A PROJECT REPORT

On

"SMART EYE"

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF

DIPLOMA IN

COMPUTER ENGNEERING

SUBMITTED TO

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

SUBMITTED BY

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GUIDED BY

Mr. N. B. Nake

GOVERNMENT POLYTECHNIC AHMEDNAGAR

DISTRICT AHMEDNAGAR

MAHRASHTRA

2022-23

GOVERNMENT POLYTECHNIC

AHMEDNAGAR

CERTIFICATE

This is to Certify that the project report entitled "SMART EYE" was successfully completed by Student of sixth semester Diploma in Computer Engineering.

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in partial fulfillment of the requirements for the award of the Diploma in Computer Engineering of Government Polytechnic Ahmednagar work carried out during a period for the academic year 2022-23 as per curriculum.

Mr. N. B. Nake
Guide

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HOD, Department of Computer Engineering

Mr. B. M. Kardile
Principal
Government Polytechnic Ahmednagar

External Examiner

ACKNOWLEDGMENT

We would like to place on record my deep sense of gratitude to **Prof. N. B. Nake, Dept. of Computer Engineering/Technology** for his generous guidance, help and useful suggestions.

We would like to express our sincere gratitude to **Prof. S. D. Muley, Head of Dept. of Computer Engineering/Technology**, for his stimulating guidance, continuous encouragement and supervision throughout the course of present work.

We are extremely thankful to **Prof. B. M. Kardile, Principal, Government Polytechnic, Ahmednagar** for providing us infrastructural facilities to work in, without which this work would not have been possible.

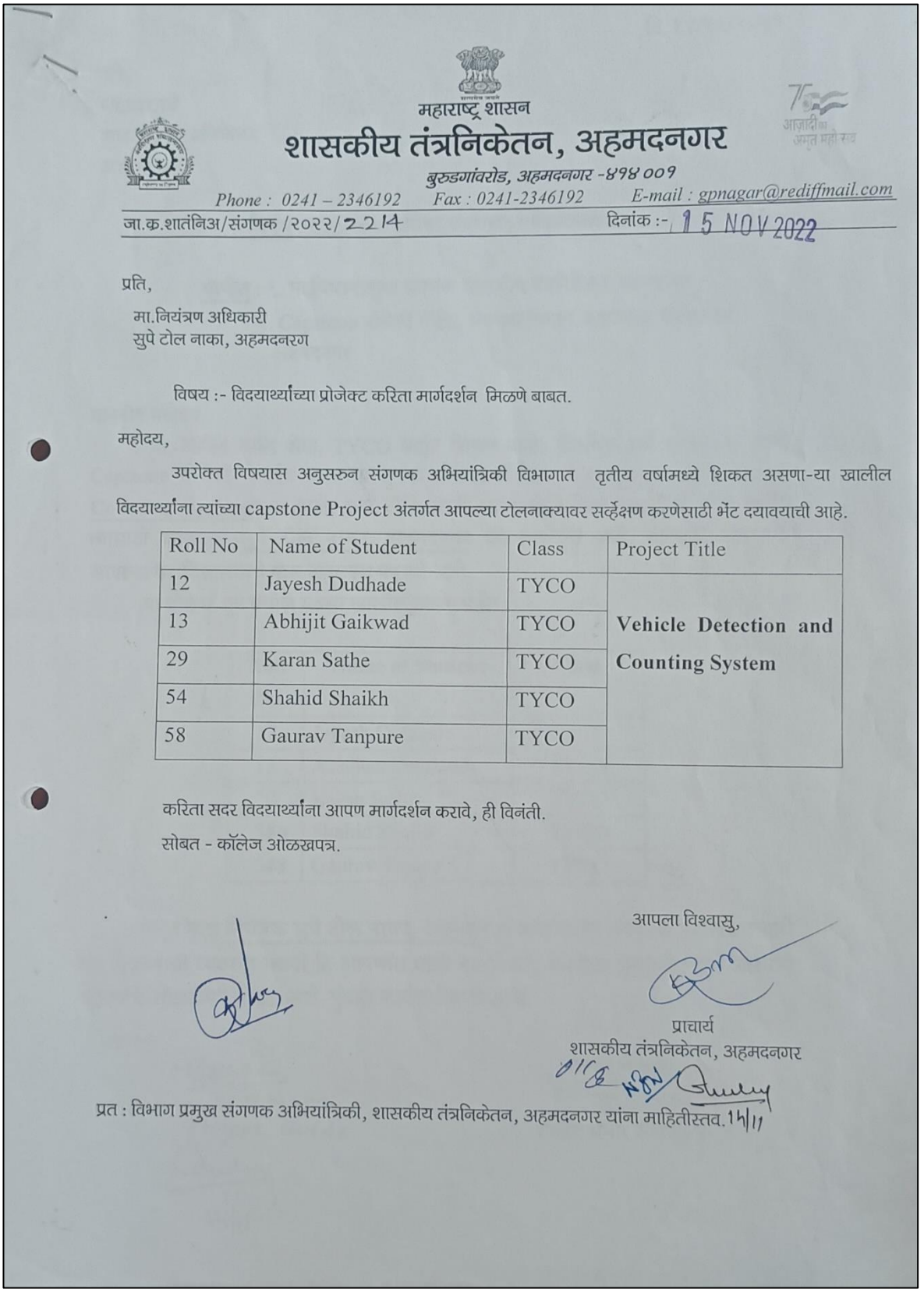
We are extremely thankful to **Manager of Supa Toll Plaza, Ahmednagar** for supporting us to conduct a survey and providing us basic knowledge of existing systems in market.

We are extremely thankful to **Mr. B. N. Thange, Director, Thange Transport Service Pvt. Ltd., Ahmednagar** for giving us sponsorship and their support to this project.

Signatures: -

1. Shaikh Shahid Sameer *(Team Leader)*
2. Dudhade Jayesh Bhausaheb
3. Gaikwad Abhijeet Popat
4. Karan Sathe
5. Tanpure Gaurav Shivaji

SURVEY LETTER



महाराष्ट्र शासन

शासकीय तंत्रनिकेतन, अहमदनगर

बुरुडगांवरोड, अहमदनगर -४९४००१

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जा.क.शातंनिअ/संगणक /२०२२/२२१४ दिनांक :- 15 NOV 2022

प्रति,

मा.नियंत्रण अधिकारी
सुपे टोल नाका, अहमदनरग

विषय :- विदयार्थ्यांच्या प्रोजेक्ट करिता मार्गदर्शन मिळणे बाबत.

महोदय,

उपरोक्त विषयास अनुसरुन संगणक अभियांत्रिकी विभागात तृतीय वर्षामध्ये शिकत असणा-या खालील विदयार्थ्यांना त्यांच्या capstone Project अंतर्गत आपल्या टोलनाक्यावर सर्व्हेक्षण करणेसाठी भेंट दयावयाची आहे.

Roll No	Name of Student	Class	Project Title
12	Jayesh Dudhade	TYCO	**Vehicle Detection and Counting System**
13	Abhijit Gaikwad	TYCO	
29	Karan Sathe	TYCO	
54	Shahid Shaikh	TYCO	
58	Gaurav Tanpure	TYCO	

करिता सदर विदयार्थ्यांना आपण मार्गदर्शन करावे, ही विनंती.

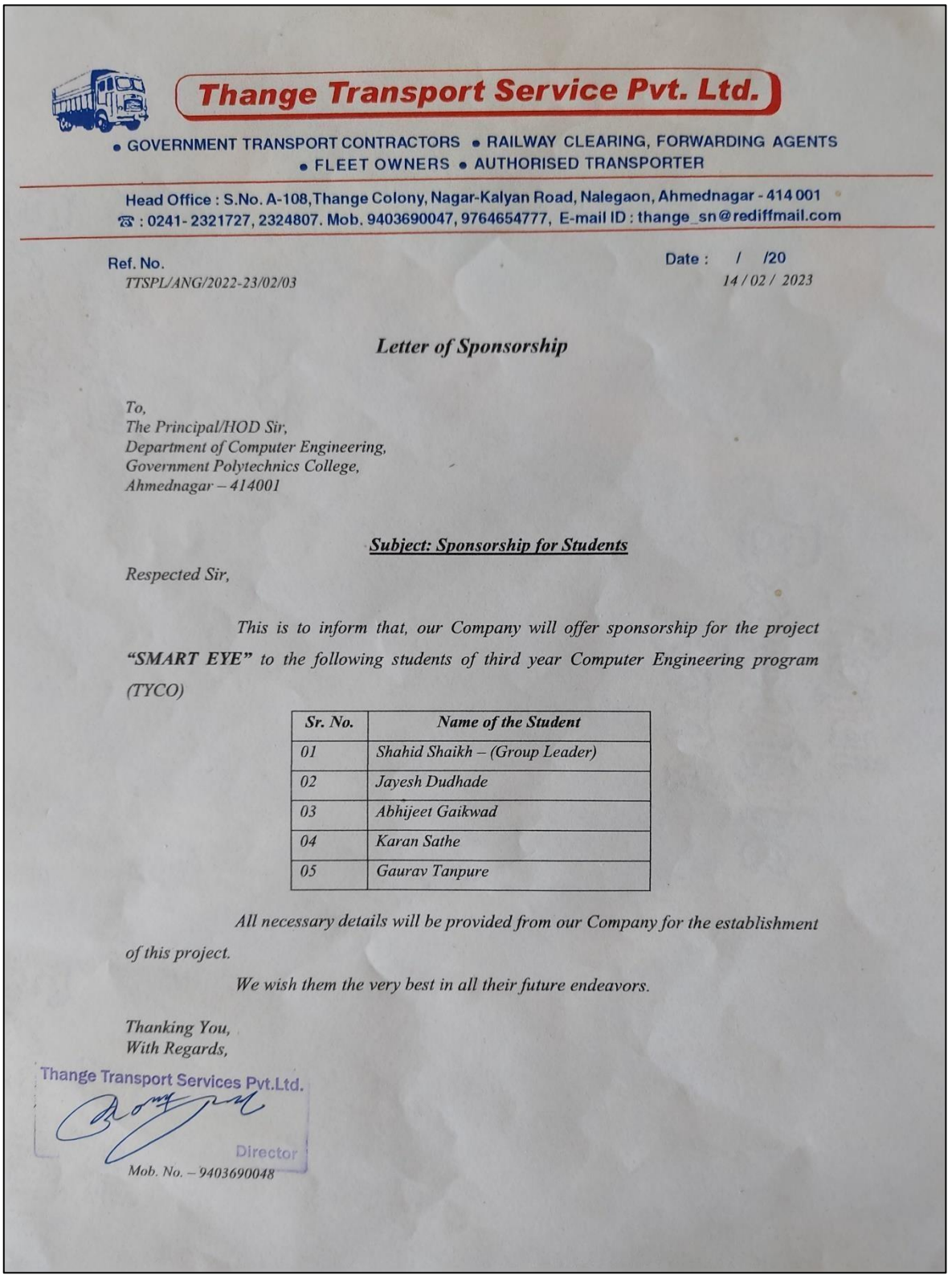
सोबत - कॉलेज ओळखपत्र.

आपला विश्वासु,

प्राचार्य
शासकीय तंत्रनिकेतन, अहमदनगर

प्रत : विभाग प्रमुख संगणक अभियांत्रिकी, शासकीय तंत्रनिकेतन, अहमदनगर यांना माहितीस्तव. 14/11

LETTER OF SPONSORSHIP



Thange Transport Service Pvt. Ltd.

