REQUIREMENTS:

Initially first the user needs to login to system and also need to Register himself to the system, then after user should have the input box where he/she can take the input i.e. the videos or say the real data from the signals which is needed to process for the timer prediction. And also shouldbe able to analyze the data uploaded to the system and should also managethe data available to the user

Administrator have access to the whole system as he is the only user of it. Admin has the authority to manage the data available and can makechanges if needed.

NON-FUNCTIONAL REQUIREMENTS:

- **Security:** The project must be safe and protect important information by using methods to keep it secure. This includes implementing security measures such as encryption and access controls to ensure that sensitive information is not accessed or stolen by unauthorized parties.
- **Ease of use**: The project must be easy for people to use by having a simple and user-friendly design. This includes designing the user interface with ease of use in mind, using clear and understandable language, and creating intuitive navigation that allows users to easilyfind what they're looking for.
- **Portability**: The project must be able to work on different devices byusing tools that support development across multiple platforms.
- **Flexibility**: The project must be flexible and able to change in the future by designing it with the ability to adapt to future changes in mind. This includes designing

the project with scalability in mind so that it can grow and expand over time, as well as using modular design principles that allow for easy updates and changes to be madewithout disrupting the overall system.

- **Real-Time Processing and Reliability** : The system must be able to process data in real time to provide timely alerts and responses and provide accurate information in timely manner.

- **Robustness** : The system must be able to handle changes in different lighting, weather and other environmental factors that can affect accuracy.

4.4 SYSTEM FEASIBILITY

Feasibility Study can be considered as a preliminary investigation that helps the management to take decisions about whether the study of a system should be feasible for development or not.

It identifies the possibility of improving an existing system, developing a new system, and producing refined estimates for further development of the system. It is used to obtain the outline of the problem and decide whether a feasible or appropriate solution exists or not.

Types of Feasibility Study:

- Technical Feasibility
- Economic Feasibility
- Operational Feasibility
- Scheduling Feasibility

1. Technical Feasibility

   It is technically possible to detect vehicle, and research on this topic hasbeen ongoing for some time. Vehicle detection can be done in a varietyof ways, including with machine learning, sensor-based, and computer vision-based methods.

Computer vision-based methods use cameras to record video of vehicles, then analyses the footage to find and follow vehicle on the traffic signal. Techniques including object detection, backgroundsubtraction, and optical flow analysis can be used for this.

2. Operational Feasibility

Operational feasibility of a vehicle detection project refers to whether the system can be implemented and operated effectively in the organization's environment. Here are some elements to take into account when assessing a vehicle detection project's operational viability.

- User Acceptance
- System Integration
- Availability of Resources
- System Scalability
- Security and Data Protection
- Operational costs

3. Economic Feasibility

It determines whether the system is operating effectively once it is developed and implemented. It ensures that the management should support the proposed system and its working feasibility in the current organizational environment. It analyses whether the users will be affected and whether they accept the modified or new business methods that affect the possible system benefits.

4. Schedule Feasibility

Given the resources at hand, the project timescales, and the expectations of the stakeholders, a workable development and implementation timetable for the proposed system will be established.It ensures that project should be completed in a given time constraint and schedule.

4.5 ACTIVITIES IS IN NEW SYSTEM

As per the requirements gathered and analysed during the beginningphase of the development of system, there were various activities discussed which are necessary for the system, and without them system might now work effectively. Some of the activities are:

LOGIN:

Login activity refers to the process of logging into a system or application using a unique set of credentials, such as a username andpassword. The login activity typically involves two steps: authentication and authorization. Authentication refers to validatingthe user's credentials and Authorization refers to validating the role of the user, overall login is necessary for prevention of unauthorizedaccess.

DATA ANALYSIS:

Data analysis activity refers to the process of examining and interpreting data using various statistical, mathematical, and analytical techniques to identify patterns, relationships, and insights.The goal of data analysis is to extract meaningful information from large and complex datasets, which can be used to inform decision- making, improve processes, or gain a deeper understanding of a particular phenomenon. This is the activity which will be performed after the vehicles have been detected from the live-data, whichcontains a lot of information, which is analyzed during this phase.

VEHICLE DETECTION:

Vehicle detection activity refers to the process of monitoring and analyzing the movements and behavior of a large number of vehiclesstanding over the signal, or present on the roads. The primary goal of vehicle detection activity is to identify the vehicles present and according to it we can provide the wait time over the signals for effective management and also we can provide alert regarding emergency responses.

OBJECT TRACKING:

Object tracking using YOLOv5 refers to the process of detecting and tracking objects in real-time using the. You Only Look Once (YOLO) deep learning algorithm. YOLOv5 is a state-of-the-art object detection algorithm that uses a single convolutional neural network (CNN) to detect and classify objects in an image, and DeepShot is an algorithm which is used for tracking objects, on which the centroid will be generated of the objects, using which we will be able

to catchthe object from video and images for further processing.

DISPLAY ANALYSIS:

Display output activity refers to the process of presenting information to a user through a visual or auditory interface. Basicallyin our system after the detection is done, various task are performedon it, like tracking, counting, giving constraints to the environment. So, when these tasks are performed, we obtain various insights fromthe data which fulfill various objectives of our system, which are displayed to user in a completely analyzed form, where we have some important information present.

4.6 Features Of New System

When the new system is generated, it overcome many issues present in the current system. Also, when a new system is developed it contains new features also which make the system more effective and helpful compare to the old system present. Some of the features which makes the system effective and responsive are:

- Using various classes to detect the different classes of vehicles.
- Creating boundaries to get the count of vehicles in a particular environment.
- Dashboard for managing the data and detection performed on data.
- Automatic detection on Image and video.
- Store history of detected videos for analysis.
- System is working on CCTV camera videos as well also provides well accuracy on night vision cameras.
- Much accurate results and informative insights obtained comparatively.

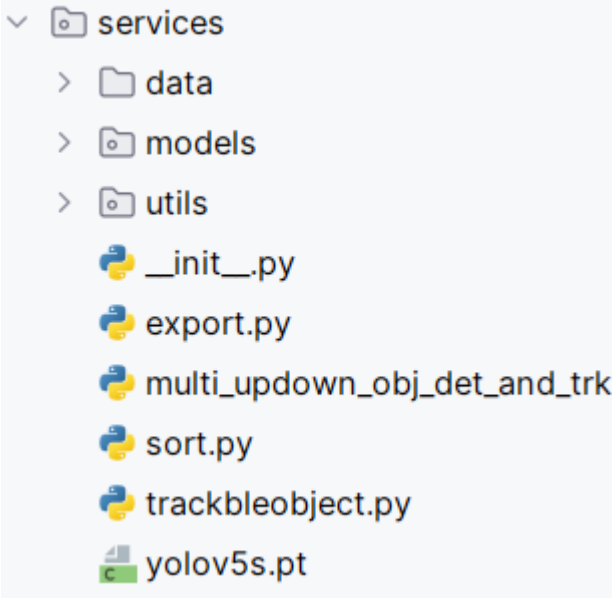
The technique of evaluating and determining the presence of a sizable group of vehicles at a specific location is known as vehicle detection. Depending on the desired requirement of system for particular task and the setting, vehicle detection and traffic management may have different specialized needs. Nonetheless, there are a few standard prerequisites for accurate vehicle detection, such as:

- **Accurate detection:** The system must be able to quickly and precisely recognize the presence of a vehicles. This can entail analyzing sensor data or video footage using sophisticated algorithms.
- **Estimating the density of vehicles:** The system ought to be able to do this correctly. This is crucial for management at the signals for appropriate wait times.
- **Real-time monitoring:** In order to identify any abrupt changes in behavior or movement patterns, the system should be able to perform real-time traffic monitoring.
- **Scalability:** is important so that the system can handle larger number of vehicles at once.
- **Integration with other systems:** In order to offer a complete solution for traffic management, the system should be able to integrate with other systems including management cameras, access control systems, and emergency response systems.

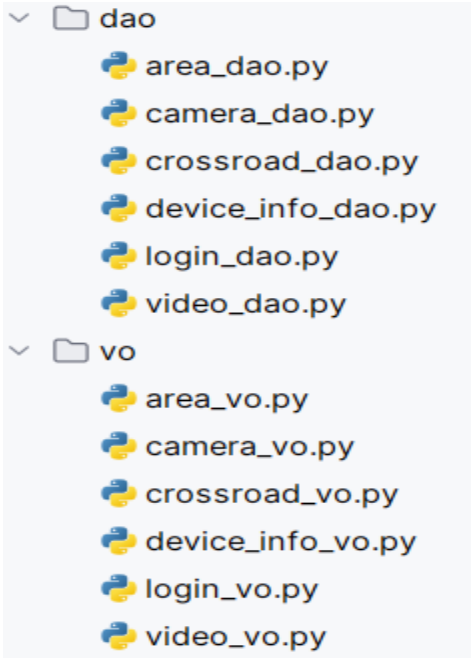
4.7 List Of Modules In New System

- **Detection Module:** Detection is the core part of the system which detects the vehicles present on the road or at the traffic signals, which gives information related to density of vehicles and congestion so that traffic Flow can be monitored and handled accurately to reduce the wait time at signals and it also provides insights to the analysis module.
- **Analysis Module:** Analysis module is the most important module as the information obtained form it helps us to manage the traffic and also helps to set the traffic lights and its wait time appropriately to manage Flow smoothly as it provides some statical and analytical results.
- **Display Module:** The insights obtained from the analysis module is processes using the code, which is not understandable to naïve people (say who have no knowledge about code and programs), and so display module does the work of providing information obtained to users in more generalized and understandable form, which makes easier for users to work on and analyze data.
- **AI Module:** A services package is a collection of related routes and functions that provide

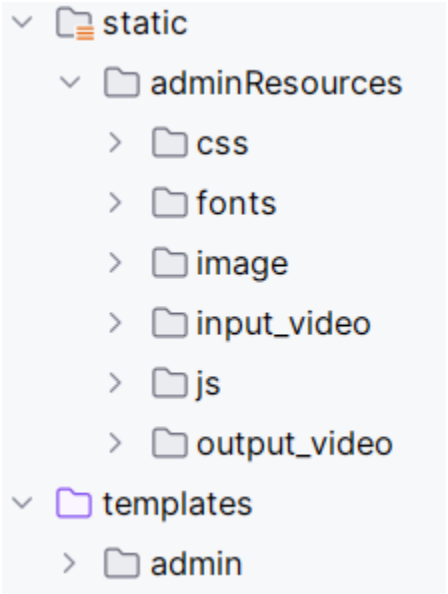
a specific set of functionalities to the web application. A services package is usually organized as a directory that contains multiple Python modules, each module defining a set of related routes and functions. Services module contain models, data, weights, python file, and other necessary files, which is the core part of system let's say heart of the traffic management system.



