Industry Oriented Mini Project Report

on

AUTOMATED VEHICLE DETECTION AND COUNTING SYSTEM

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

BACHELOR OF TECHNOLOGY

in

Information Technology

by

B. Anika Reddy (20WH1A1232)

S. Jeevitha (20WH1A1233)

Ch. Likitha Reddy (20WH1A1248)

Under the esteemed guidance of

Ms. M. Sudha Rani

Assistant Professor

Department of Information Technology

BVRIT HYDERABAD College of Engineering for Women

Rajiv Gandhi Nagar,Nizampet Road, Bachupally,Hyd–500090

(Affiliated to Jawaharlal Nehru Technological University, Hyderabad)

(NAAC 'A' Grade & NBA Accredited- ECE, EEE, CSE & IT)

December 2023

BVRIT HYDERABAD
College of Engineering for Women

Rajiv Gandhi Nagar, Nizampet Road, Bachupally, Hyderabad – 500090
(Affiliated to Jawaharlal Nehru Technological University Hyderabad)
(NAAC 'A' Grade & NBA Accredited- ECE, EEE, CSE & IT)

CERTIFICATE

This is to certify that the Project report on **" Automated Vehicle Detection And Counting System "** is a bonafide work carried out by **B. Anika Reddy (20WH1A-1232), S. Jeevitha (20WH1A1233), Ch. Likitha Reddy (20WH1A1248)** in the partial fulfillment for the award of B.Tech degree in **Information Technology, BVRIT HYDERABAD College of Engineering for Women, Bachupally, Hyderabad** affiliated to Jawaharlal Nehru Technological University, Hyderabad, under my guidance and supervision. The results embodied in the project work have not been submitted to any other university or institute for the award of any degree or diploma.

Internal Guide
Ms. M. Sudha Rani
Assistant Professor
Department of IT

Head of the Department
Dr. Aruna Rao S L
Professor & HoD
Department of IT

External Examiner

DECLARATION

We hereby declare that the work presented in this project entitled **"Automated Vehicle Detection And Counting System"** submitted towards completion of in IV year II sem of B.Tech IT at "BVRIT HYDERABAD College of Engineering for Women",Hyderabad is an authentic record of our original work carried out under the esteemed guidance of **Ms. M.Sudha Rani, Assistant Professor**, Department of Information Technology.

B.Anika Reddy (20WH1A1232)

S.Jeevitha (20WH1A1233)

Ch.Likitha Reddy (20WH1A1248)

ACKNOWLEDGMENTS

We would like to express our profound gratitude and thanks to **KVN. Sunitha, Principal, BVRIT HYDERABAD College of Engineering for Women** for providing the working facilities in the college.

Our sincere thanks and gratitude to **Dr. Aruna Rao S L, HoD Designation & Head, Department of IT, BVRIT HYDERABAD College of Engineering for Women** for all the timely support, constant guidance and valuable suggestions during the period of our project.

We are extremely thankful and indebted to our internal guide, **: Ms. M. Sudha Rani, Assistant Professor, Department of IT, BVRIT HYDERABAD College of Engineering for Women** for her constant guidance, encouragement and moral support throughout the project.

Finally, we would also like to thank our Project Coordinators **Neeraja, Assistant Professor and Aruna Jyothi, Assistant Professor**, all the faculty and staff of Department of IT who helped us directly or indirectly, parents and friends for their cooperation in completing the project work.

B. Anika Reddy (20WH1A1232)

S. Jeevitha (20WH1A1233)

Ch. Likitha Reddy (20WH1A1248)

ABSTRACT

In the rapidly evolving field of modern transportation, effective traffic management is crucial for ensuring smooth mobility and alleviating congestion. This project introduces an innovative Automated Vehicle Counting System that goes beyond conventional methods, providing a sophisticated solution for monitoring vehicles across diverse transportation scenarios. Utilizing state-of-the-art video analysis techniques, the system extracts multiple frames from video clips, accurately estimates the background, considers shadows, and employs frame subtraction to detect moving objects. In dynamic scenes, the system excels in detecting, classifying, and precisely counting vehicles. Notably, it incorporates advanced license plate detection for comprehensive traffic estimation. One key feature of this system is its capability to send the detected number plates in an Excel sheet, enhancing its utility for traffic management applications. This functionality allows for seamless integration with other systems, providing a comprehensive solution for traffic monitoring and analysis. The integration of advanced object detection, tracking algorithms, and license plate recognition represents a significant stride towards efficient transportation management. This technological innovation not only addresses current challenges in traffic management but also holds promise for future advancements. By providing accurate vehicle counts and detailed license plate information, this system emerges as a pivotal tool for effective traffic management and congestion alleviation in the ever-evolving landscape of urban mobility.

Keywords: Traffic Estimation, License plate detection, Classifying

Contents

List of Figures

Chapter 1

Introduction

The contemporary challenges in highway traffic management demand innovative solutions to address increasing congestion, enhance road safety, and contribute to informed urban planning. Current methods fall short in providing real-time, accurate, and comprehensive data for efficient traffic control, especially in scenarios where monitoring both sides of the road is imperative. Manual vehicle counting and classification processes are labor-intensive, error-prone, and lack the agility needed for dynamic traffic scenarios. Furthermore, existing systems often do not fully exploit advanced technologies such as license plate recognition, limiting their potential impact on road safety measures. Efficient highway traffic management hinges on the accurate detection and data collection from surveillance videos. Automation of vehicle detection, classification, number plate recognition, and counting is pivotal for advancing traffic management, promoting road safety, and facilitating informed urban planning. This project is dedicated to the development of an Automated Vehicle Counting System designed to streamline these processes, transcending conventional methods. The utilization of cutting-edge video analysis techniques, including frame extraction, background estimation, and object detection, marks a significant leap towards achieving comprehensive and intelligent highway traffic management. Beyond mere enumeration, the integration of advanced technologies promises to contribute to a safer and more seamlessly orchestrated urban transportation landscape. As we embark on this endeavor, we are dedicated to not just addressing current challenges but also contributing to the future evolution of highway traffic management through technological innovation and intelligent data-driven solutions.