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Head Office : S.No. A-108, Thange Colony, Nagar-Kalyan Road, Nalegaon, Ahmednagar - 414 001
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Ref. No.
TTSPL/ANG/2022-23/02/03

Date : / /20
14 / 02 / 2023

Letter of Sponsorship

To,
The Principal/HOD Sir,
Department of Computer Engineering,
Government Polytechnics College,
Ahmednagar – 414001

Subject: Sponsorship for Students

Respected Sir,

This is to inform that, our Company will offer sponsorship for the project ***"SMART EYE"*** to the following students of third year Computer Engineering program (TYCO)

Sr. No.	Name of the Student
01	Shahid Shaikh – (Group Leader)
02	Jayesh Dudhade
03	Abhijeet Gaikwad
04	Karan Sathe
05	Gaurav Tanpure

All necessary details will be provided from our Company for the establishment of this project.

We wish them the very best in all their future endeavors.

Thanking You,
With Regards,

Thange Transport Services Pvt.Ltd.
Director
Mob. No. – 9403690048

ABSTRACT

The **“SMART EYE”** is a Python-based system designed to provide a comprehensive solution for monitoring and management of vehicles in various sectors like traffic management, law enforcement, parking management, transportation, toll plaza management. It features four primary modules: vehicle counting, speed detection, vehicle classification, and number plate detection. The vehicle counting module accurately counts the number of vehicles passing through a particular point and stores the data in an Excel sheet with the time and date. The speed detection module can detect the speed of vehicles and issue alerts if the speed limit is exceeded, providing a critical safety feature in school zones, residential areas, and busy intersections. The vehicle classification module can classify different types of vehicles and provide valuable insights into traffic patterns and volume. The number plate detection module can detect number plates and automatically store images to the number plates folder and converted text to excel sheet with time and date. The system operates on both live and recorded footage, making it suitable for various sectors, including traffic authorities, parking operators, and toll plaza management teams. It can also assist law enforcement agencies in investigating and solving crimes, making our communities safer. The data collected by the features can be stored in Excel sheets for further analysis and reporting, providing a valuable tool for optimizing road networks, public transportation routes, and parking facilities. Overall, the "SMART EYE" system has the potential to revolutionize the way we monitor and manage vehicle movements in various sectors, making it an essential asset in the modern world.

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CHAPTER 01

INTODUCTION

1.1 Overview

In today's world, where population growth and urbanization have resulted in increased vehicular traffic, managing vehicle movements has become increasingly important for various sectors, including traffic management, transportation, law enforcement, parking management, and toll plaza management.

The "SMART EYE" system aims to provide a comprehensive solution for monitoring and managing vehicles in various sectors. The system comprises four primary modules that work together seamlessly to provide real-time data on vehicle movements and speed, vehicle types, and number plate detection. The vehicle counting module accurately tracks and counts the number of vehicles passing through a particular point, while the speed detection module alerts the user if the speed limit is exceeded, providing a critical safety feature in school zones, residential areas, and busy intersections. The vehicle classification module offers valuable insights into traffic patterns and volume by classifying different types of vehicles, and the number plate detection module detects number plates and automatically stores images and text to Excel sheets with time and date. The "SMART EYE" system's ability to operate on both live and recorded footage makes it an ideal solution for various sectors, enabling them to optimize their operations and provide a safer environment. The data collected by the system can be analyzed and reported on to improve road networks, public transportation routes, and parking facilities, making it an essential tool for modern society. The "SMART EYE" system is a revolutionary technological innovation that has the potential to change the way we monitor and manage vehicle movements in various sectors.

1.2 Objective

The primary objective of the "SMART EYE" system is to provide an innovative solution for efficient and effective monitoring and management of vehicles across various sectors, such as transportation, security, law enforcement, parking, and toll plaza management.

- To develop a Python-based system that features four primary modules, including vehicle counting, speed detection, vehicle classification, and number plate detection.
- To provide valuable features that can benefit various sectors, including security agencies, law enforcement agencies, parking operators, and toll plaza management teams.
- To operate on both live and recorded footage and store data in Excel sheets for further analysis and reporting.
- To improve the accuracy, efficiency, and usability of monitoring and management activities by automating the process of vehicle counting, speed detection, vehicle classification, and number plate detection.
- To enhance security measures in various sectors by providing a system that can detect and recognize vehicle number plates and classify different types of vehicles.
- To provide a real-time analysis of the traffic flow and vehicle movement patterns to improve transportation planning and management.
- To enable law enforcement agencies to track and monitor the movement of vehicles for effective investigation and enforcement of traffic laws.
- To reduce traffic violations and accidents by detecting and reporting speeding and other violations, and provide a system for parking and toll plaza management.

1.3 Purpose and organization of project report

The purpose of the "SMART EYE" system is to provide a comprehensive solution for traffic management, law enforcement, parking operators, and toll plaza management teams to effectively monitor and manage traffic flow, detect traffic violations, and improve overall traffic safety. The system is designed to detect and report speeding and other traffic violations, count vehicles and classify them by type, and automatically capture number plates and store the data in an Excel sheet with a timestamp for future reference. Additionally, the system can be integrated with live cameras or recording devices for real-time monitoring and analysis. The purpose of this report is to provide a detailed analysis and documentation of the development and implementation of the "SMART EYE" system. The report outlines the objectives, methodology, and results of the project, including the features and functions of the system, the programming language and tools used, and the data processing and storage methods. The report also includes a discussion of the potential benefits and applications of the system in various sectors, such as traffic management, law enforcement, parking, and toll plaza management. Furthermore, the report highlights the limitations and future scope of the system and provides recommendations for further development and improvement. The primary audience for this report includes researchers, practitioners, and policymakers in the fields of traffic management, law enforcement, and transportation. Organization of Project Report includes total 10 chapters. Chapter 1 is related with introduction of the project which includes overview, objectives and purpose of the project. Chapter 2 includes a literature survey which consists of motivation, existing system and proposed system. Chapter 3 includes problem definition and system design which consist of problem statements, scope, system requirements specification, system design, technologies to be used, assumption, constraints, user interface design. Chapter 4 includes object-oriented models which consist of need of modeling, E-R diagram, activity diagram, data flow diagram, use case diagram. Chapter 5 includes a project plan which consists of overview, project estimates, and project schedule. Chapter 6 includes test plan and reports which consist of goals and objectives, test procedure and reports. Chapter 7 includes future scope. Chapter 8 includes conclusion. Chapter 9 includes Appendix which consist glossary (definition / abbreviation), achievements. Chapter 10 includes bibliography.

CHAPTER 02

LITERATURE SURVEY

2.1 Existing System

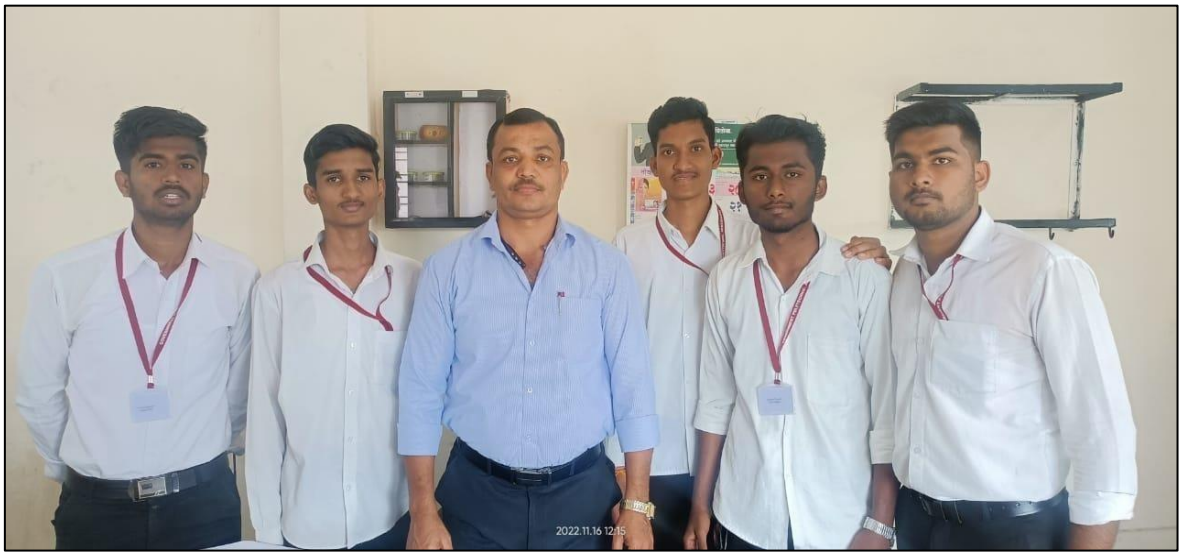
For decades, various systems have been developed and implemented to monitor and manage vehicles in different sectors to ensure safe and efficient traffic flow. The first systems were developed in the 1960s and relied on basic sensors to detect the presence and count of vehicles. Automatic number plate recognition (ANPR) system, which was first introduced in the 1970s. Over time, these systems have undergone significant advancements, resulting in more advanced solutions that can now detect vehicle speed, classification, and license plate numbers.

Today, several existing vehicle monitoring and management systems are widely used in various sectors. Traffic management systems such as "SCATS" and "MIST" use sensors to count the number of vehicles passing through specific points and are commonly used in traffic management and toll collection applications. Speed cameras such as "Vitronic PoliScan" and "Jenoptik TraffiStar" use radar and laser technology to accurately detect vehicle speed and issue alerts if the speed limit is exceeded. These systems are typically deployed in school zones, residential areas, and busy intersections, where speed limits are strictly enforced to ensure public safety. License plate recognition and vehicle classification systems such as "FLIR ITS-Series Dual HD," "Tattile Vega Basic," "Plate Smart," and "Neology" use machine learning algorithms to accurately identify and classify vehicles based on various parameters such as size, shape, and weight. License plate recognition systems can also read and store license plate numbers, which can be used by law enforcement agencies to track and investigate vehicles.

These existing systems have proven to be valuable tools in monitoring and managing vehicle movements in various sectors, including traffic authorities, parking operators, toll plaza management teams, and law enforcement agencies. While each system offers unique functionalities, the combination of all four features into a single, integrated platform like the "SMART EYE" system can provide a comprehensive solution for efficient vehicle monitoring and management. However, the availability of these existing systems indicates the continued importance of monitoring and managing vehicle movements in today's modern world.

To gain basic knowledge about existing system, our team conducted survey at Supa Toll Plaza.

2.1.1 Supa Toll Plaza



2.1.2 With Supa Toll Plaza Manager

2.1.3 With Supa Toll Plaza Workers

By conducting this survey, we got some basic knowledge about existing systems in the market.

2.2 Limitations of existing System

There are several challenges in the existing systems. They are listed in the following:

- Limited accuracy, high maintenance costs, compatibility issues, and security concerns: Existing systems may face various other challenges, including limited accuracy in detecting vehicle speed, high maintenance costs, compatibility issues with other systems, and security concerns related to data breaches and unauthorized access to sensitive information.

- Inability to operate on both live and recorded footage: Some existing systems may not be able to operate on both live and recorded footage, limiting their functionality and applicability in various sectors.

- Difficulty in converting fancy number plates into text: The detection and conversion of fancy number plates into text can be challenging due to their unique design, leading to inaccuracies in data collection.

- Problem of multiple vehicle detection at the same time: In some systems, multiple vehicles passing through the detection zone simultaneously can cause inaccuracies and errors in vehicle counting and classification.