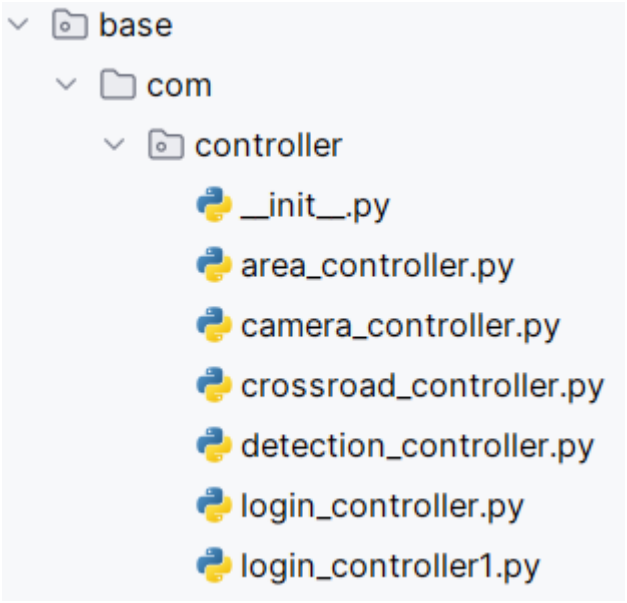
- **Database Module:** The database module is used to interact with a database from within a Flask application. Flask supports a variety of database systems, including MySQL, PostgreSQL, SQLite, and more. Database module includes VO and DAO file which is used for creating table schema and writing queries. It stores information about login and registration information and data analysis information about the traffic data.



- **Frontend Module:** The frontend module is used to handle the presentation layer of a web application. This module contains the HTML templates, static assets such as images and style sheets, and the Flask views that render the templates and serve the static assets. Basically, it provides the interface between the system, backend, database and the user using the system.



- **Backend Module:** The backend module is used to handle the business logic and data processing of a web application. This module typically contains the Flask routes and functions that handle incoming requests, process data, and generate responses.

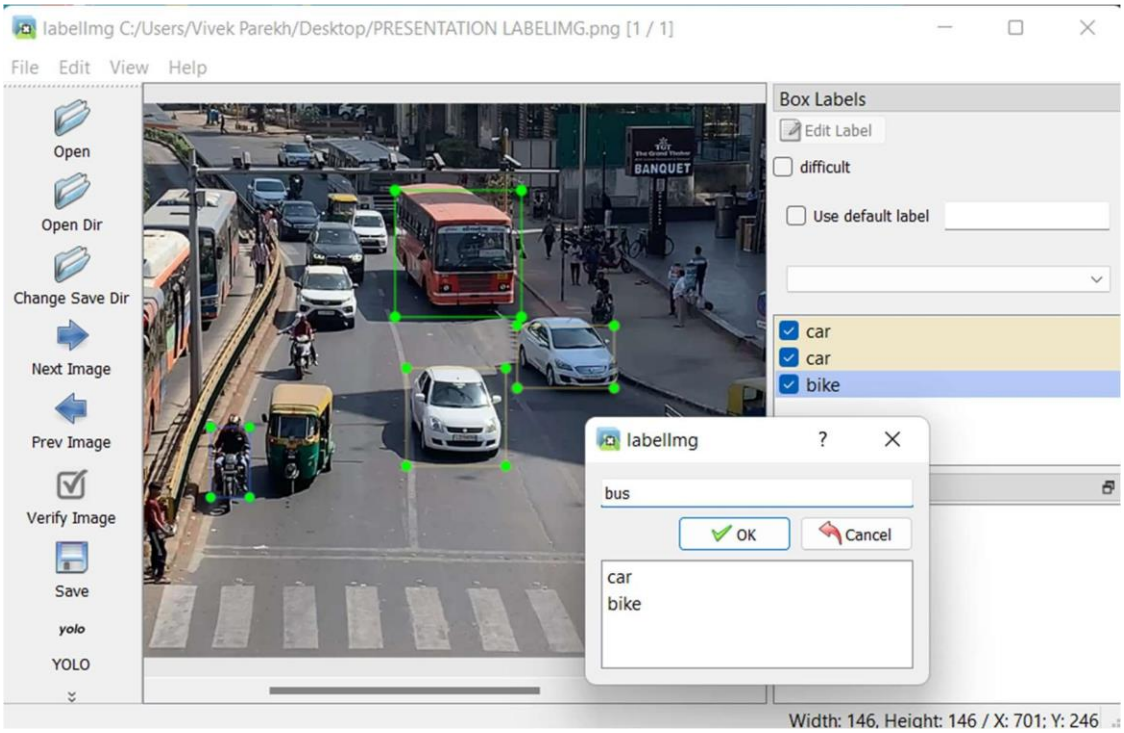


4.8 Software / Tools Used

The Software/tools used in this project is:

- **PYCHARM**: PyCharm is a dedicated Python Integrated Development Environment (IDE) providing a wide range of essential tools for Python developers, tightly integrated to create a convenient environment for productive Python, web, and data science development.
- **MySQL**: MySQL is a relational database management system based on SQL – Structured Query Language. The application is used for a wide range of purposes, including data warehousing, e-commerce, and logging applications. The most common use for MySQL however, is for the purpose of a web database.
- **SQLYOG**: SQLYOG Ultimate is the best MySQL GUI for database developers. Com-pare and synchronize data, manage SQL queries, and keep your database safe. SQLYOG provides a full graphical interface to make using MySQL's powerful features simple even for beginners.

- **Labelimg**: LabelImg is a graphical image annotation tool. LabelImg is a straightforward and basic tool to label a few hundred images to create a dataset for computer vision model training. The annotations can be saved as XML files in PASCAL VOC format.

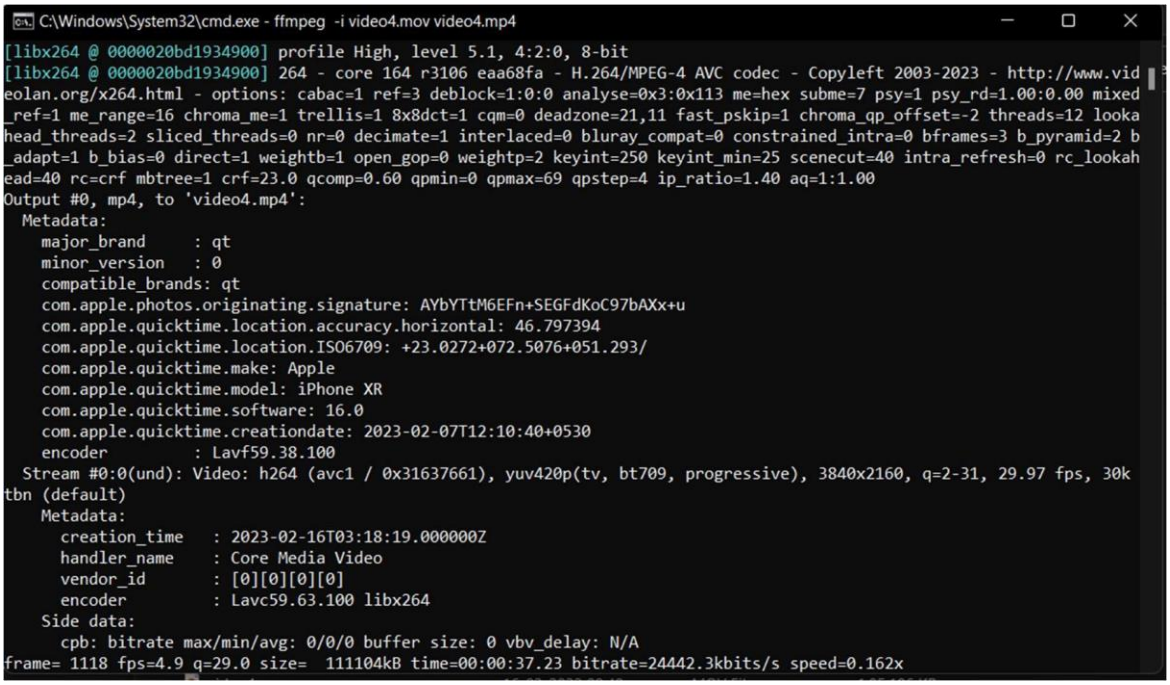


- **FFMPEG**: FFMPEG is a powerful open-source software that is used for video and audio conversion, processing and streaming. It is a command-line tool that is available for Windows, Linux. FFMPEG supports wide range of multimedia formats like MP4, MOV,

```
  libavformat    59. 38.100 / 59. 38.100
  libavdevice    59.  8.101 / 59.  8.101
  libavfilter     8. 56.100 /  8. 56.100
  libswscale      6.  8.112 /  6.  8.112
  libswresample   4.  9.100 /  4.  9.100
  libpostproc    56.  7.100 / 56.  7.100
Input #0, image2, from 'alec-jones-WDsmqzxy8Ig-unsplash.jpg':
  Duration: 00:00:00.04, start: 0.000000, bitrate: 927508 kb/s
  Stream #0:0: Video: mjpeg (Progressive), yuvj420p(pc, bt470bg/unknown/unknown), 5455x3637 [SAR 72:72 DAR 5455:3637], 2
5 fps, 25 tbr, 25 tbn
Stream mapping:
  Stream #0:0 -> #0:0 (mjpeg (native) -> png (native))
Press [q] to stop, [?] for help
[swscaler @ 0000019fd91ee3c0] deprecated pixel format used, make sure you did set range correctly
    Last message repeated 3 times
Output #0, image2, to 'alec-jones-WDsmqzxy8Ig-unsplash.png':
  Metadata:
    encoder         : Lavf59.38.100
  Stream #0:0: Video: png, rgb24(pc, gbr/unknown/unknown, progressive), 5455x3637 [SAR 1:1 DAR 5455:3637], q=2-31, 200 k
b/s, 25 fps, 25 tbn
    Metadata:
      encoder         : Lavc59.63.100 png
[image2 @ 0000019fd9153480] The specified filename 'alec-jones-WDsmqzxy8Ig-unsplash.png' does not contain an image seque
nce pattern or a pattern is invalid.
[image2 @ 0000019fd9153480] Use a pattern such as %03d for an image sequence or use the -update option (with -frames:v 1
 if needed) to write a single image.
frame=    1 fps=0.4 q=-0.0 Lsize=N/A time=00:00:00.00 bitrate=N/A speed=   0x
video:47913kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing overhead: unknown

C:\Users\cpa\Downloads>
```

MKV and also supports type conversion of for videos. It also supports conversion of video into the frames of image as all the detection and analysis is done on the frames obtained from video and has libraries to manipulate and handle video files.



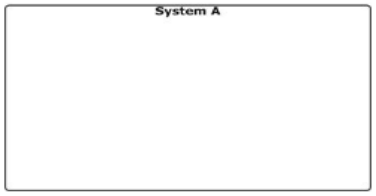
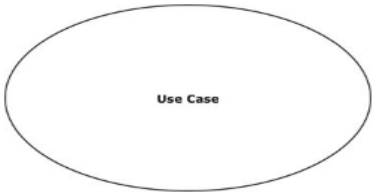
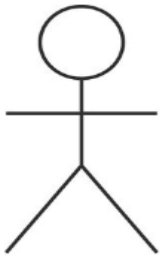
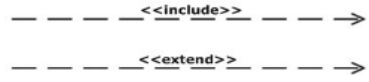
Chapter 5 – SYATEM DESIGN

5.1 System Design & Methodology

5.1.1 Use Case Diagram:

To represent the active behaviour of a system and document its requirements, both originating internally and externally, a use case diagram is employed. It exhibits the agents and components accountable for executing the use cases, along with their interactions. In essence, this diagram portrays the interaction between a certain section of the system and an external entity.

Table 5.1.1: Symbols and components of Use Case Table

	**System** The rectangular boundary is the system. Use cases fall inside it, and actors will be placed outside it.
	**Use Case** An oval shape represents a use case. Use cases represent the functionality of the system, as well as the end-goal of the actor. Use cases should be placed inside the system.
	**Actor** When an actor interacts with the system, it triggers a use case. Actors should be placed outside the system.
	**Relationships** Arrows are used to indicate a relationship between an actor and a use case, or between two use cases. An extension indicates that one use case may include the behaviour of another use case. An inclusion represents one use case using the functionality of another use case.