- Poor video/image quality affecting vehicle detection and system effectiveness: Low-quality images or videos can limit the accuracy of vehicle detection and negatively impact the overall effectiveness of the system.

- Lack of proper and effective GUI in many existing systems: The absence of an intuitive and user-friendly graphical user interface (GUI) can make it difficult for operators to effectively manage the system and make informed decisions.

2.3 Proposed System

This system is designed to provide a comprehensive solution for monitoring and managing vehicles in various sectors, such as traffic management, law enforcement, parking management, transportation, and toll plaza management. The system, named "SMART EYE," is Python-based and comprises four primary modules:

- Vehicle Counting Module: This module accurately counts the number of vehicles passing through a particular point and stores the data in an Excel sheet with the time and date.
- Speed Detection Module: This module can detect the speed of vehicles and issue alerts if the speed limit is exceeded, providing a critical safety feature in school zones, residential areas, and busy intersections.
- Vehicle Classification Module: This module can classify different types of vehicles and provide valuable insights into traffic patterns and volume.
- Number Plate Detection Module: This module can detect number plates and automatically store images to the number plates folder and converted text to an Excel sheet with time and date.

The system can operate on both live and recorded footage, making it suitable for various sectors, including traffic authorities, parking operators, and toll plaza management teams. It can also assist law enforcement agencies in investigating and solving crimes, making our communities safer.

The data collected by the system can be stored in Excel sheets for further analysis and reporting, providing a valuable tool for optimizing road networks, public transportation routes, and parking facilities.

Overall, the "SMART EYE" system has the potential to revolutionize the way we monitor and manage vehicle movements in various sectors, making it an essential asset in the modern world.

2.4 Summary

The literature survey covers the existing vehicle monitoring and management systems, their limitations, and the proposed system called "SMART EYE." Existing systems include traffic management systems, speed cameras, license plate recognition and vehicle classification systems, and automatic number plate recognition systems. However, these systems face challenges like limited accuracy, compatibility issues, and poor GUI. The proposed "SMART EYE" system is a Python-based solution comprising four primary modules: Vehicle Counting, Speed Detection, Vehicle Classification, and Number Plate Detection. It can operate on live and recorded footage, classify different types of vehicles, and provide valuable insights into traffic patterns and volume. The data collected can be stored in Excel sheets for further analysis and reporting, making it an essential asset for optimizing road networks, public transportation routes, and parking facilities.

CHAPTER 03

PROBLEM DEFINITION AND SYSTEM DESIGN

3.1 Problem Statement:

The current management and monitoring of vehicles in various sectors, such as traffic management, law enforcement, parking management, transportation, and toll plaza management, lack an integrated and comprehensive solution. The lack of a reliable and efficient system to accurately count vehicles passing through specific points, detect their speed, classify different types of vehicles, and capture number plates automatically poses significant challenges in optimizing road networks, public transportation routes, and parking facilities. Complicated and unintuitive user interfaces, leading to errors and delays in decision-making processes for traffic authorities, parking operators, and toll plaza management teams.

To address these challenges, there is a need for a Python-based system that can provide a comprehensive solution to revolutionize the way we monitor and manage vehicle movements in various sectors, making it an essential asset in the modern world. The "SMART EYE" system aims to fill this gap and provide an all-in-one solution for monitoring and managing vehicle movements in different sectors.

Here are 4 important points on the problems overcome by the "SMART EYE" system:

- Accurate vehicle counting, overcoming limitations of existing systems.
- Speed detection and alerting when speed limits are exceeded, enhancing safety features in school zones, residential areas, and busy intersections.
- Vehicle classification providing valuable insights into traffic patterns and volume, optimizing road networks and public transportation routes.
- Number plate detection, automatically storing images and text in Excel sheets with time and date, facilitating law enforcement agencies in investigating and solving crimes.
- User interface design that is intuitive and efficient, allowing users to navigate through the system and access the information they need quickly and easily.

3.2 Scope

The scope of the "SMART EYE" system includes providing a comprehensive solution for monitoring and managing vehicles in various sectors, including traffic management, law enforcement, parking management, transportation, and toll plaza management. The system is designed to address the challenges associated with the increasing number of vehicles on the road and the traditional manual methods of monitoring and managing them, which are time-consuming and often ineffective.

In traffic management, the system can assist in optimizing road networks and public transportation routes by providing real-time data and insights into traffic patterns and volume. Law enforcement agencies can use the system to investigate and solve crimes by detecting number plates and providing images and converted text to Excel sheets with time and date. In parking management, the system can assist parking operators in managing parking facilities by providing real-time data on parking availability and usage. In toll plaza management, the system can assist toll plaza management teams in managing toll collection by providing data on the number of vehicles passing through a particular point and storing the data in an Excel sheet with the time and date.

The system's primary modules, vehicle counting, speed detection, vehicle classification, and number plate detection, can provide valuable data and insights to various sectors, making it a comprehensive solution for monitoring and managing vehicles. Overall, the "SMART EYE" system has a wide scope, and its applications can be extended to various sectors, making it an essential asset in the modern world.

3.3 System Requirement Specifications

The system requirements specification of the "SMART EYE" system outlines the software and hardware requirements and also the specific functional and non-functional requirements of the system. The functional requirements specify the tasks and services that the system should be able to perform, while the non-functional requirements specify the quality attributes that the system should exhibit.

The functional requirements of the system include the following:

- Vehicle Counting: The system should accurately count the number of vehicles passing through a particular point and store the data in an Excel sheet with the time and date.
- Speed Detection: The system should be able to detect the speed of vehicles and issue alerts if the speed limit is exceeded, providing a critical safety feature in school zones, residential areas, and busy intersections.
- Vehicle Classification: The system should be able to classify different types of vehicles and provide valuable insights into traffic patterns and volume.
- Number Plate Detection: The system should be able to detect number plates and automatically store images to the number plates folder and converted text to Excel sheet with time and date.

The non-functional requirements of the system include the following:

- Accuracy: The system should be highly accurate in counting vehicles, detecting speed, classifying vehicles, and recognizing number plates.
- Reliability: The system should be reliable, with a low error rate, and should be able to operate continuously without interruption.
- Scalability: The system should be scalable, able to handle large volumes of data and operate efficiently as the number of cameras and the amount of data increases.
- Security: The system should be secure, with restricted access to authorized users only, and the data should be protected from unauthorized access and tampering.
- Usability: The system should be user-friendly, with a simple and intuitive user interface, making it easy for users to operate and manage the system.

Software Requirements:

- Operating System -Windows 11 is used as the Operating System as it is stable and supports more features and is more user-friendly.
- Microsoft Excel is used to maintain and retrieve records.
- Development Tools and Programming Language- Python 3.11.4

Hardware Requirements:

- Intel core i5 11th generation is used as a processor because it is fast than other processors an provide reliable and stable and we can run our pc for longtime. By using this processor, we can keep on developing our project without any worries.
- Ram 8 GB is used as it will provide fast reading and writing capabilities and will in turn support in processing.

Overall, the system requirements specification outlines the functional and non-functional requirements of the "SMART EYE" system, ensuring that the system meets the specific needs of its users and performs its tasks accurately, reliably, and efficiently.

3.4 System Design

The system design of the "SMART EYE" system includes the architectural design, database design, and interface design.

- Architectural Design:

The system architecture is designed to be modular, with four primary modules: vehicle counting, speed detection, vehicle classification, and number plate detection. These modules are integrated into the system to provide a comprehensive solution for monitoring and managing vehicles. The system architecture is designed to be scalable, able to handle large volumes of data and operate efficiently as the number of cameras and the amount of data increases. The system is designed to operate on both live and recorded footage, making it suitable for various sectors, including traffic authorities, parking operators, and toll plaza management teams.

- Database Design:

The system database design is designed to store and manage the data collected by the system. The system stores the data in Excel sheets with the time and date to enable easy retrieval and analysis. The database design is designed to be scalable, able to handle large volumes of data and operate efficiently as the amount of data increases.

- Interface Design:

The system interface design is designed to be user-friendly, with a simple and intuitive user interface, making it easy for users to operate and manage the system. The system interface design is designed to provide a graphical representation of the data collected by the system, enabling users to analyze and make decisions based on the data.

Overall, the system design of the "SMART EYE" system is designed to be modular, scalable, and user-friendly, providing a comprehensive solution for monitoring and managing vehicles in various sectors. The system architecture, database design, and interface design are all designed to work together to provide a seamless user experience, enabling users to operate and manage the system efficiently and effectively.

3.5 Technologies to be used

The technologies used in the "SMART EYE" system include the following:

- Python: The system is built using the Python programming language, which is a high-level, interpreted language with a focus on code readability and ease of use.

- OpenCV: The OpenCV (Open-Source Computer Vision) library is used for image processing and computer vision tasks, such as object detection, tracking, and recognition.

- NumPy: The NumPy library is used for scientific computing tasks, such as numerical computations, linear algebra, and statistics.

- Tkinter: The Tkinter library is used for creating the graphical user interface of the system.

- Cascade Classifier Files: Cascade classifier files are XML files containing data that are used for object detection and recognition tasks in the OpenCV library.

- Pytesseract: The Pytesseract library is used for optical character recognition (OCR) tasks, such as detecting number plates and converting text to digital format.

- Openpyxl: The Openpyxl library is used for reading and writing Excel files, allowing the system to store and manage data collected by the system in an organized and efficient manner.

Overall, the technologies used in the "SMART EYE" system are chosen to provide a comprehensive solution for monitoring and managing vehicles in various sectors. The Python programming language provides a flexible and easy-to-use platform for building the system, while OpenCV provides powerful tools for image processing and computer vision tasks. The NumPy library provides tools for data analysis, and the Tkinter library enables the creation of a user-friendly graphical user interface. Cascade classifier files are used for object detection and recognition tasks in the OpenCV library, Pytesseract is used for OCR tasks, and Openpyxl is used for reading and writing Excel files, allowing the system to store and manage data collected by the system in an organized and efficient manner.

3.6 Assumptions

- Availability of footage: The system assumes that there is a constant supply of footage from cameras placed in strategic locations. Without a consistent flow of footage, the system cannot operate.
- Clarity of footage: The system assumes that the footage is of sufficient quality to allow for accurate vehicle detection, classification, and number plate recognition. Poor quality footage may result in inaccurate data and system malfunction.
- Vehicle speed limits: The system assumes that accurate speed limit data is available for the areas where it is being used. Without this data, the system cannot accurately detect and alert when vehicles exceed the speed limit.
- Proper installation and maintenance of cameras: The system assumes that the cameras are installed and maintained correctly, with regular checks and maintenance to ensure proper functioning. Poor installation and maintenance can lead to system malfunctions and inaccurate data.
- Adequate lighting conditions: The system assumes that there are adequate lighting conditions in the areas where it is being used. Poor lighting conditions can lead to inaccurate data and system malfunction.

- Accuracy of cascade classifier files: The system assumes that the cascade classifier files used for object detection and recognition are accurate and up to date. Inaccurate files can lead to incorrect data and system malfunction.
- Accuracy of OCR data: The system assumes that the OCR data generated by Pytesseract is accurate and can correctly recognize number plates. Inaccurate OCR data can lead to incorrect data and system malfunction.

These assumptions are important to keep in mind when using the "SMART EYE" system. By ensuring that these assumptions are met, the system can operate effectively and provide accurate and valuable data for monitoring and managing vehicles in various sectors.