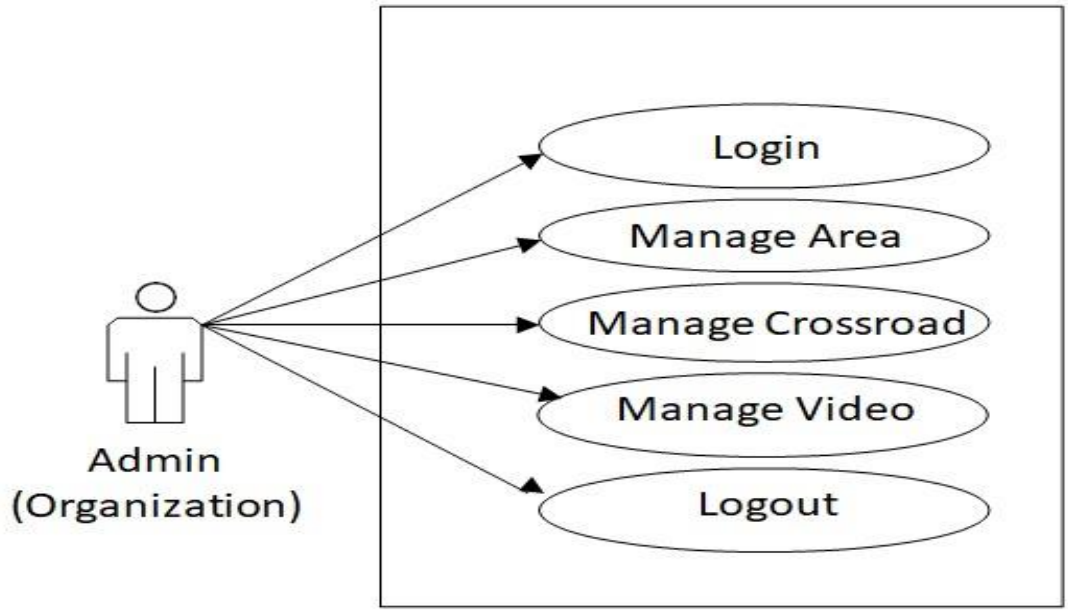


Fig 5.1.1 Use Case Diagram

5.1.2Activity Diagram:

Activity diagrams are visual aids that display the progression of activities within a system. They present the sequence of events from the beginning to the end, encompassing diverse decision pathways that may exist among the activities. These diagrams are employed when multiple activities are carried out simultaneously. Activity diagrams are especially beneficial in business modeling, as they proficiently depict the procedures engaged in various business activities.

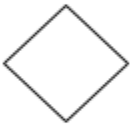
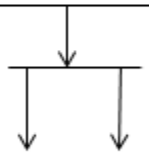
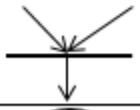
Name	Symbol
Start Node	
Action State	
Control Flow	
Decision Node	
Fork	
Join	
End State	

Table 5.1.2: Symbols and components of Activity Table

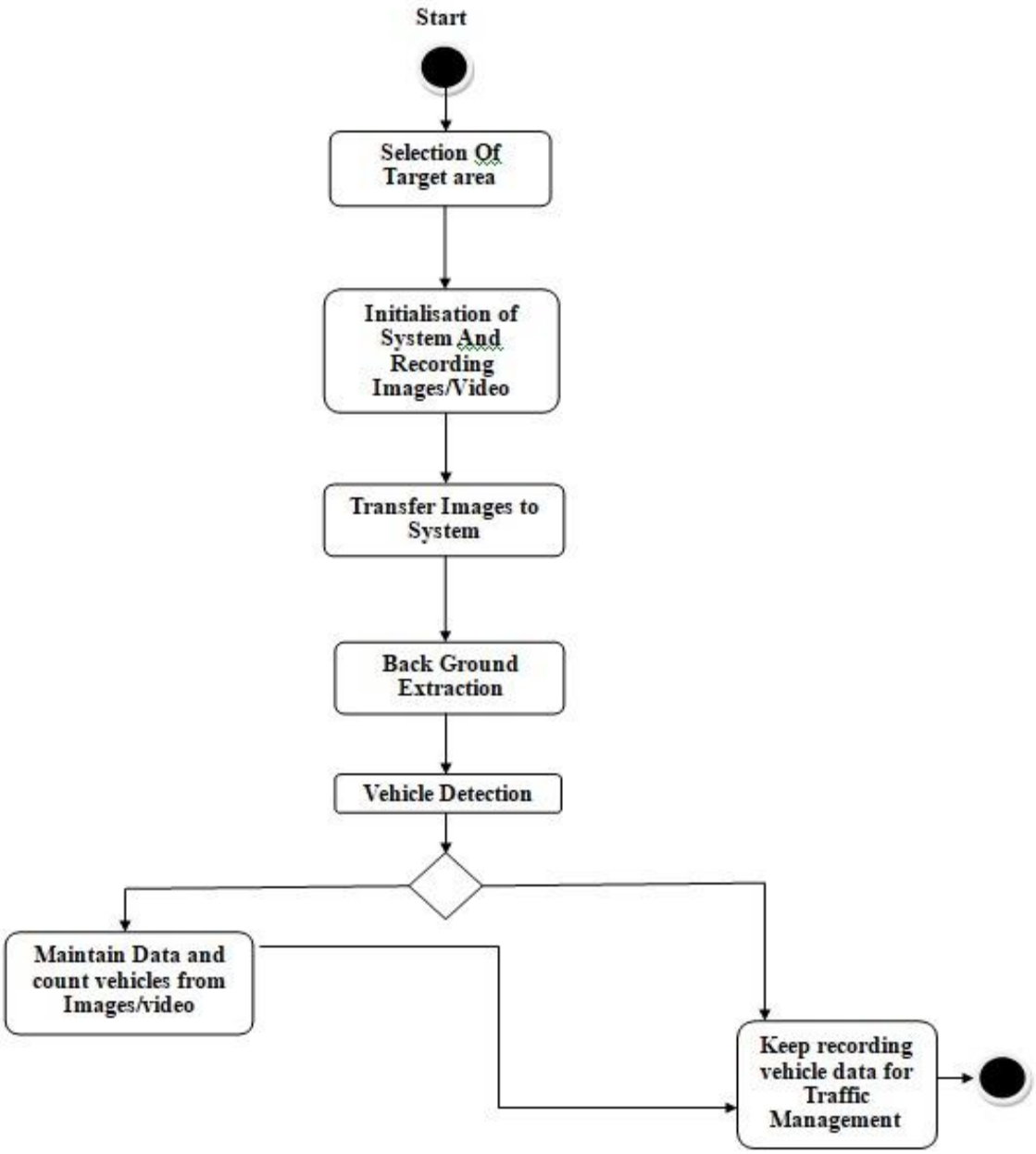


Fig 5.1.2 Activity Diagram

5.1.3 Sequence Diagram:

A sequence diagram is categorized as an interaction diagram as it delineates the way a cluster of objects collaborates and the order in which they do so. These diagrams are utilized by both software developers and business professionals to comprehend the prerequisites for a new system or to record an already existing process.

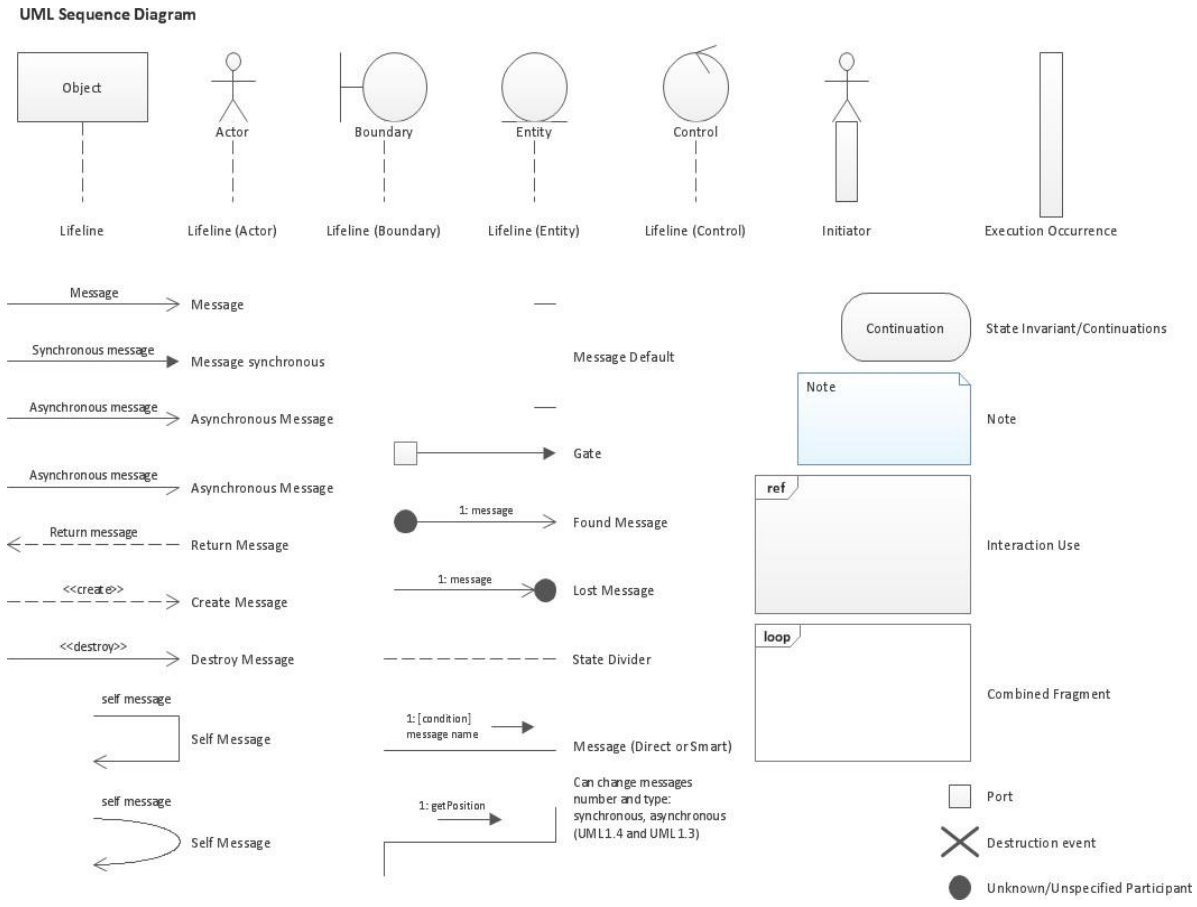


Table 5.1.3: Symbols and components of Sequence Table

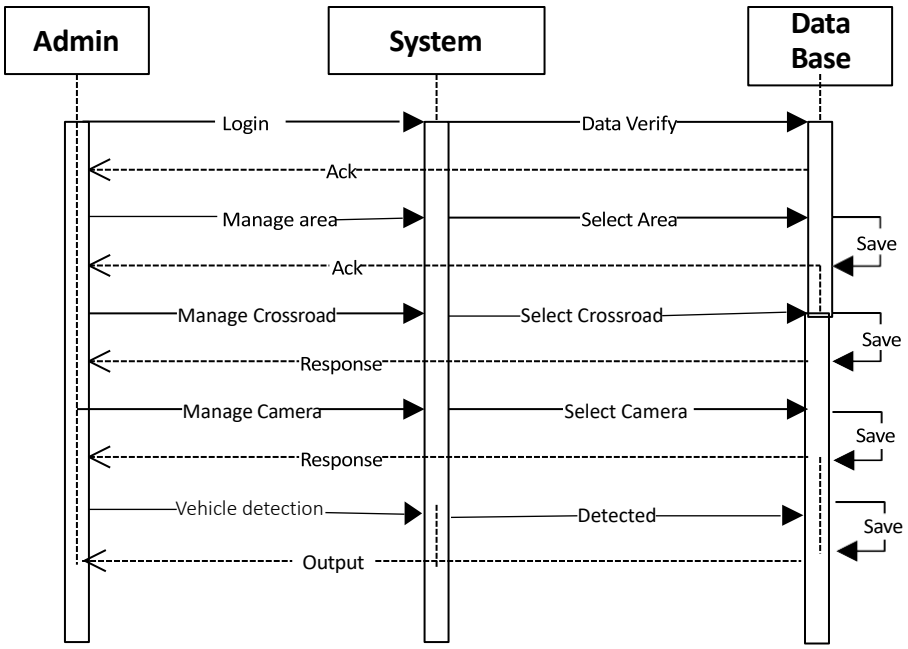
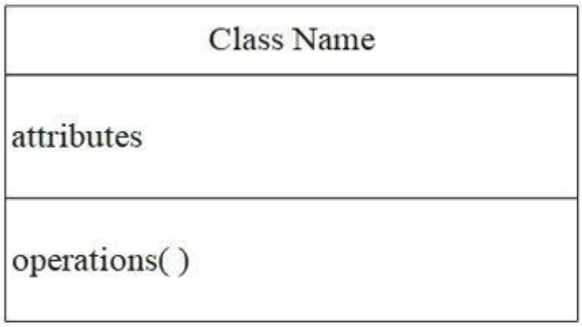


Fig 5.1.3: Admin Sequence Diagram

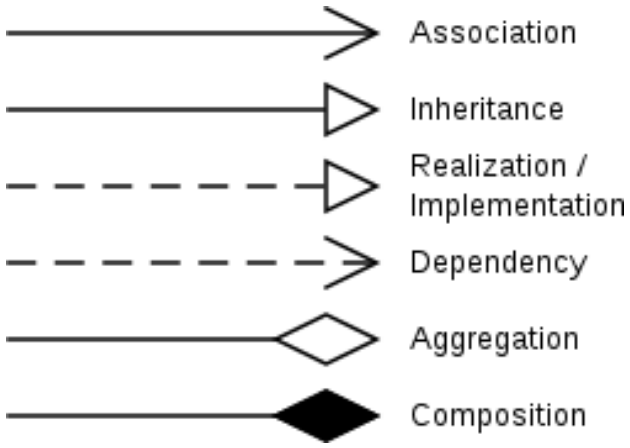
5.1.4 Class Diagram:

A class diagram is a type of diagram that offers a static outlook of an application. Its function is not only to represent, elucidate, and record different aspects of a system, but also to build executable code for the software application. In a class diagram, the traits, functionalities, and restrictions of a class are defined. It is widely employed in the modeling of object-oriented systems as it is the only UML diagram that directly mapped with object-oriented programming languages. A class diagram demonstrates a set of classes, interfaces, associations, collaborations, and constraints, and is sometimes referred to as a structural diagram.



Class Name
attributes
operations( )
responsibility

Table 5.1.4: Symbols and components of Class Table



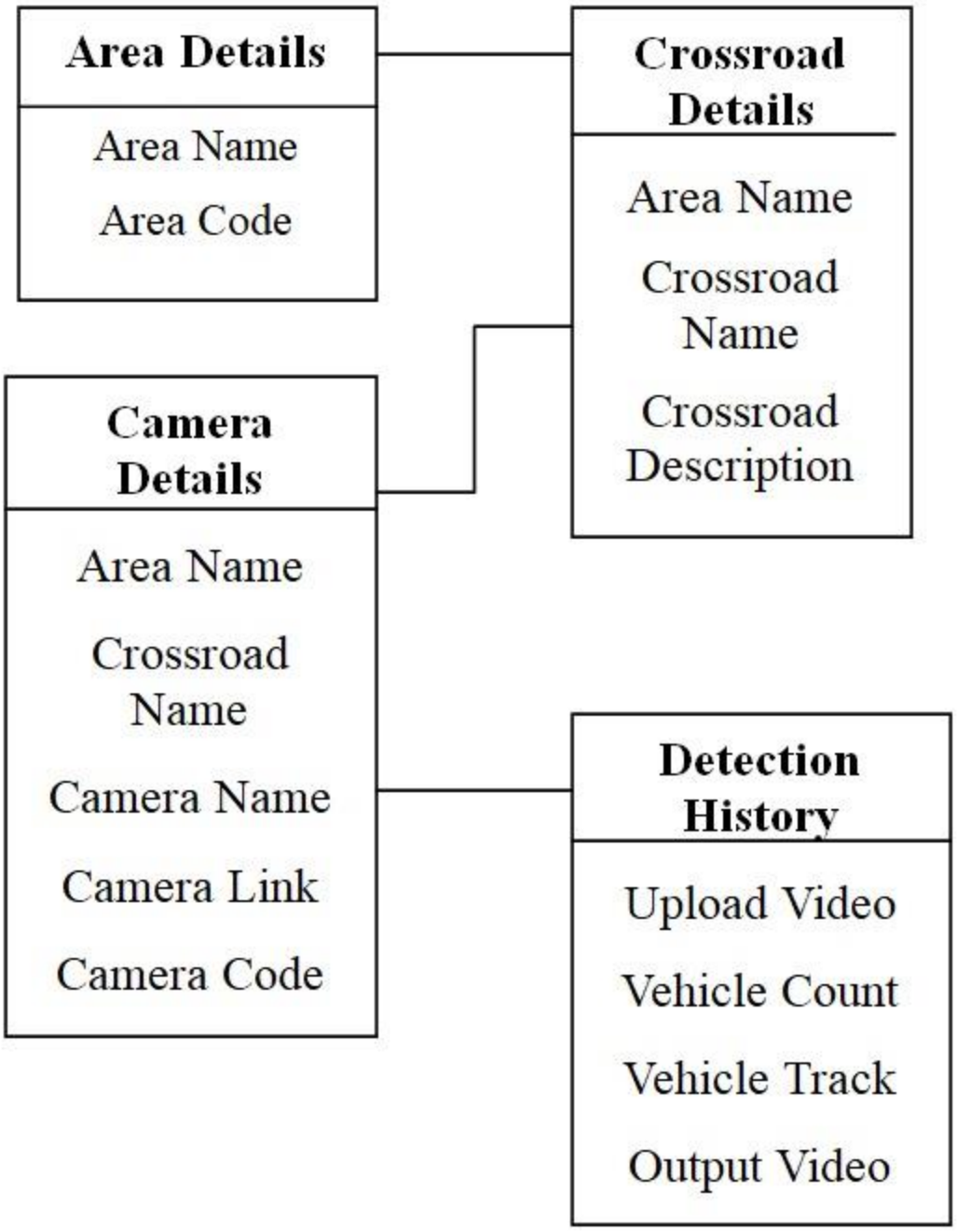


Fig 5.1.4: Class Diagram

5.1.5 ER Diagram:

The Entity-Relationship (ER) model is a data model utilized to define data elements and relationships within a system. It offers a simple and easy-to-design perspective of data, helping to develop a conceptual design for a database. The ER model portrays the structure of the database through an entity-relationship diagram, which is a graphical representation of the entities, attributes, and the associations between them.

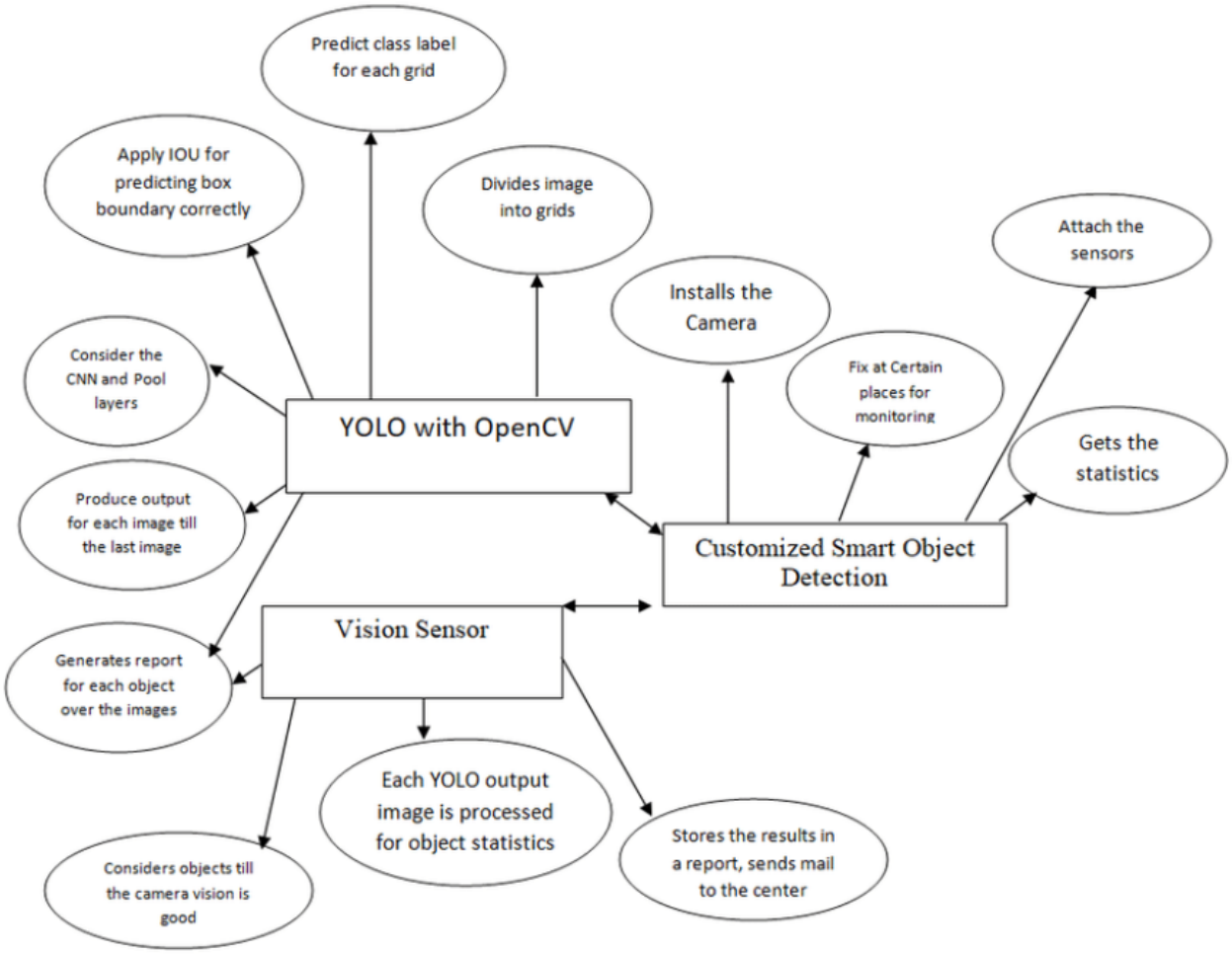


Fig 5.1.5 ER Diagram

5.1.6 Flow Chart:

A flowchart is an illustration of the individual steps of a process arranged in a specific sequence. It is a versatile tool that customized to suit diverse purposes, and it utilized to portray a range of procedures, such as a manufacturing process, an administrative or service process, or a project plan.