3.7 Constraints

- Hardware limitations: The system's performance may be affected by the processing power and memory of the computer or device it is installed on. Therefore, it may not be possible to process high-quality video footage or a large number of cameras simultaneously on low-end hardware.
- Lighting conditions: The accuracy of the system's object detection and recognition algorithms may be affected by poor lighting conditions. For example, if a camera is placed in an area with low visibility or uneven lighting, the system may struggle to accurately detect objects, such as license plates or vehicle types.
- Camera placement: The accuracy and effectiveness of the system depend on the placement and orientation of the cameras. If the cameras are placed too high or too low, the system may not be able to capture the required details of the passing vehicles.
- Data privacy: The system collects sensitive information, such as license plate numbers, and must adhere to data privacy laws and regulations. The storage and processing of such data must be done securely, and access to the data must be restricted to authorized personnel only.
- Maintenance and upkeep: The system requires regular maintenance, such as cleaning of the cameras and replacing faulty components. The system may also require software updates to address any bugs or security vulnerabilities.

- Cost: The cost of installing and operating the system may be a constraint for some organizations, particularly those with limited budgets. The cost of hardware, software, and personnel training must be taken into account when considering the implementation of the system.

These constraints are essential to consider during the development and implementation of the "SMART EYE" system. By understanding and addressing these constraints, the system can be designed and implemented to operate efficiently and effectively in various sectors.

3.8 User Interface Design

- Login Page:

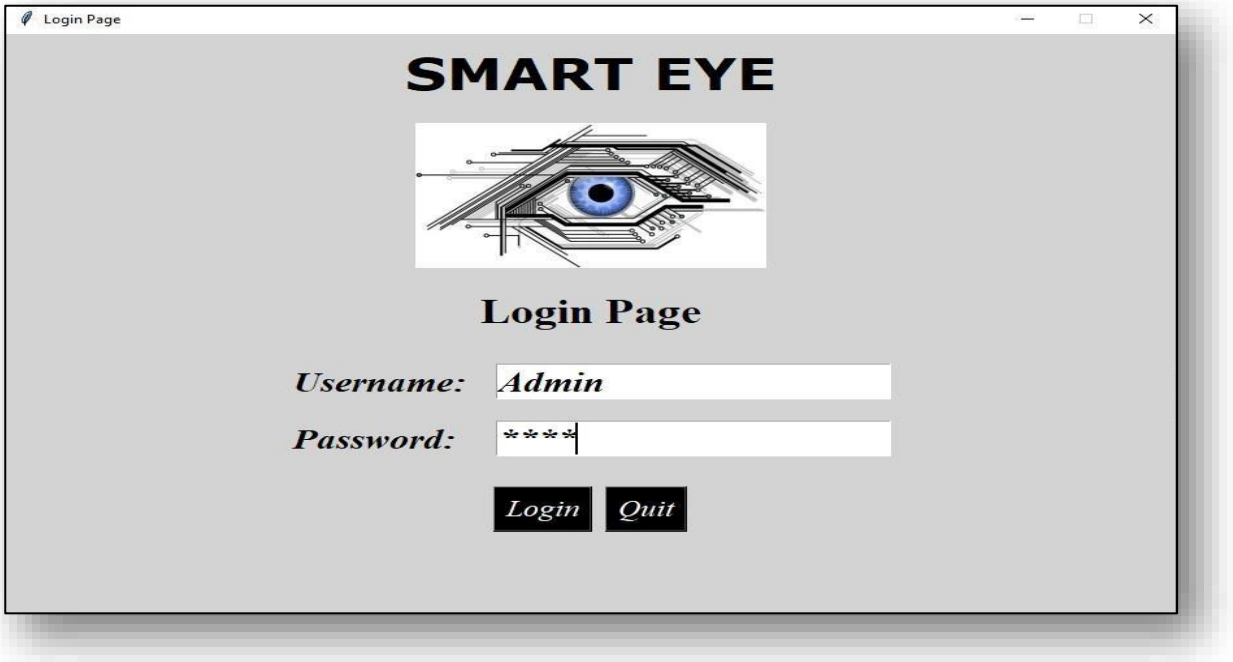


Fig. 3.8.1 Login Page

- Home Page:

Fig. 3.8.2 Home Page

- Module 1:

Counting vehicle and storing date

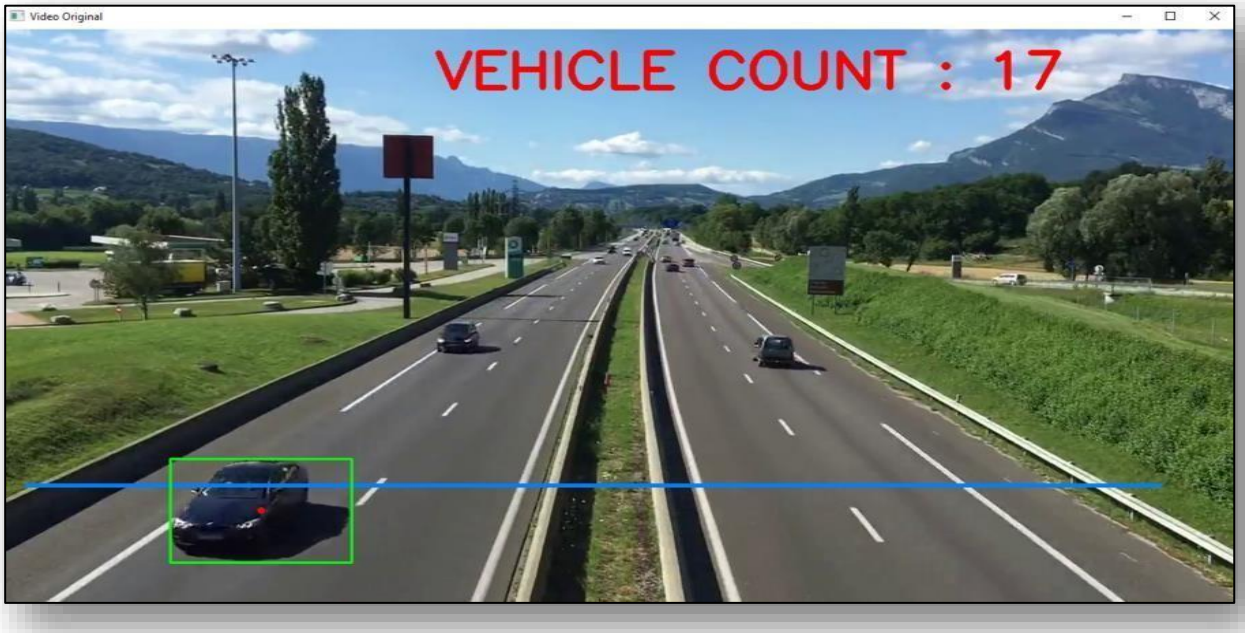
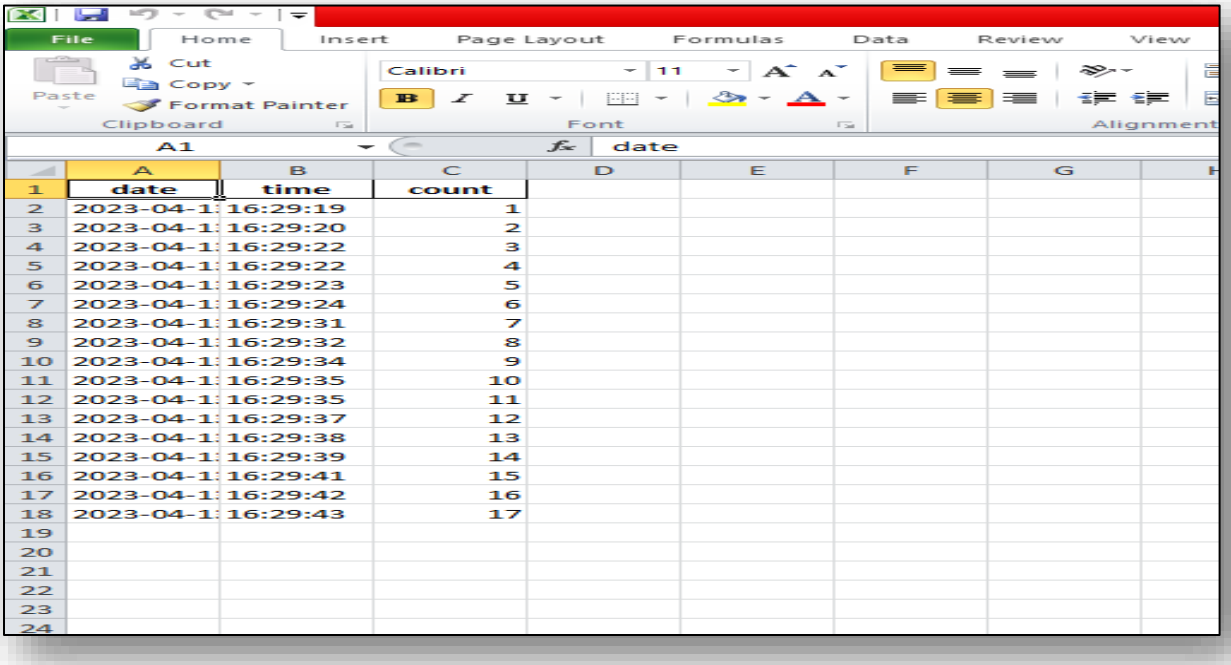


Fig. 3.8.3 Counting Vehicles

- Storing files of count module:



	A	B	C
1	date	time	count
2	2023-04-1:	16:29:19	1
3	2023-04-1:	16:29:20	2
4	2023-04-1:	16:29:22	3
5	2023-04-1:	16:29:22	4
6	2023-04-1:	16:29:23	5
7	2023-04-1:	16:29:24	6
8	2023-04-1:	16:29:31	7
9	2023-04-1:	16:29:32	8
10	2023-04-1:	16:29:34	9
11	2023-04-1:	16:29:35	10
12	2023-04-1:	16:29:35	11
13	2023-04-1:	16:29:37	12
14	2023-04-1:	16:29:38	13
15	2023-04-1:	16:29:39	14
16	2023-04-1:	16:29:41	15
17	2023-04-1:	16:29:42	16
18	2023-04-1:	16:29:43	17

Fig. 3.8.4 Vehicle count data

- Module 2:

Counting speed and differential normal speed and over speeded vehicle.