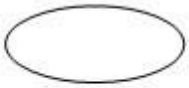
Symbol	Symbol Name
	Terminal
	Process
	Decision
	Input / Output
	Connector
	Flow line

Table 5.1.6: Symbols and components of Flow Chart

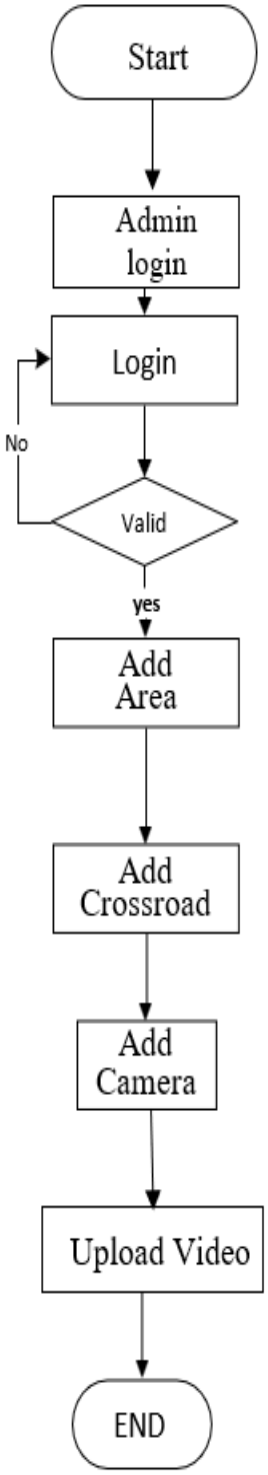


Fig 5.1.6.1 Admin Flow chart

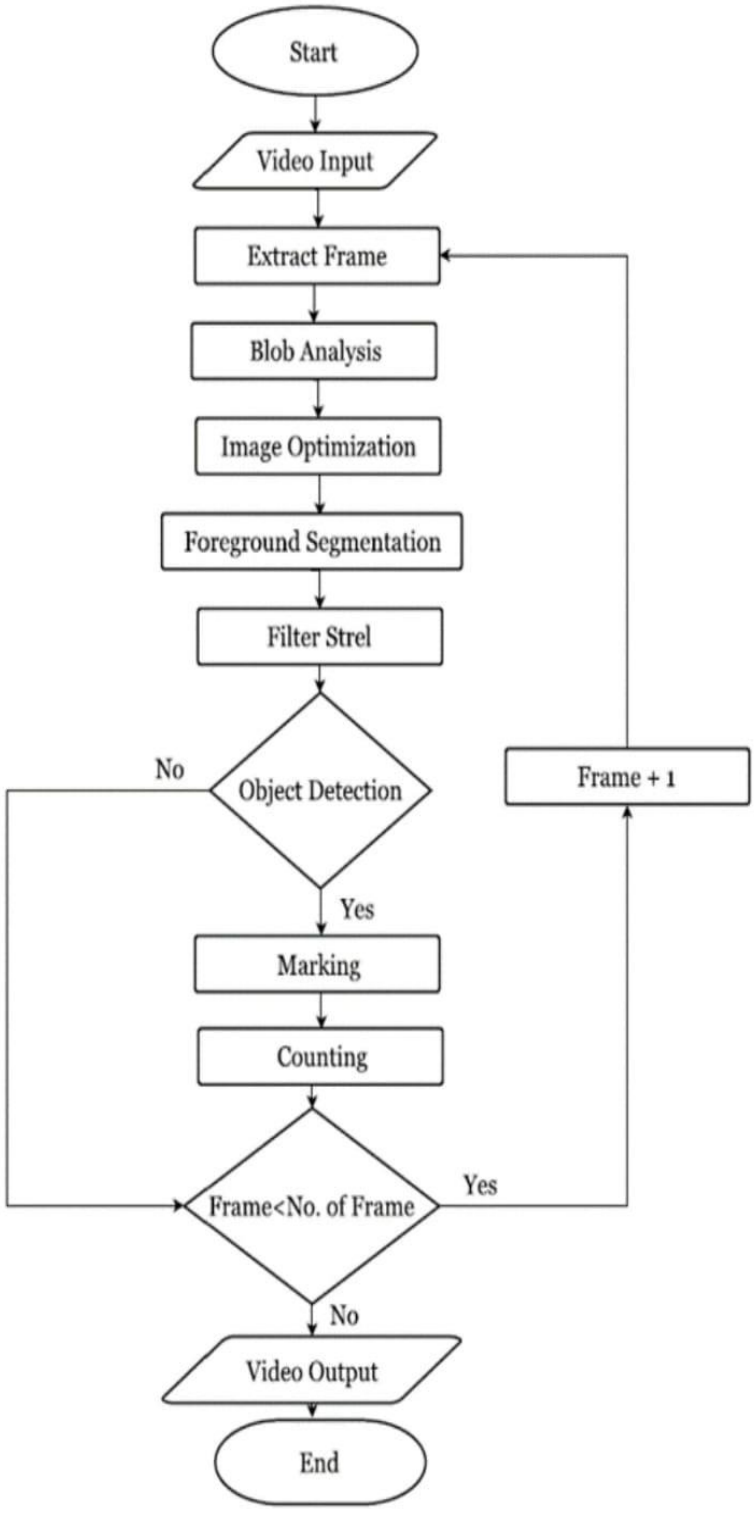


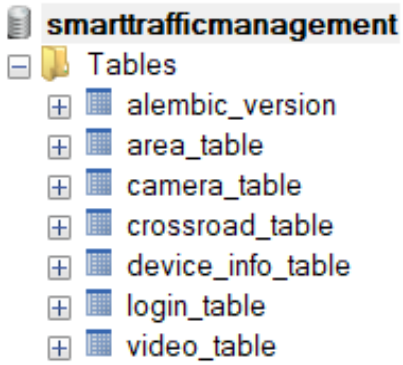
Fig 5.1.6.2 Video Processing Flow chart

5.2 Database Design

A database is typically designed so that it is easy to store and access information. Database Systems or DBMS is software that caters to the collection of electronic and digital records to extract useful informationand store that information. The database design process typically involves identifying the entities or objects that need to be stored in thedatabase.

The data inserted, deleted and updated are stored in the database in anorganized manner which can be easily accessed by the user. The database designing is done keeping in mind the future scalability and modifiability of the system as needed.

The current system has a database of 5 data tables consisting of multiplerecords in each. The database is hosted on MySQL Server. The tables weneeded for the current system is Login table, Area Table, Crossroad Table, Camera Table and Video table.



Data Dictionary :

SR	FEILD	DATA TYPE	CONSTRAINTS	DESCRIPTION
1	login_id	Int (11)	Primary Key	Uniquely identifies admin
2	user_name	Varchar (255)	Not Null	Username
3	password	Varchar (255)	Not Null	Encrypted Password
4	login_role	Varchar (100)	Not Null	Role of person
5	login_status	Tinyint (1)	Not Null	Person status

SR	FEILD	DATA TYPE	CONSTRAINTS	DESCRIPTION
1	area_id	Int (11)	Primary Key	Uniquely identifies Area
2	area_name	Varchar (255)	Not Null	Area Name
3	area_code	Int (11)	Not Null	Area Pin Code

SR	FEILD	DATA TYPE	CONSTRAINTS	DESCRIPTION
1	crossroad_id	Int (11)	Primary Key	Uniquely identifies Crossroad
2	crossroad_name	Varchar (255)	Not Null	Crossroad Name
3	Crossroad_discrip-tion	Int (11)	Not Null	Crossroad discription
4	Crossroad_area_id	Int (11)	Foreign Key	Uniquely identifies Area

SR	FEILD	DATA TYPE	CONSTRAINTS	DESCRIPTION
1	camera_id	Int (11)	Primary Key	Uniquely identifies Camera
2	camera_name	Varchar (255)	Not Null	Camera Name
3	camera_code	Int (11)	Not Null	Camera code
4	camera_link	Varchar (255)	Not Null	Camera link
5	camera_area_id	Int (11)	Foreign Key	
6	Camera_cross-road_id	Int (11)	Foreign Key	

SR	FEILD	DATA TYPE	CONSTRAINTS	DESCRIPTION
1	video_id	Int (11)	Primary Key	Uniquely identifies Video
2	Video_datetime	Datetime	Not Null	Date and time of video
3	Input_video	Varchar (255)	Not Null	Input video
4	Output_video	Varchar (255)	Not Null	Output video
5	Time_diff	Int (11)	Not Null	
6	Entry_count	Int (11)	Not Null	Vehicle entry count
7	Exit_count	Int (11)	Not Null	Vehicle exit count
8	Video_area_id	Int (11)	Foreign Key	
9	Video_crossroad_id	Int (11)	Foreign Key	
10	Video_camera_id	Int (11)	Foreign Key	

CHAPTER 6 - IMPLEMENTATION

6.1 IMPLEMENTATION PLATFORM

The next step after the completion of system design was to start implementing the ideas, layout, features, and functionalities of the systembased on the requirements. The three main platform that were used by usfor the development of the system were:

- JetBrains PyCharm:

  PyCharm is a dedicated Python Integrated Development Environment (IDE) providing a wide range of essential tools for Python developers, tightly integrated to create a convenient environment for productive Python, web, and data science development.

- MYSQL:

  MySQL is a relational database management system based on SQL – Structured Query Language. The application is used for a wide range of purposes, including data warehousing, e-commerce, and logging applications. The most common use for MySQL however,is for the purpose of a web database.

- WERKZEUG:

  Werkzeug is a comprehensive WSGI web application library. It beganas a simple collection of various utilities for WSGI applications and has become one of the most advanced WSGI utility libraries. Flask project is implemented on Werkzeug server and Jinja2 templates.

6.2 TECHNOLOGY/ PROCESS SPECIFICATIONS

TECHNOLOGY SPECIFICATIONS

There were certain different technologies/ languages that were used inthe development of the web application. We worked with technologieslike HTML, CSS, JAVASCRIPT, Python, Flask, Open CV.

- **FRONTEND**
  - HTML is a markup language that is used to structure and organize content on a web page. HTML uses tags to define different elements on a web page, such as headings, paragraphs, images, links, and forms. HTML also provides semantic markup, which

allows developers to define the meaning of content on a web page,making it more accessible to users and search engines.

- CSS is a style sheet language that is used to add visual styling to web pages created with HTML. CSS provides a wide range of properties that can be used to control the appearance of different elements on a web page, such as fonts, colors, backgrounds, borders, and layout. CSS allows developers to separate the presentation of a web page from its content, making it easier to maintain and update.
- JavaScript can be used for client-side form validation to ensure thatuser input is valid before submitting the form to the server. This helps to prevent errors and improve the user experience by providing instant feedback to the user when they enter invalid data.

➢ **BACKEND**

- Python is a high-level, interpreted programming language that is widely used for web development, data analysis, artificialintelligence, scientific computing, and many other applications.
- Flask is a lightweight web framework for Python that is designed to be simple and easy to use. It is often used for building small tomedium-sized web applications, APIs, and microservices.

➢ **AI (ARTIFICIAL INTELLIGENCE)**

- OpenCV is a library of programming functions mainly aimed at real-time computer vision. It is written in C++ and Python and is available for Windows, Linux, and MacOS. OpenCV provides a wide range of functions and algorithms that can be used to process and analyze images and video streams, such as object detection, face recognition, image segmentation, and motion tracking.

PROCESS SPECIFICATION

The entire process of system development was carried out in followingsteps like: Deciding the system design and features as per the requirements, Implementing the layout designed in the previous step and creating a framework of the web application, adding necessary styling elements to the forms, applying validation to the requiredfields, finally connecting the database to the system and respective forms of the application. Various steps of the process that are

performed while developing the projects is,

- DEFINE REQUIREMENTS

  In this phase you gather all the related requirements of system whatyou are going to, develop by discussing the requirements with clientsand discussing with the development team.

- DESIGN SYSTEM ARCHITECTURE

  This phase is between the analysis and implementation stages. In design phase you will make rough design the project, that hoe it is going to look and work. It has some attributes such as:

  - Data Structure
  - Software Architecture
  - Interface Representation
  - Algorithm Details

  The all requirements are translated in some easy to represents fromusing which coding can be done effecting and efficiently. The design needs to be documented for further use.

- CHOOSE TECHNOLOGY

  Select the appropriate technology stack for the system, including hardware and software components. This might include selecting a deep learning framework, a camera system, and a server infrastructure.

- COLLECT DATA AND PREPROCESSING

  Collect a large dataset of vehicles and traffic images and videos, including labeled data for training machine learning algorithms. During this phase we have collected the real-time data while on signal where the height of the camera were at soma height say 15 feet, so that we get an better eye on the vehicles.

- RESEARCH ON OBJECT DETECTION MODELS

  Train and validate machine learning models for vehicle detection using the collected data. This might include object detection models,image classification models, and anomaly detection models. Then after some research is done, we have selected the YOLOV5 model, as it is the mostly used and accurate model for detection of vehicle.

- IMPLEMENTATION SYSTEM

  Implement the vehicle detection system using the selected technology stack, including the camera system, machine learning models, and server infrastructure.

- TESTING

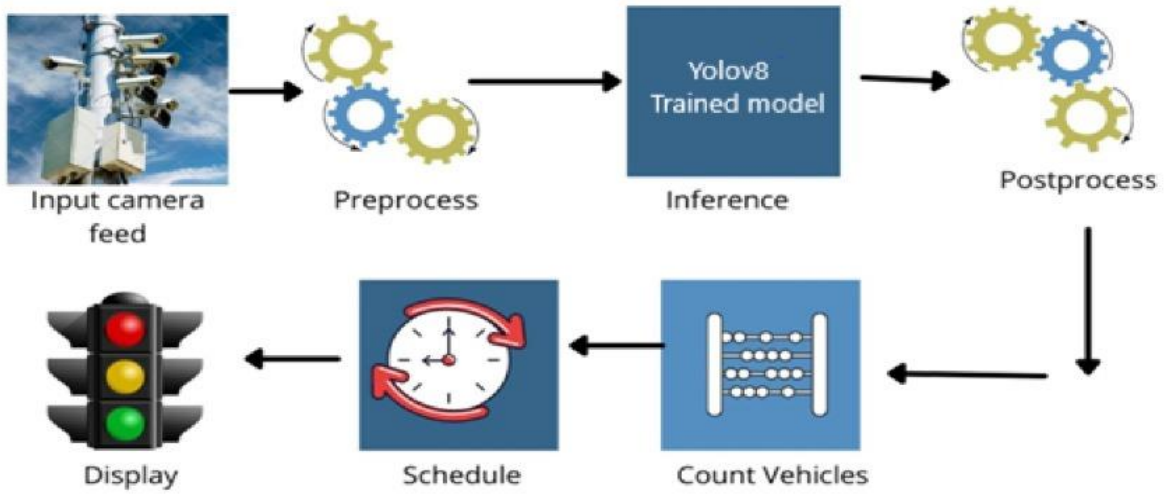
  Test the system to ensure that it meets the requirements and performs accurately and efficiently as it is the crucial part to ensure the reliability and to work without interference. For the testingpurpose we have taken various data from different environments sothat we get the better accuracy of the result and in generalized formso that it works better on the unknown data sets.

- MONITOR SYSTEM

  Continuously monitor the system to ensure that it is performing as expected and make adjustments as needed. As the work can get sometimes complex due to congested traffic on the traffic signal andwe didn't get better detection result and wait time is not appropriate.

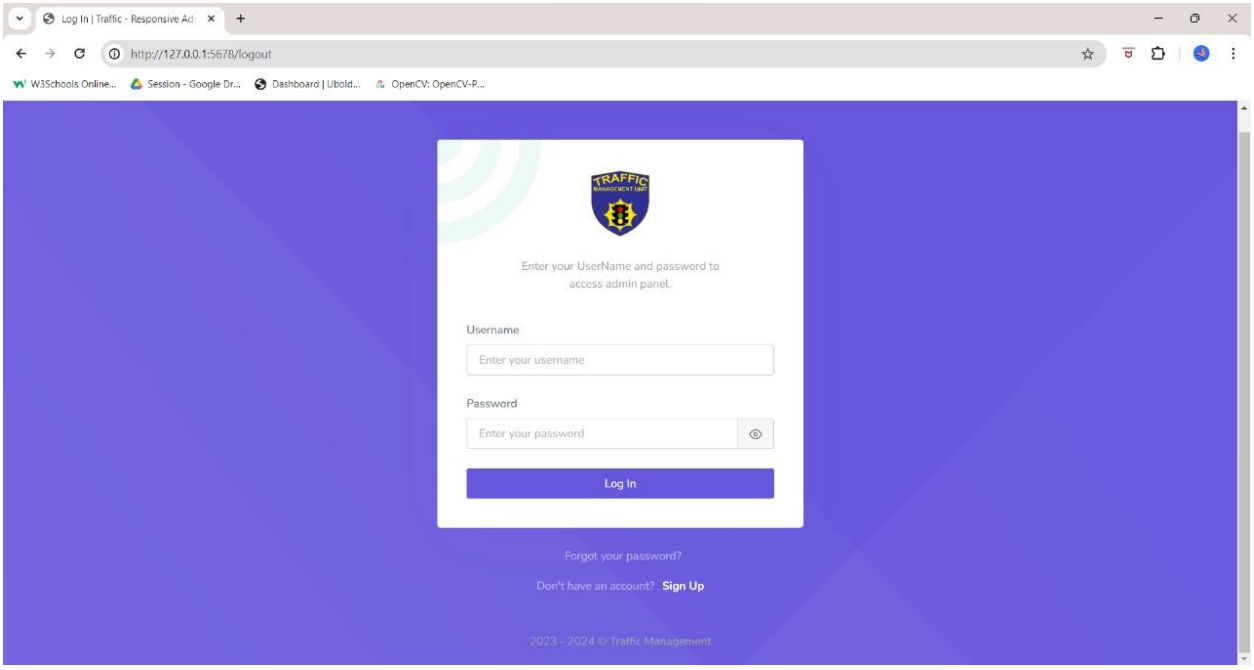
- MAINTAIN SYSTEM

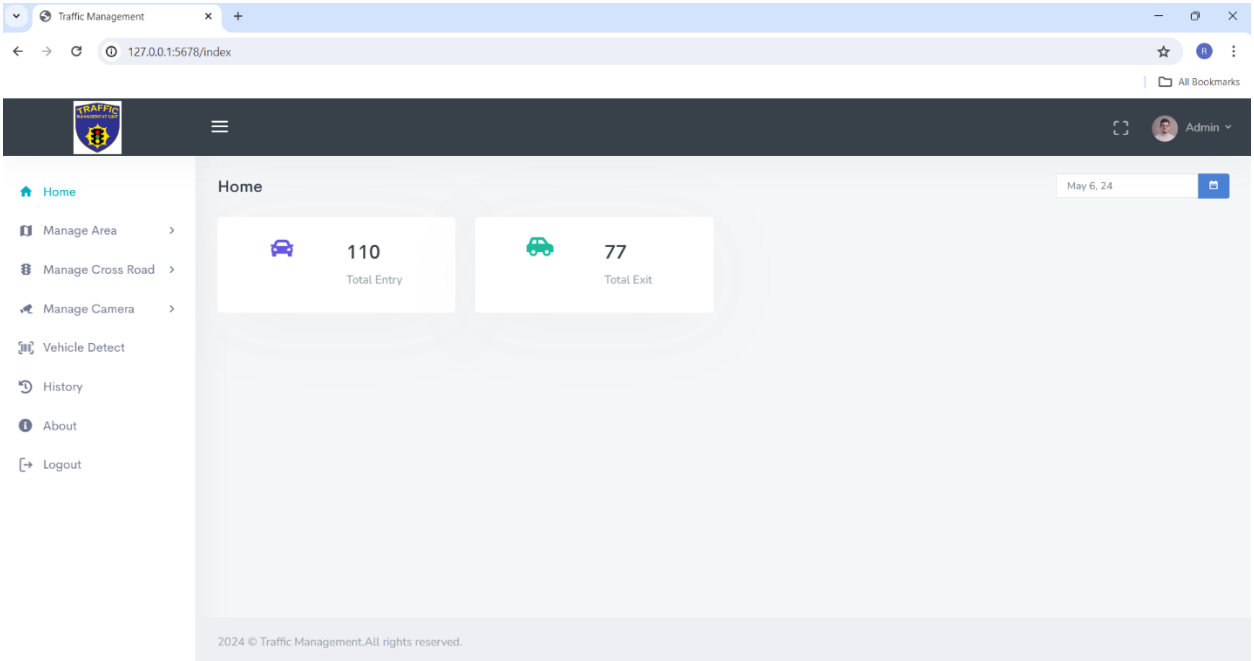
  Maintain the system over time, including updating the softwarecomponents, replacing hardware components as needed, and addressing any issues or bugs that arise. And also give the training tothe professionals on daily basis to keep up with updates of the system and system works accurately.

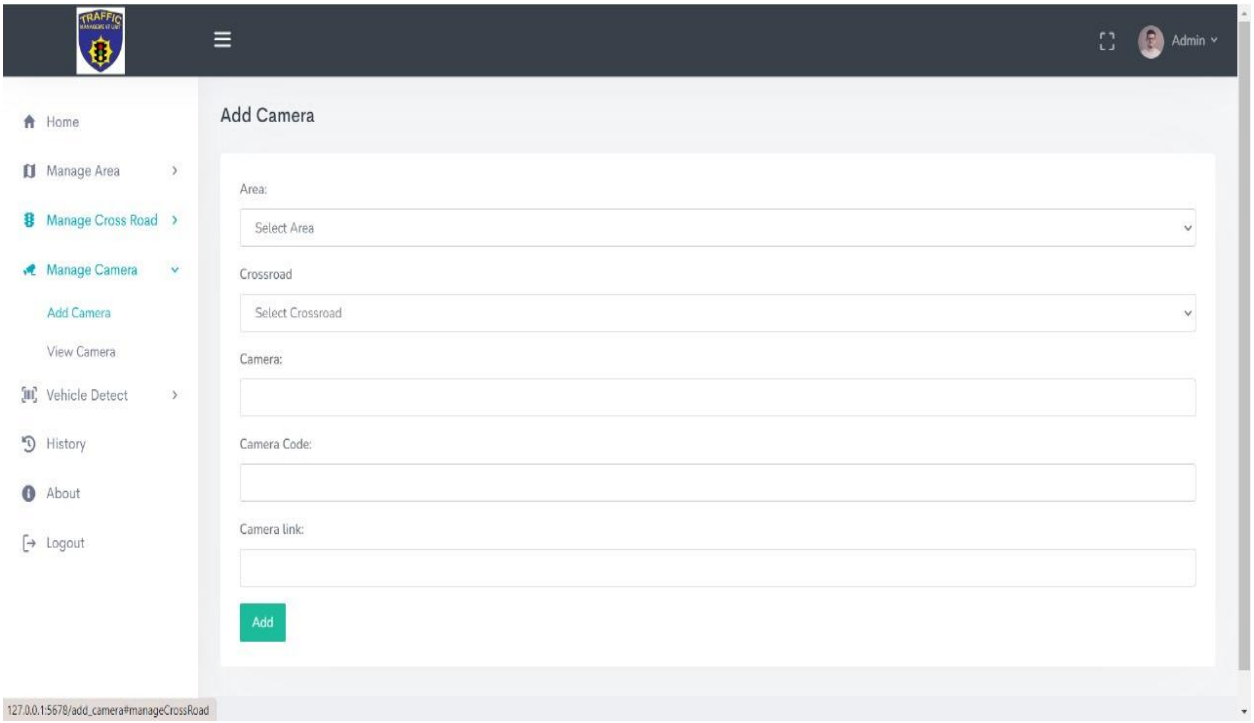


6.3 RESULTS/ OUTCOMES

Finally, after the front end and backend programming we were able to create a system that matches the design and requirements of the web application. Some of the snapshots of the web application created are as