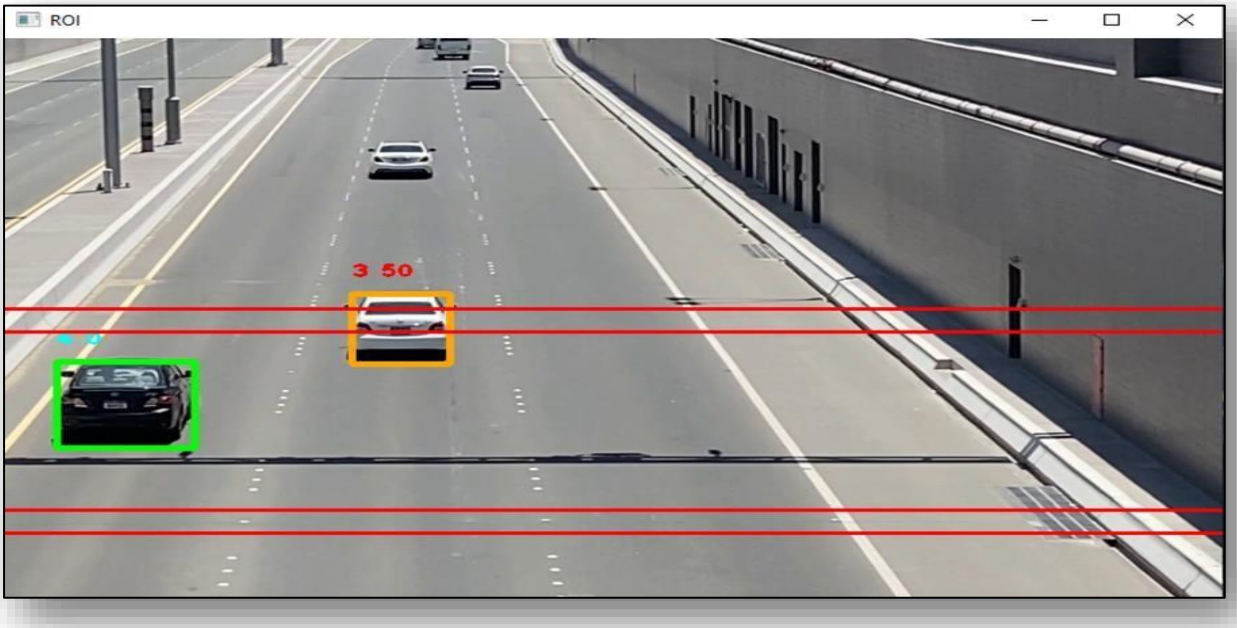


Fig. 3.8.5 Detect Vehicle Speed

- Storing file of Speed module:

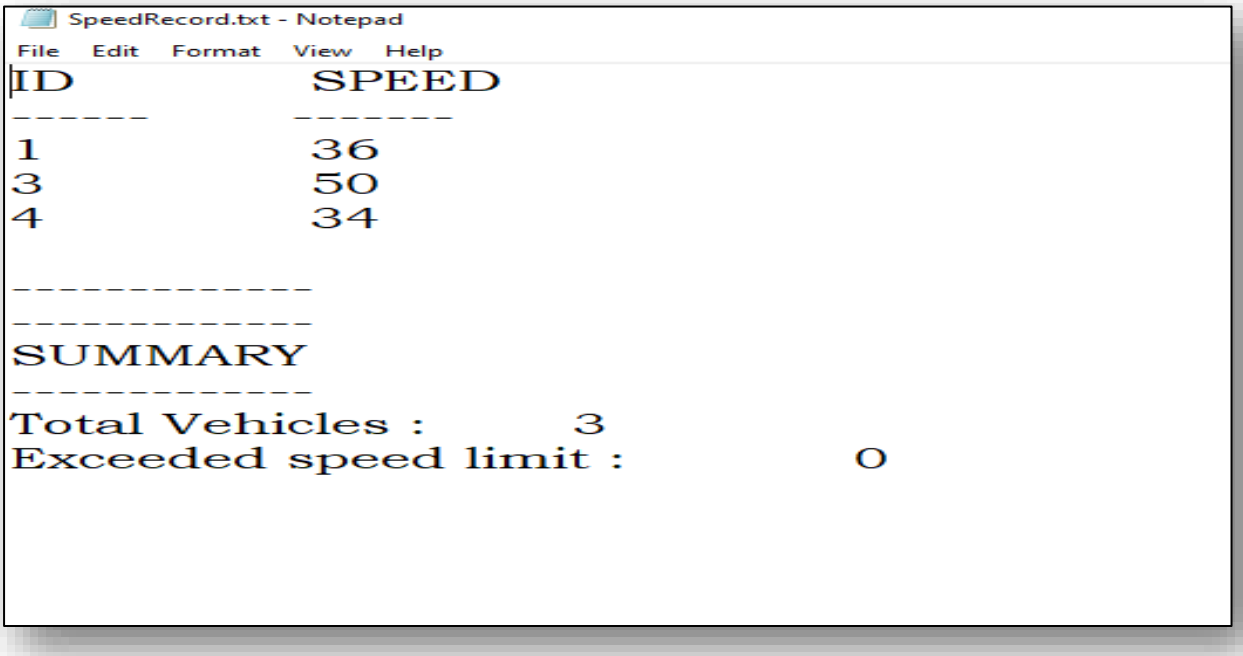


Fig. 3.8.6.1 Normal speed vehicle data

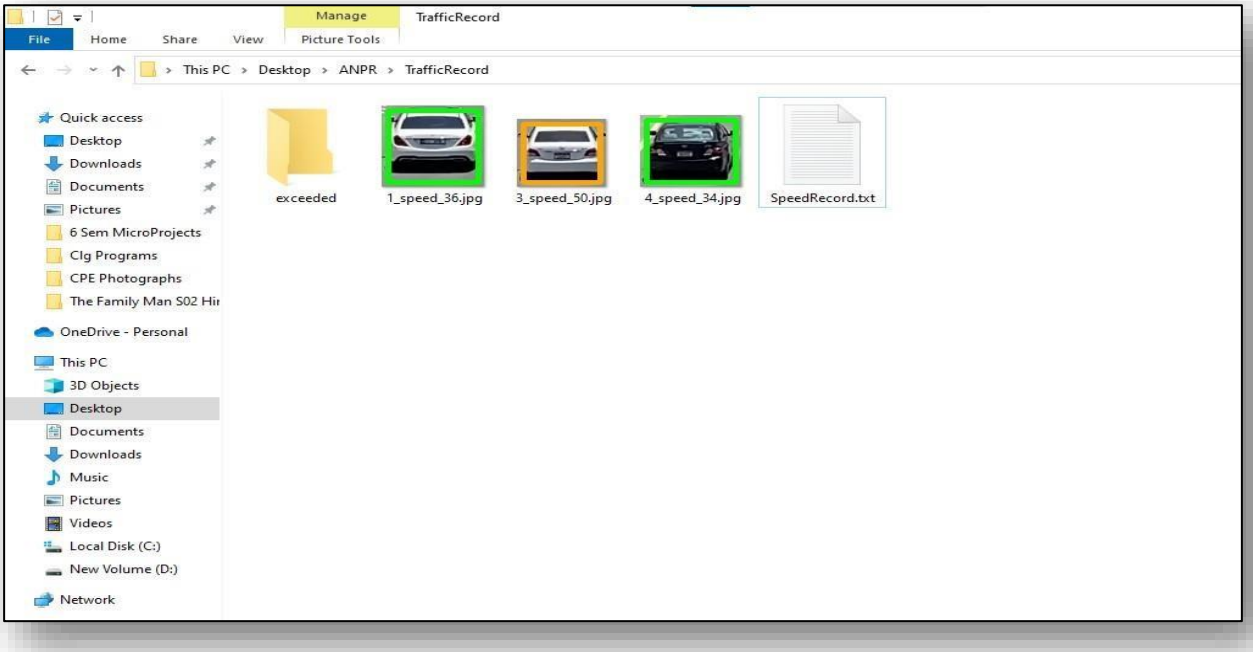


Fig. 3.8.6.2 Vehicle screenshot data folder

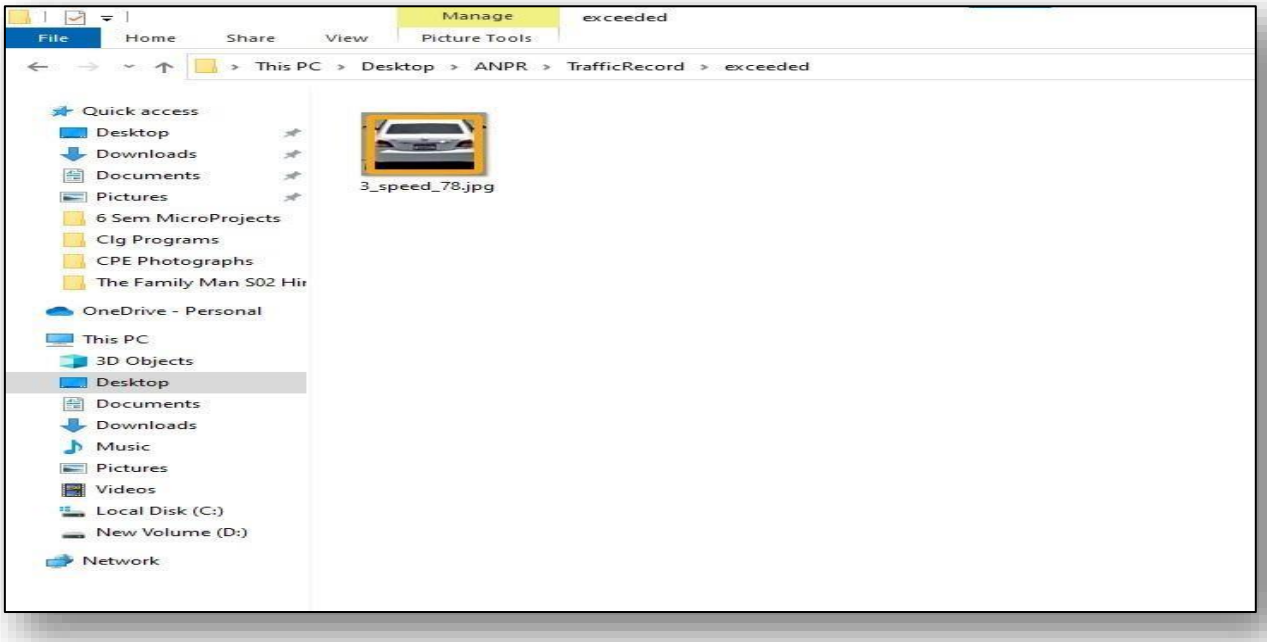


Fig. 3.8.6.3 Exceeded speed vehicle data

- Module 3:

  Storing images of vehicle cropped number plate

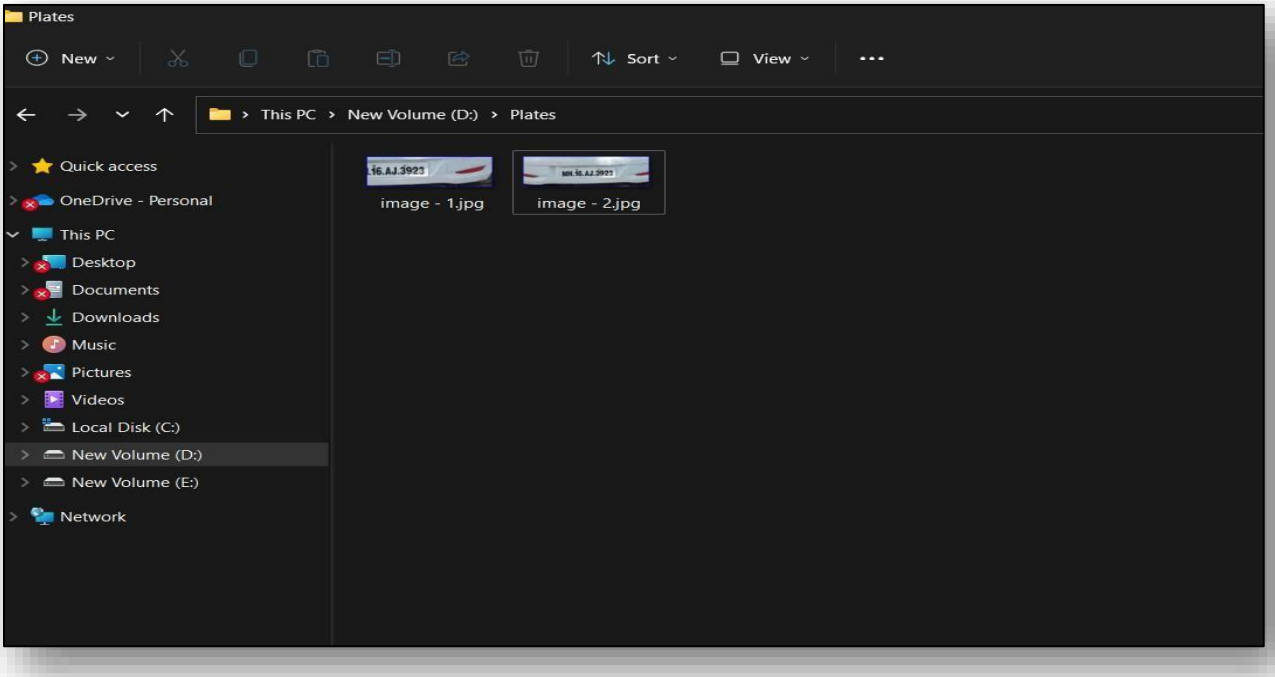
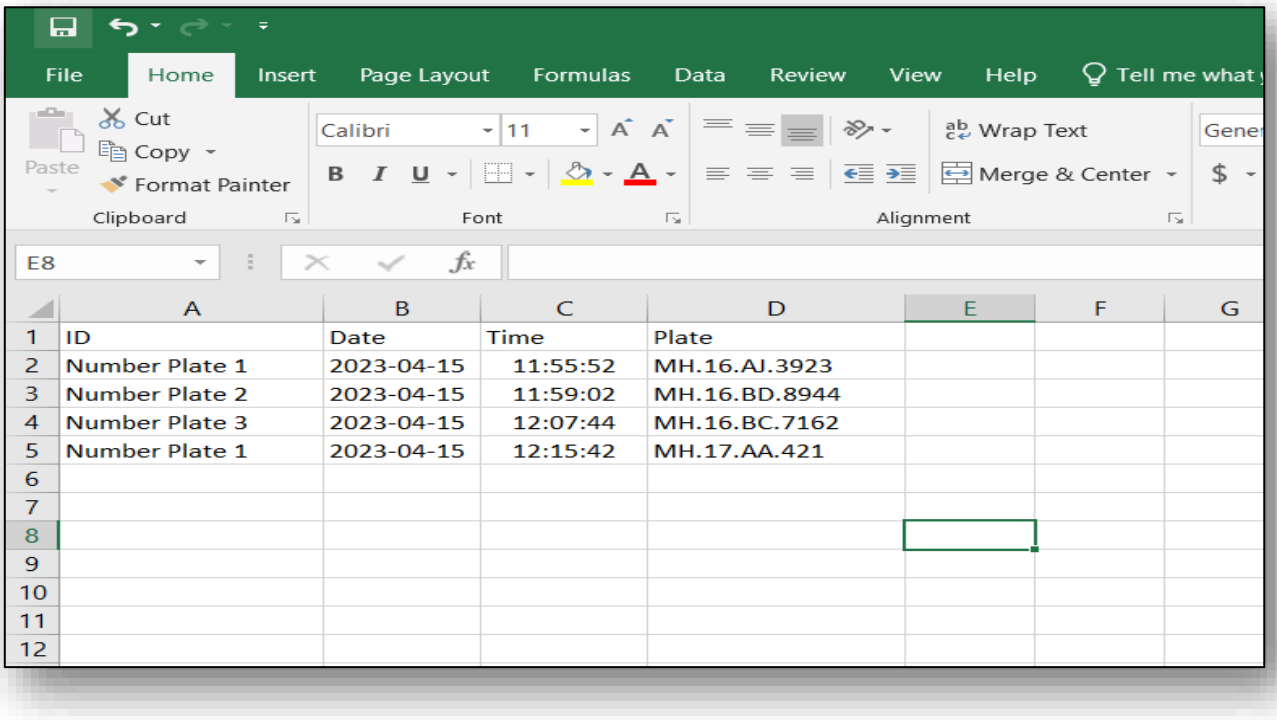


Fig. 3.8.6.4 Stored number plate images

- Storing vehicle number plate file



	A	B	C	D	E	F	G
1	ID	Date	Time	Plate			
2	Number Plate 1	2023-04-15	11:55:52	MH.16.AJ.3923			
3	Number Plate 2	2023-04-15	11:59:02	MH.16.BD.8944			
4	Number Plate 3	2023-04-15	12:07:44	MH.16.BC.7162			
5	Number Plate 1	2023-04-15	12:15:42	MH.17.AA.421			
6							
7							
8							
9							
10							
11							
12							

Fig. 3.8.6.5 Number Plate Data

3.9 Summary

It outlines the problem definition and system design for the "SMART EYE" vehicle monitoring system. The problem statement highlights the need for a comprehensive solution for monitoring and managing vehicles in various sectors. The scope of the system is defined, along with the system requirements specification, which outlines the functional and non-functional requirements of the system. The system design is explained, along with the technologies to be used, including Python, OpenCV, NumPy, Tkinter, Cascade Classifier Files, Pytesseract, and Openpyxl. Assumptions and constraints are also outlined, along with the user interface design. Overall, it provides a comprehensive overview of the system design and requirements for the "SMART EYE" vehicle monitoring system.

CHAPTER 04

OBJECT ORIENTED MODEL

4.1 Need of modeling

Modeling is a crucial aspect of any project, including Smart Eye, which involves counting, speed measurement, and number plate detection. It involves creating a simplified representation of the system or process, which can help in better understanding, analyzing, and improving it.

The need for modeling arises due to several reasons. Firstly, it helps in identifying the key components and their relationships within the system, which can aid in detecting potential errors or inefficiencies. Secondly, it allows for testing and simulation of the system under different scenarios, enabling the evaluation of its performance and behavior.

The main purpose is as follows: -

- To improve the efficiency.
- Provide an interface to enter data faster and stores efficiently.
- To provide user friendly environment.
- Efficient storage and maintenance of database.
- To give all information and reports with accuracy at any time according to user requirement

4.2 ER Diagram

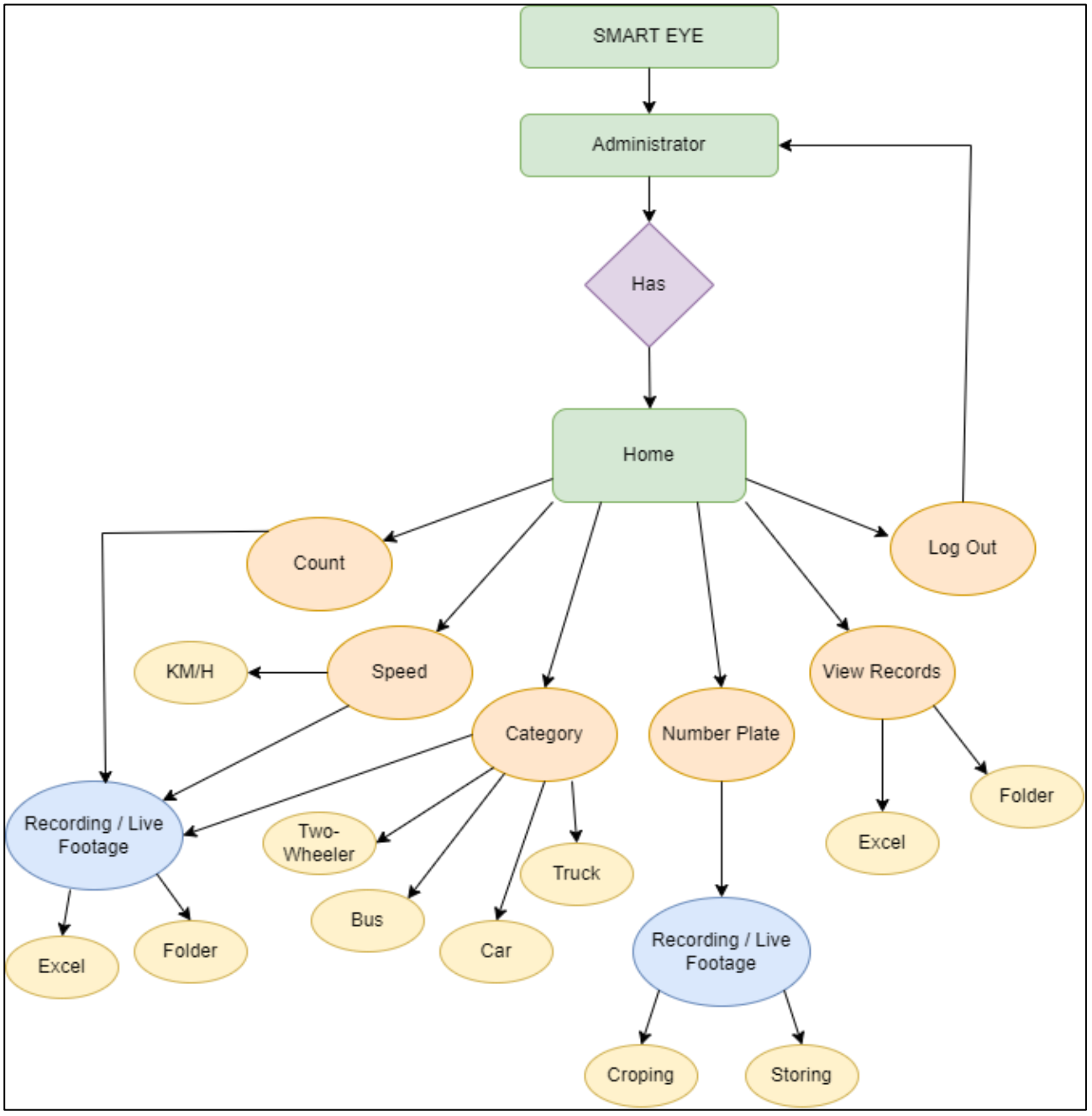


Fig. 4.2.1 E-R Diagram

4.3 Activity Diagram

Activity diagram is another important diagram in UML to describe the dynamic aspects of the system. Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system. The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams deal with all type of flow control by using different elements such as fork, join, etc. Activity is a particular operation of the system. Activity diagrams are not only used for visualizing the dynamic nature of a system, but they are also used to construct the executable system by using forward and reverse engineering techniques. Activity diagram is sometimes considered as the flowchart. Although the diagrams look like a flowchart, they are not. It shows different flows such as parallel, branched, concurrent, and single. In below activity diagram we displaying the flow of system from stating login module up to the log out module. And in between also the various modules we are displayed.

- **Count Activity:**

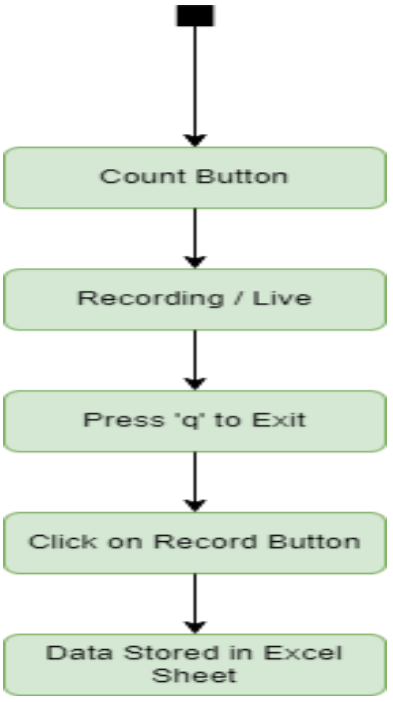


Fig. 4.3.1 Count Module Activity Diagram

- **Speed Activity:**

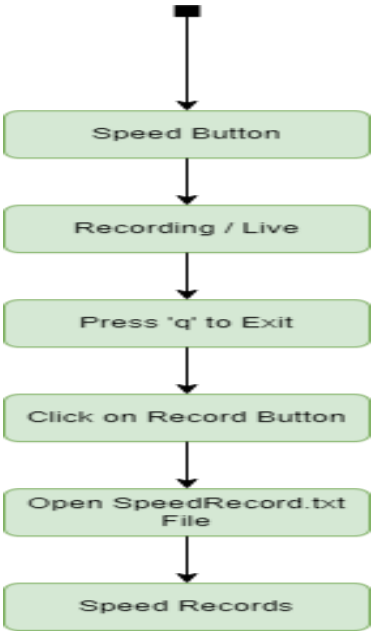


Fig. 4.3.2 Speed Module Activity Diagram

- **Number Activity:**

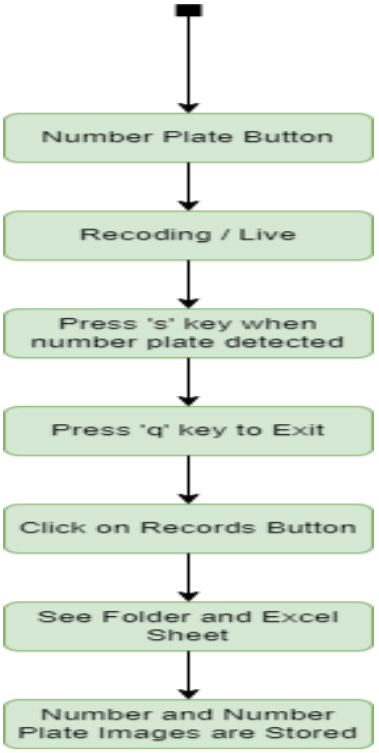


Fig. 4.3.3 Number-Plate Module Activity Diagram

4.4 Data Flow Diagram

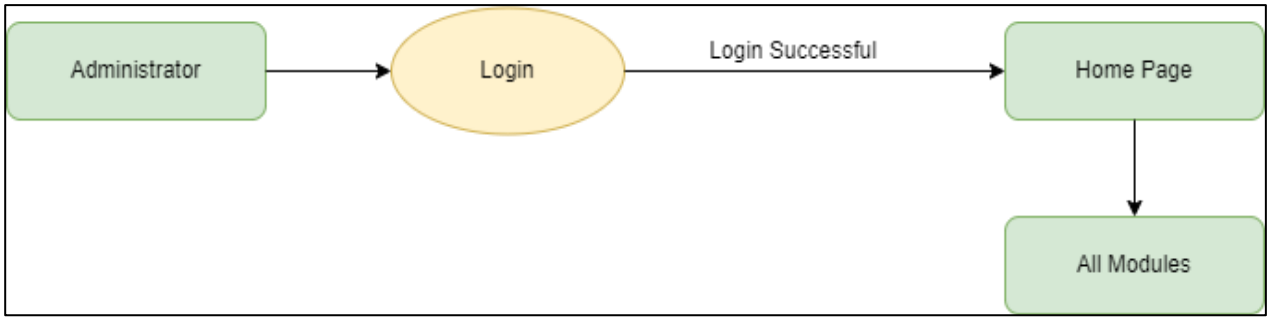


Fig. 4.4.1: Level 0 DFD

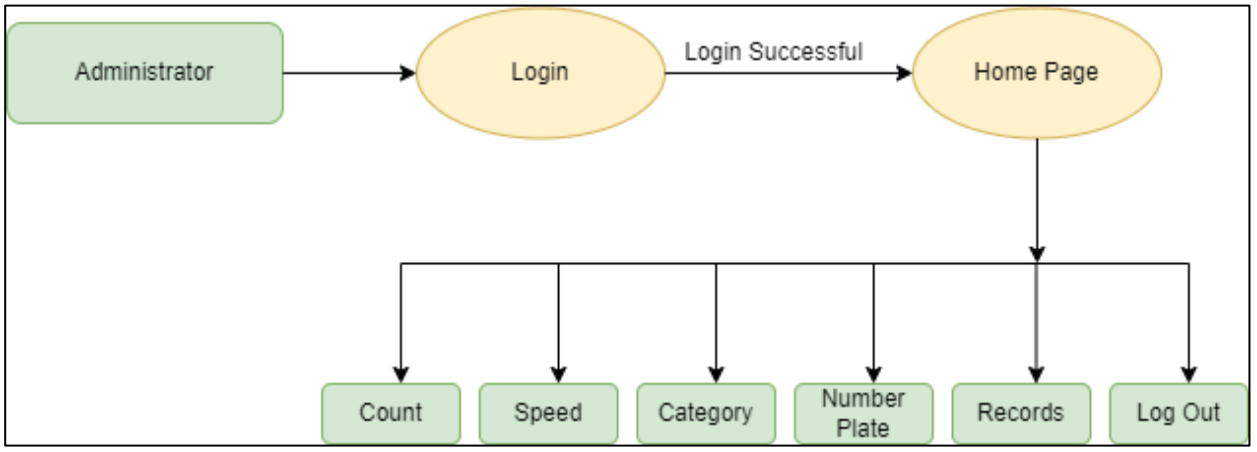


Fig. 4.4.2 Level 1 DFD

4.5 Use Case Diagram

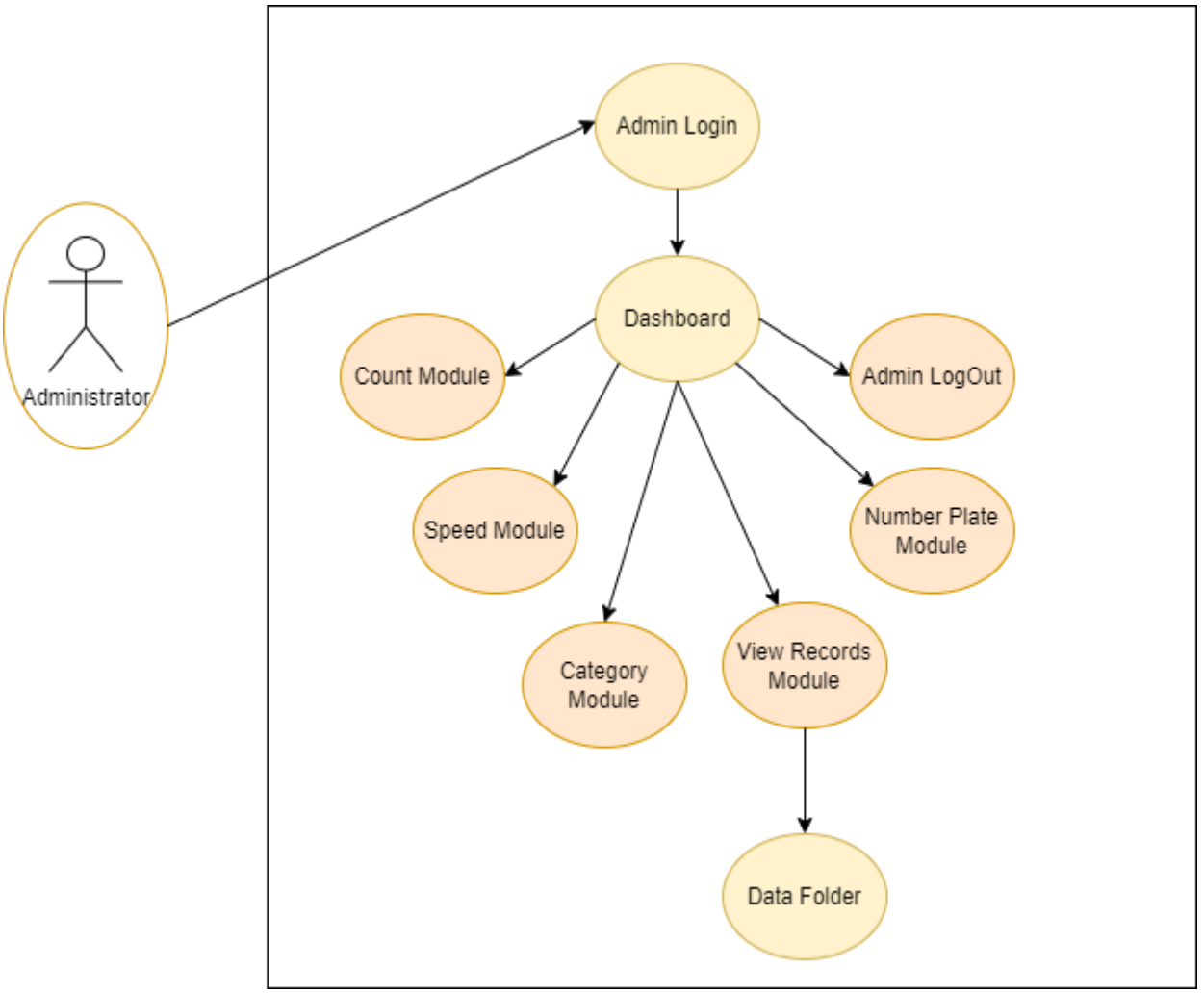


Fig. 4.5.1 Use Case Diagram

4.6 Summary

In this fourth chapter there is an object-oriented model it is completely manually so what's that E – R Diagram, data flow diagram, Activity diagram, Use Case Diagram are discussed in this chapter. Draw the Entity Relation diagram that is ER diagram. Draw the Activity diagram of Smart Eye software system different activities. Draw data flow diagram and use case diagram respective to Vehicle detection and accounting system

CHAPTER 05

PROJECT PLAN

5.1 Overview

The "SMART EYE" system project plan outlines the steps taken to develop, implement, and deploy a Python-based system for monitoring and managing vehicles in various sectors.

The project's goals were to design and develop a system that could accurately count vehicles, detect vehicle speeds, classify vehicles, and recognize number plates. The system's development aimed to provide a comprehensive solution for traffic management, law enforcement, parking management, transportation, and toll plaza management.

The project's scope included identifying the various sectors that could benefit from the system and defining the key features needed to fulfill their requirements. The system's objectives included developing a system that could accurately count vehicles, detect vehicle speeds, classify vehicles, and recognize number plates. The project's scope also included developing a user-friendly interface that would allow users to easily access and analyze the system's data.

The system requirements specifications included defining the technical requirements for the system, including the technologies needed to build the system, such as Python and various libraries, and the hardware requirements, such as cameras and sensors. The user interface requirements included developing a user-friendly interface for data analysis and reporting.

To develop the system, the team first identified the scope and objectives of the project. Next, the team conducted a thorough analysis of the requirements and designed the various modules required for the system.

After developing the system's design and requirements, the team began the implementation phase. This involved building the system and integrating the various modules into a cohesive system. The team also conducted extensive testing to ensure the system's accuracy and reliability. The project plan's overview outlines the system's goals, scope, objectives, and requirements.

5.2 Project Estimate

To calculate the effort, development time, average staff size, and productivity based on LOC, we can use the COCOMO model. COCOMO stands for Constructive Cost Model, and it is a popular method for estimating software development effort and cost.

The COCOMO model consists of three different levels: Basic, Intermediate, and Detailed. For the purpose of this question, we will use the Intermediate COCOMO model, which is suitable for small to medium-sized projects.