Admin
Home
Manage Area
Manage Cross Road
Manage Camera
Add Camera
View Camera
Vehicle Detect
History
About
Logout
Add Camera
Area:
Select Area
Crossroad
Select Crossroad
Camera:
Camera Code:
Camera link:
Add
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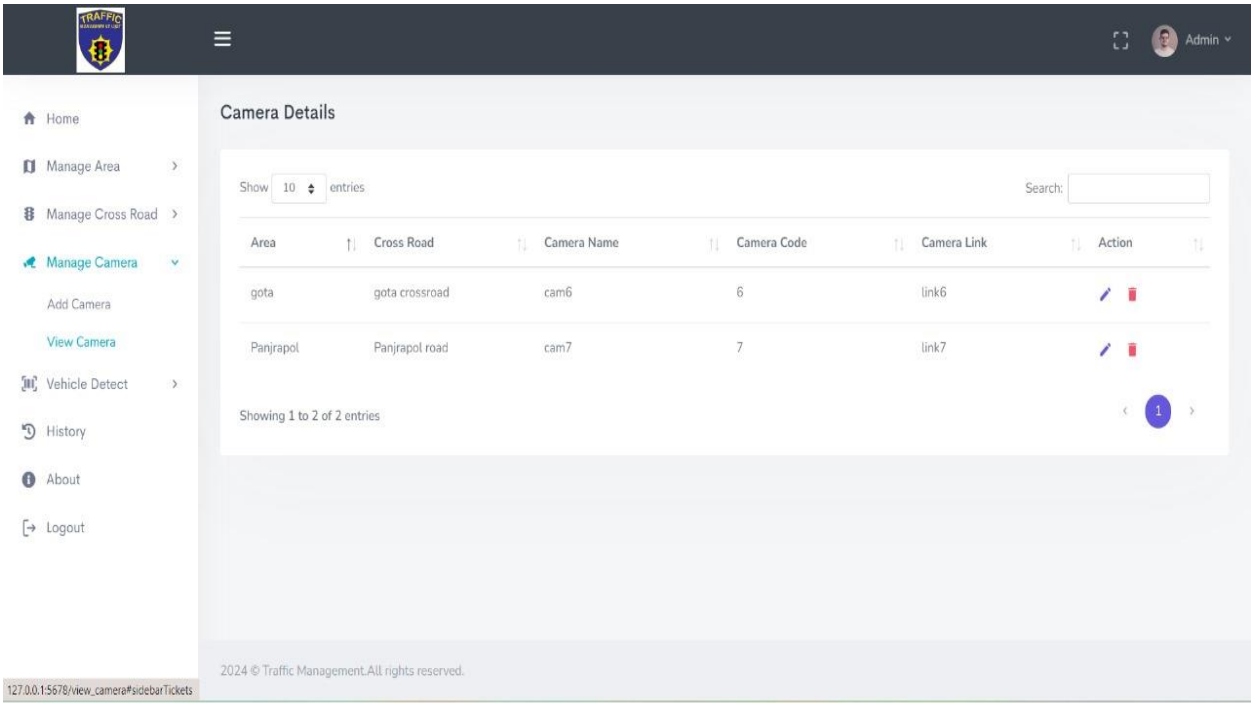
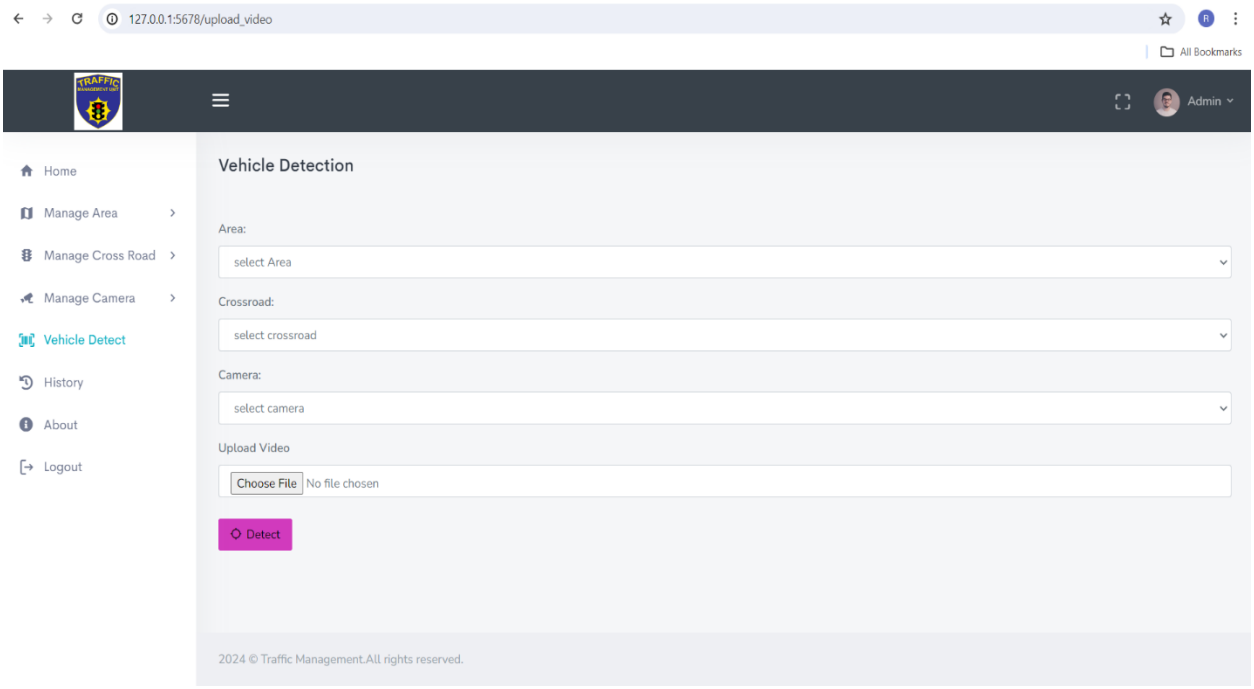
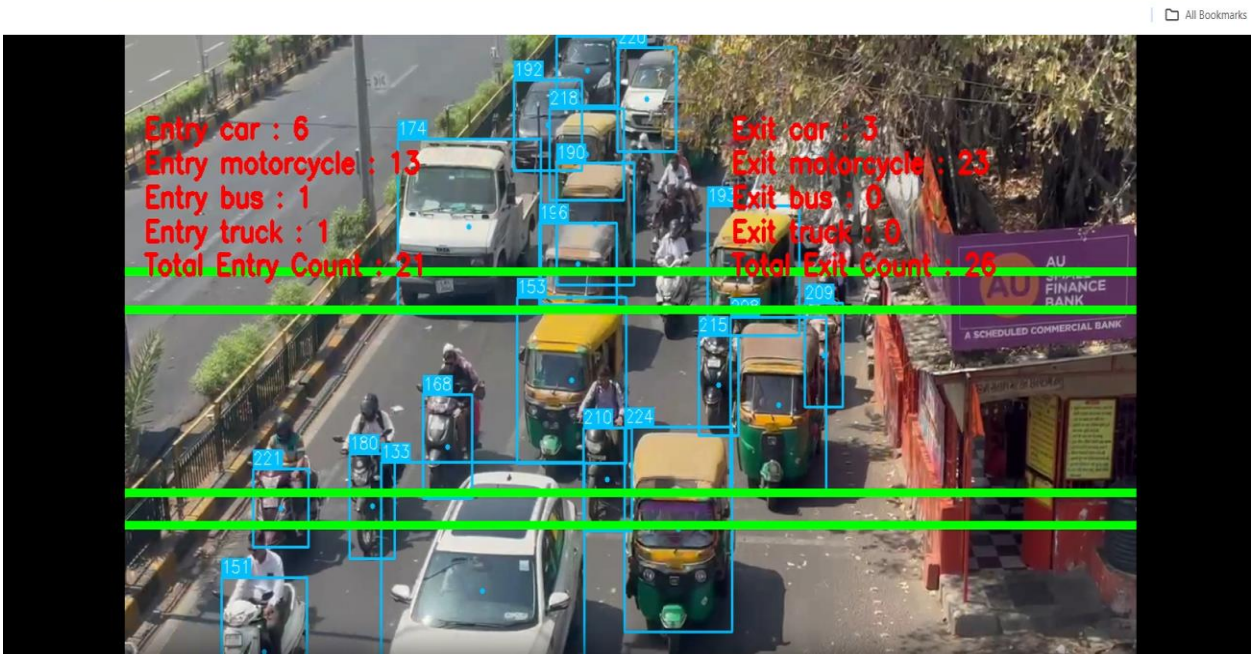

Admin
Home
Manage Area
Manage Cross Road
Manage Camera
Add Camera
View Camera
Vehicle Detect
History
About
Logout
Camera Details
Show 10 entries
Search:
Area
Cross Road
Camera Name
Camera Code
Camera Link
Action
gota
gota crossroad
cam6
6
link6
Panjrapol
Panjrapol road
cam7
7
link7
Showing 1 to 2 of 2 entries
1
2024 © Traffic Management.All rights reserved.
127.0.0.1:5678/view_camera#sidebarTickets


127.0.0.1:5678/upload_video
All Bookmarks
Admin
Home
Manage Area
Manage Cross Road
Manage Camera
Vehicle Detect
History
About
Logout
Vehicle Detection
Area:
select Area
Crossroad:
select crossroad
Camera:
select camera
Upload Video
Choose File
No file chosen
Detect
2024 © Traffic Management.All rights reserved.


All Bookmarks
Entry car : 6
Entry motorcycle : 13
Entry bus : 1
Entry truck : 1
Total Entry Count : 21
Exit car : 3
Exit motorcycle : 23
Exit bus : 0
Exit truck : 0
Total Exit Count : 26

CHAPTER 7 – TESTING

7.1 TESTING STRATEGIES

System testing is a testing to evaluate the functionality of a software application with an intent to find whether the developed software met thespecified requirements or not and to identify the defects to ensure that the product is bug-free in order to produce a quality product. It is performed to test the system beyond the bounds mentioned in the Software Requirements Specification (SRS).

The company's testing strategy was quite distinctive and aggressive. It consisted of several different testing strategies to make sure that the system created is efficient and stands true to all the expectations of the user.