- Formula for Calculating the Effort:

  Effort = a * (LOC / 1000) ^b * EAF

  where:

  a = 2.94

  b = 1.05

  EAF = 1.0 (assuming normal constraints)

  Effort = 2.94 * (1289 / 1000) ^1.05 * 1.0

  Effort = 4.57 person-months

- Formula for Calculating the Development Time:

  Development Time = c * (Effort)^d

  where:

  c = 2.5

  d = 0.38

  Development Time = 2.5 * (4.57) ^0.38

  Development Time = 5.49 months

- Formula for Calculating the Productivity:

  Productivity = LOC / Effort

  Productivity = 1289 / 4.57

  Productivity = 281.98 LOC/person-month

Therefore, based on the COCOMO model, the effort required for this project is 4.57 person-months, the development time is 5.49 months, the average staff size is 0.83 persons, and the productivity is 281.98 LOC/person-month.

- Time Estimation:
  1. Requirements gathering and analysis: 25 hours
  2. Software and hardware connective: 18 hours
  3. Implementation of different module such as vehicle counting, speed counting and category: 47 hours
  4. Learning cascade files: 36 hours
  5. Storing information to Excel sheets: 16 hours
  6. User interface development and testing: 35 hours
  7. Software and hardware testing: 30 hours
  8. Deployment and release: 22 hours
  9. Purchase hardware's such as camera sensor and wires as per requirement :18999Rs.
  10. Total estimated time: 229 hours for a team of 4-5 developers and purchasing sensor in 18999 Rs.

- Developing Cost:

  Total estimated hours * Developer salary per Hour.

  229 * 35 =

  8,015 Rs.

- Total Cost Project:

  Developing Cost + Hardware.

  8,015 + 18,999 =

  27,014 Rs.

5.3 Project Schedule

Sr. No.	Points to be covered	Planned Start Date	Planned End Date	Name of Responsible Team Members
01	Designing the Project	19/02/2023	05/03/2023	All Team Members
02	Creation of Design and Modeling	05/03/2023	12/03/2023	All Team Members
03	Implementation	12/03/2023	12/04/2023	All Team Members
04	Testing	12/04/2023	16/04/2023	All Team Members
05	Project Report Writing	16/04/2023	23/04/2023	All Team Members
06	Project Presentation	23/04/2023	25/04/2023	All Team Members
07	Project Demo	As per notice		All Team Members
08	Defense			All Team Members

5.4 Summary

The project plan for the SMART EYE system outlines the steps taken to develop, implement, and deploy a Python-based system for monitoring and managing vehicles in various sectors. The project estimate was determined by analyzing the requirements and designing the various modules required for the system, as well as identifying the technologies that would be used to build the system. The project schedule outlines the timeline for working on requirement gathering, analysis, planning, system and project design, implementation, testing, and report writing. The summary highlights the project's scope, objectives, requirements, and estimated timeline for completion.

CHAPTER 06

TEST PLAN AND REPORTS

6.1 Goals and objectives

- To design and implement a robust vehicle detection algorithm that accurately counts the number of vehicles passing through a given area.
- To develop a speed detection module that measures the speed of vehicles and categorizes them according to their speed.
- To design and implement a vehicle categorization module that classifies the vehicles into different categories such as cars, buses, trucks, and motorcycles based on their size and shape.
- To develop a license plate recognition system that can capture and store the license plate numbers of the vehicles passing through the monitored area.
- To integrate all the modules into a single system that provides real-time monitoring and reporting of the traffic data.

6.2 Test procedures and report

- GUI Test Cases:

Test Case ID	Test Case	Input	Steps to be followed	Expected Results	Actual Results	Status
TC_01	Admin Login	Enter correct username and password	1.Enter Username. 2.Enter Password 3.Click Login Button.	Should goes to Home Page.	Going to Home Page.	Pass
TC_02	Count Button	Click on Count Button.	1. Open Home Page 2. Click on Count Button.	Count module window should open and start it's working.	It Opens Count module and start working.	Pass
TC_03	Speed Button	Click on Speed Button.	1. Open Home Page. 2. Click on Speed Button.	Speed module window should open and start it's working.	It Opens Speed module and start working.	Pass
TC_04	Category Button	Click on Category Button.	1. Open Home Page. 2. Click on Category Button.	Category module should open and start it's working.	It Opens Category module and start working.	Pass
TC_05	Number Plate Button	Click on Number Plate Button.	1. Open Home Page. 2. Click on Number Plate Button.	Number Plate module should open and starts it's working.	It Opens Number Plate module and start working.	Pass

TC_06	Record Button	Click on Record Button.	1. Open Home Page. 2. Click on Record Button.	Record module should open and start it's working.	It Opens Record module and start it's working.	Pass
TC_07	Log Out Button	Click on Log Out Button.	1. Open Home Page. 2. Click on Log Out Button.	Home Page Should close and Login Page should open.	It Closes Home Page and open Login Page.	Pass

- Functionality Test Cases:

Test Case ID	**Test Case**	**Input**	**Steps to be followed**	**Expected Results**	**Actual Results**	**Status**
TC_01	Count Module	Click on Count Button.	1. Open Home Page. 2. Click on Count Button. 3. See It's Working.	It Should work Properly and data will store in excel file with correct date and time.	It work properly and data is stored to excel file.	Pass
TC_02	Speed Module	Click on Speed Button.	1. Open Home Page. 2. Click on Count Button. 3. See It's Working.	It Should work Properly and data will store in excel file and images will store in folder and exceeded speed images will store in diff. folder	It working properly and speed of vehicles are correctly stored in text file and images are storing in folder and

				with correct date and time.	exceeded speed images are storing I different folder.	
TC_03	Category Module	Click on Category Button.	1. Open Home Page. 2. Click on Count Button. 3. See It's Working.	It should work properly and vehicles should be categorized with its type.	It Working properly and categorized types of vehicles correctly.	Pass
TC_04	Number Module	Click on Number Plate Button.	1. Open Home Page. 2. Click on Count Button. 3. Click 's' button when number plate is detected. 3.See It's Working.	It Should work properly and number plate text with date and time will store in excel and image will store in folder when admin press the key.	It working properly and storing data like number plate text with date and time and number plate image in folder.	Pass
TC_05	Record Module	Click on Record Button.	1. Open Home Page. 2. Click on Record Button	It will work properly and all images and excel files are stored in that folder will open to show data.	It is opening the folder where all data is stored.	Pass
TC_06	Number Plate Text	Click on Number	1. Open Home Page.	It will work properly and	It is storing the number	Pass

		Plate Button.	2. Click on Number Plate Button. 3. Check the number plate will store or not. 4. Check excel file number should save properly.	extracted text from number plate image should save to excel file with high efficiency.	of vehicles to excel effectively.	

Test Report:

- Summary: Provide a brief summary of the test results.
- Testing Methods: Explain the testing methods used, including the tools and techniques used for testing.
- Test Results: Provide detailed test results for each module, including anyerrors or issues encountered during testing.
- Bug Report: List any bugs found during testing, including a description ofthe problem, how it was discovered, and the steps to reproduce the issue.

6.3 Summary

Test Plan:

The test plan for the Smart eye (Vehicle Detection) includes unit testing, integration testing, regression testing. The software will be examined by means of avariety of tools and methodologies on a range of platforms and devices.

CHAPTER 7

FUTURE SCOPE

The future scope of the "SMART EYE" system is vast and diverse, promising to revolutionize the way we monitor and manage vehicles.

- The system can also be enhanced to operate on a server-side architecture, allowing for more centralized management and monitoring of the system.
- Integration with AI and machine learning technologies can enhance the system's capabilities, enabling it to detect and predict traffic patterns, optimize traffic flow, and identify potential security threats.
- More Accurate vehicle counting, speed detection, vehicle classification, and number plate detection modules can provide valuable insights into traffic patterns and volume, making it an essential tool for optimizing road networks, public transportation routes, and parking facilities.
- The system can be used by government agencies to enforce traffic laws and apply fines to violators, promoting safer driving practices and reducing congestion on the roads.
- The system can be an effective tool for traffic police and government agencies, promoting transparency and reducing corruption in traffic fine management.
- Integration with facial recognition and other biometric technologies can enable the system to identify and track individuals for security and law enforcement purposes.
- It can be used in other applications beyond traffic management, such as surveillance and security. For instance, the system could be deployed in high-security areas to detect and track suspicious vehicles and individuals.
- Emergency situation monitoring can detect and manage accidents and natural disasters, providing emergency responders with valuable data insights and helping to coordinate a rapid response.

With continued innovation and integration with emerging technologies, the SMART EYE system holds the key to a smarter, safer, and more efficient future for vehicle monitoring and management.

CHAPTER 8

CONCLUSIONS

In conclusion, the Smart Eye project is an innovative and advanced computer vision-based system that has the potential to revolutionize vehicle management and monitoring. The system uses cameras and advanced image processing techniques to detect and count vehicles in real-time, providing up-to-date information about traffic flow that can be used to make informed decisions about managing traffic and improving road safety.

The Smart Eye project's key features include its ability to work in real-time, its scalability, and its ability to be easily integrated with other traffic management systems and technologies.

The system can be deployed on a small or large scale, making it suitable for a variety of applications such as parking management, toll collection, and traffic management on highways and city centers. Overall, the Smart Eye project has the potential to improve the efficiency and safety of transportation infrastructure, making it an exciting development in the field of vehicle management and monitoring.

CHAPTER 9

APPENDIX

9.1 Glossary (Definitions/Abbreviations)

1. Vehicle Detection: The process of identifying vehicles present in a given area using cameras sensors.
2. Vehicle Counting: The process of counting the number of vehicles that pass through a specific area over a certain period of time.
3. Vehicle Speed Counting: The process of counting vehicle speed by using python pre-define library there are cv2, time, dlib and math.
4. Camera: A device that captures and records images or videos of a specific area.
5. ROI: Region of Interest. A specific area of an image or video where the vehicle detection and counting system is focused.
6. Frame: A single image of vehicle captured by a camera.
7. FPS: Frames per Second. The number of frames captured by a camera in pre millisecond.
8. Object Detection: The process of identifying objects within an video using cascade file.
9. Object Tracking: The process of following a specific object within a series of frames in a video and frame will be shown in the rectangular shape.
10. Deep Learning: Vehicle counting is performed in two steps: the captured video is sent to You Only Look Once (YOLO) based deep learning framework to detect, count and classify the vehicle and predefined cascade file.

11. Pytesseract: pytesseract is python predefined library that are used for Convert the data of image in text format and store in excel file.
12. Algorithm: Haar cascade is an algorithm that can detect objects in images, irrespective of their scale in image and location. This algorithm is not so complex and can run in real-time. Accuracy: The measure of how closely the results of a system match the true or expected results.
13. Automatic Number Plate Recognition (ANPR): A system that reads the number plates of vehicles to detect and count them.
14. Machine Learning: A system that uses algorithms and statistical models to detect and count vehicles based on data gathered from various sensors.
15. Counting Line: A line drawn across the road that is used to count the number of vehicles passing through a certain area.

CHAPTER 10

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  - https://www.section.io/engineering-education/license-plate-detection-and-recognition-using-opencv-and-pytesseract/
  - https://pypi.org/project/pytesseract/
  - https://pypi.org/project/opencv-python/

- **YouTube Channels Referred**
  - Nicholas Renotte: - https://youtu.be/0-4p_QgrdbE
  - sKSama: - https://youtu.be/y6-GKSoCvTc
  - crazzylearners: - https://youtu.be/mNJ2BzTRDQw

- **Documents Referred**
  - https://etrr.springeropen.com/articles/10.1186/s12544-019-0390-4
  - https://en.wikipedia.org/wiki/Road_traffic_control
  - https://en.wikipedia.org/wiki/Toll_road