Software testing can be divided into two steps:

- **VERIFICATION**: it refers to the set of tasks that ensure that thesoftware correctly implements a specific function.
- **VALIDATION:** it refers to a different set of tasks that ensure that thesoftware that has been built is traceable to customer requirements.

Different testing strategies used are as follow:

- **FUNCTIONALITY TESTING**: Functional testing is a kind of black-box testing that is performed to confirm that the functionality of an application or system is behavingas expected.
- **USABILITY TESTING**: It is a type of testing method for measuring how easy and User-friendly a software is, carried out by a small focus group similar to the users of the system. It's also known as User Experience (UX) Testing. It tests how easily can a user navigate through the system.
- **INTERFACE TESTING**: Three areas are tested here: Application, Database and Web Browseras all of them are interacting with each other.
    - APPLICATION**:** Test requests are sent correctly to the Databaseand output at the client side is displayed correctly.

  - WEB SERVER: Test Web server is handling all application requestswithout any service denial.
  - DATABASE SERVER: Make sure queries sent to the database giveexpected results.

- **DATABASE TESTING:** It is a type of software testing that checks the schema, tables, triggers, etc. of the Database under test. It also checks data integrityand consistency. It checks whether the data entered in the web application is stored correctly in the database and vice versa.

- **COMPATIBILITY TESTING**: Compatibility testing is a part of non-functional testing conducted onapplication software to ensure the application's compatibility with different computing environment. Different web browsers like Google Chrome, Opera, etc. were used to test the system.

7.1.1 BLACK BOX TESTING FOR TRAFFIC MANAGEMENT

Black Box testing is a type of software testing that focuses on testing the system's external behavior without knowledge of its internal working of the programs behind it. When it comes to traffic management, black box testing can be used to evaluate the system's ability to detect and monitor traffic in a reliable and accurate manner.

Overall, black box testing can help to ensure that a traffic managementsystem is functioning correctly and meeting the need of its users, without requiring detailed knowledge of the system's internal working.

7.1.2WHITE BOX TESTING FOR TRAFFIC MANAGEMENT

White box testing is a type of software testing that involves analyzingthe internal workings of a system to ensure that it is functioningcorrectly. In our case, white box testing can be used to assess thesystem's code and algorithms to ensure that they are working properly.

Mainly, the source code of the identified components and ensure thatit conforms to best practice sand coding standards. Identify potential errors and issues that could impact system's performance.

Overall, white box testing can help to ensure that a traffic managementsystem's code and algorithms are working correctly and can identify issue and solve it for better performance.

7.2 TEST RESULT AND ANALYSIS

Based on the above testing strategies several test cases were deduced in order to ensure the efficient and smooth functioning of the system. A briefdetail about different test cases and their results are as follows:

TEST CASES

TEST CASE FOR ADMIN LOGIN

- Make use of legitimate admin credentials to evaluate the adminlogin capability.
- Use faulty admin credentials to test the admin login capability.
- Ensure that after a successful login, the admin is taken to theirdashboard.
- Check to see if an error message appears after a failed login.

TEST SCENARIO FOR VEHICLE TRACKING AND COUNTING

- **Varying vehicle sizes**: Test the accuracy of the vehicle detection system on different sizes of vehicles.
- **Different lighting conditions**: Test the accuracy of the vehicle detection system in different lighting conditions, such as bright daylight, low light, and night-time.
- **Vehicles with different types of movements**: Test the vehicle detection system on vehicles with different types of movements, such as stationary vehicles, slow-moving vehicles, and fast-moving vehicles.
- **Vehicles with different levels of density**: Test the vehicle detection system on vehicles with different levels of density, such as sparse vehicles and dense vehicles.
- **Vehicles with overlapping**: Test the vehicle detection system onoverlapped vehicles.
- **Vehicles with different category**: Test the vehicle detection system on vehicles with different types of categories, such as car, bus, truck,motorcycle.
- **Vehicles with different camera angles**: Test the vehicle detection system on vehicles captured from different camera angles, such as overhead shots or ground-level shots.
- **Vehicles with occlusions**: Test the vehicle detection system on vehicles with occlusions, such as vehicles with obstructed views due to buildings, people coming around it while on pedestrian crossing, or other obstacles.

DATABASE MANAGEMENT TEST SCENARIO FOR ADMIN

- Keeping all the detected video in database.
- We are providing history section which shows all detected videos.
- Testing on Adding video and Deleting Video.

DETECTION TEST CASE

- We are providing automatic detection feature which generatesvehicle detected video.
- Also detected video contains entry and exit counts of vehicles.
- Make that the system guards against unapproved access and datamodification.

SYSTEM PERFORMANCE TEST CASE

- In order to evaluate the system's performance, simulate intensiveusage.
- Make that the system is responsive and reliable even when it is beingheavily used.

CHAPTER 8 – CONCLUSION AND DISCUSSION

8.1 Overall Analysis of Internship/Project Viabilities

Our project is based on traffic management. The current traffic control system in India are inefficient due to randomness in the traffic density pattern throughout the day. The traffic signal times have a fixed time period to switch traffic between different directions. Due to this, the vehicles have to wait for a long time even if the traffic density is less, so our project is on signal timer. If the traffic signal timer can be programmed to be manipulated with the continuously varying traffic density, the problem of traffic can be reduced to a lower level. The proposed system adapts the random traffic density using image processing technique. This model uses high resolution cameras to sense the changing traffic patterns.

Throughout the project, our mentor provided us with continuous feedback and valuable suggestions. This feedback helped us to improve our work and make necessary changes to ensure the success of the project. We carefully considered this feedback and incorporated it into our work, which paved the way for the successful completion of the project.

Some of the key factors of this internship are:

- **Learning opportunities:** An internship should provide opportunities for you to learn new skills and gain valuable experience in your field of interest. Consider whetherthe internship will allow you to work on challenging projects, learn fromexperienced professionals, and gain exposure to different aspects of theindustry.
- **Networking opportunities:** An internship provided us opportunities to build professional relationships and network with other professionals in your field. Consider whether the internship will allow you to meet and work with professionals in your industry and whether it will provide opportunitiesfor you to attend industry events or conferences.
- **Compensation:** Consider whether the internship provides fair compensation for the work you will be doing. This might include a salary, stipend, or other benefits such as housing or transportation.
- **Company culture:** Consider whether the company has a culture that aligns with your values and work style. This might include factors such as work-lifebalance, company mission,

and company policies and practices.

- **Career prospects:** Consider whether the internship will provide opportunities for career advancement or help you build a portfolio of work that will be attractiveto future employers.

The viability of an internship focused on developing a traffic management system with a Flask dashboard depends on a number of factors, including the availability of resources, the specific requirements of the project, and the skills and experience of the intern.

Some of the key features of the system we developed are:

- **Technical Knowledge:** Developing a traffic management system using the Flask dashboard requires expertise in machine learning, computer vision, and web development. We had a strong background in these areas with a focus on Python programming, the Flask web framework, and data analysis tools such as NumPy, Pandas, and Scikit-learn.
- **Availability of resources:** Developing a traffic management system requires access to resources such as a large dataset of vehicle images and videos, powerful hardware, and a reliable Internet connection. We had access to these resources in order to work effectively on the project.
- **Project Requirements:** Specific traffic management system requirements will affect the viability of the internship. For example, if a project requires the integration of multiple technologies, such as a camera system, a machine learning framework, and a web dashboard, we had the technical knowledge to work effectively with these technologies.
- **Time frame:** The internship time frame should be sufficient to allow traffic management system development, testing and deployment. We also had enough time to work on our skills and gain knowledge about new technologies.

8.2 Problem Encountered and Possible Solutions

Performance issues: The system may be slow or unresponsive, especially when dealing with large amounts of data. This addressed by optimizing the code, using caching mechanisms, or scaling up the hardware resources.

Security vulnerabilities: The system may be vulnerable to hacking, data breaches, or

other security threats. This mitigated by implementing strong authentication and authorization mechanisms, encrypting sensitive data, and performing regular security audits.

Integration issues: The system may have difficulty integrating with other existing systems or APIs. This resolved by carefully designing the integration points, using standardized protocols, and conducting thorough testing before deployment.

User adoption: The system may be difficult for users to learn and use, leading to low adoption rates. This addressed by conducting user research, designing a user-friendly interface, and providing adequate training and support.

Cost overruns: The development costs may exceed the budget, causing delays or even project cancellation. This avoided by conducting thorough cost estimation, monitoring the project closely, and making necessary adjustments to stay within budget.

8.3 Conclusion

• Thus, our project creates an awareness about the automation in traffic system. It thereby reduces human effort and traffic congestion. By the implementation of this system, traffic rules can be regulated and violators will be reduced. This system reduces the waiting time as traffic signal's light will change according to current traffic density. So it also reduces traffic jams.

• Blinking of traffic signal light according to the traffic level present on the road.

• Easy traffic regulation in busy cities such as Delhi, Mumbai etc.

• Help the traffic police in easy control of traffic.

• A modernized way of controlling traffic.

8.4 Limitation and Future Enhancement

Limitation in Current System

- Sometimes our system may not count vehicles properly because of camera limitation and sometimes due to bad weather algorithm may not work properly because of camera limitation.
- Our system not recognise emergency vehicle like Ambulance and fire brigade vehicles so sometimes due to our system that type of vehicle may stuck in traffic. But we will trying to solve this problem in the future.
- A lack of data or of reliable data will likely require you to limit the scope of your analysis, the size of your sample, or it can be a significant obstacle in finding a trend and a meaningful relationship. You need to not only describe these limitations but to offer reasons why you believe data is missing or is unreliable. However, don't just throw up your hands in frustration; use this as an opportunity to describe the need for future research.

Future Enhancement

- **Improved Accuracy:** One of the most important enhancements to a traffic management system would be to improve its accuracy. This could be done by using more advanced computer vision algorithms or machine learning modelsto better identify and classify vehicles at traffic signals in congestion andbetter-quality cameras.
- **Real-time monitoring**: Another important enhancement would be to enable real-time monitoring of vehicle's activity. This would require faster processing speeds and more sophisticated algorithms to quickly analyze and interpret data.
- **Integration with other systems**: Traffic management systems could be enhanced by integrating with other systems such as security cameras, public address systems, and emergency response systems. This would enable more coordinated andeffective responses to incidents such as accidents, pot holes etc.
- **Contextual Awareness**: Traffic management systems could be enhanced by incorporating contextual awareness, such as the time of day, weather conditions, or the location of the event. This would enable more customized responses to specific vehicle density at particular time.
- **Privacy Protection**: As traffic management systems become more advanced, it will be important to ensure that they are designed with privacy in mind. This could involve using

encryption or other privacy-enhancing technologiesto protect the identities of individual's vehicles by protecting number plates data.

- **Compatibility With Multiple Camera Types**: Traffic management systems could be enhanced by improving their compatibility with different types of cameras, such as thermal cameras,which can detect heat signatures, or 360-degree cameras, which can capture a full view of the traffic signal with better quality.
- **Integration With Smart City Technology**: Traffic management system could be integrated with other smart city technologies, such as public transportation system, emergency response system, etc. This could help create a more efficient and coordinated city wide management system.

REFERENCES

- https://stackoverflow.com/
- https://medium.com/search?q=Deep+learning+models
- https://themeforest.net/
- https://www.w3schools.com/
- https://www.geeksforgeeks.org/
- https://docs.opencv.org/4.x/
- https://flask.palletsprojects.com/en/2.2.x/