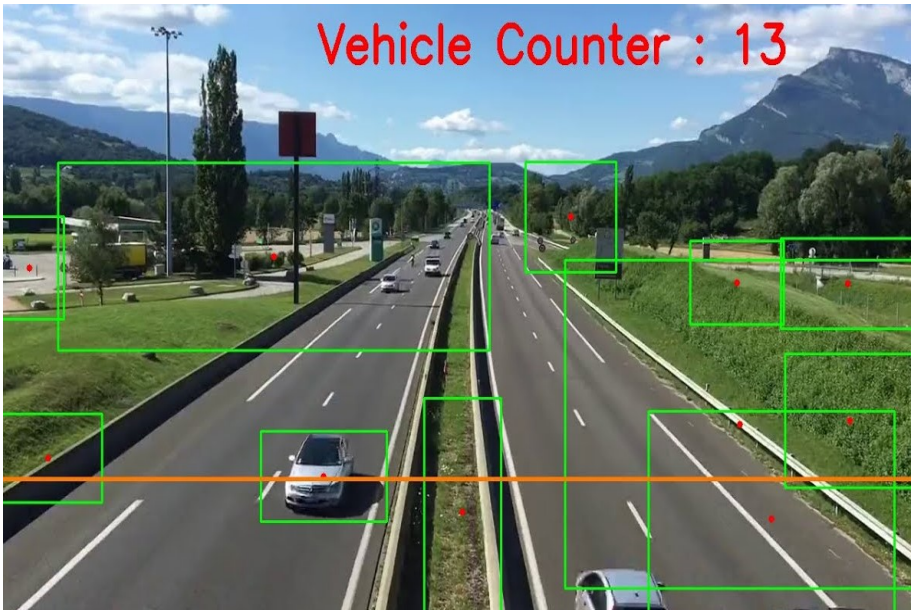

Figure 1.1: Real-time Vehicle Detection and Counting System

1.1 Motivation

Our project is fueled by a recognition of the profound challenges and opportunities presented by the evolving landscape of modern transportation. As urbanization continues to surge, so does the complexity of managing vehicular traffic on highways. The motivation behind our Automated Vehicle Detection and Counting System is rooted in the realization that traditional methods of traffic management are becoming increasingly insufficient to meet the demands of growing urban mobility.

The surge in vehicular density not only exacerbates traffic congestion but also poses significant challenges in ensuring road safety and facilitating informed urban planning. This motivated us to embark on the development of a system that goes beyond mere enumeration, aiming to contribute to a smarter and safer urban transportation experience.

Automating the intricate processes of vehicle detection, classification, and license plate recognition serves as a strategic response to these challenges. By harnessing advanced technologies, such as YOLOv8 and EasyOCR, our system aims to empower traffic management authorities with real-time, accurate, and comprehensive data. The ultimate goal is to pave the way for a more responsive, adaptive, and intelligent traffic management system that aligns with the evolving needs of urban mobility.

In essence, our project is motivated by the belief that embracing cutting-edge

technologies can revolutionize how we approach highway traffic management, leading to safer roads, improved urban planning, and a more seamless experience for all commuters.

Figure 1.2: Real-time Traffic Surveillance Snapshot

1.2 Objective

Our project, the Automated Vehicle Detection and Counting System, sets out with a paramount objective—to revolutionize the paradigm of highway traffic management. At its core, the system leverages cutting-edge technologies, encompassing automated vehicle detection, classification, and counting, to furnish real-time data for elevated and efficient traffic control. The integration of advanced techniques, especially in license plate recognition, marks a crucial stride toward fortifying road safety measures. Beyond the immediate scope of traffic management, our system aspires to be a linchpin in informed urban planning. Through the generation of comprehensive datasets that unravel intricate traffic patterns, our aim is to contribute invaluable insights. These insights empower city planners and authorities to make informed decisions that transcend immediate challenges and foster sustainable urban development. The implementation of sophisticated object tracking algorithms and the continuous refinement of object detection techniques exemplify our unwavering commitment to optimizing traffic flow dynamics. We

envision a system that not only streamlines highway traffic but also becomes an integral part of the broader landscape of intelligent transportation systems. Going beyond the confines of highways, our project extends its influence, contributing to a future where state-of-the-art technologies play a transformative role in the realm of transportation management. In essence, our project stands at the intersection of technological innovation and societal impact, embodying the potential of cutting-edge solutions to reshape the future of urban mobility and transportation management.

1.3 Problem Definition

The Automated Vehicle Detection and Counting System is designed to address the challenges of traditional traffic management methods by incorporating advanced capabilities. This project goes beyond conventional approaches, as it involves detecting, classifying, and counting vehicles, along with the added functionality of detecting number plates. The focus is not just on monitoring both sides of the road but also on providing a transformative solution to modern transportation management. This includes sending the detected number plates to an Excel sheet for comprehensive data analysis, marking a significant advancement in intelligent transportation systems. The project aims to meet the dynamic demands of traffic management by integrating cutting-edge technologies for accurate and insightful data processing.

Chapter 2

Literature Survey

2.1 Research Papers

The paper entitled "Vehicle Number Plate Detection using YoloV8 and EasyOCRs" tackles the challenges posed by increasing traffic, advocating for effective traffic control through an Automatic License Plate Recognition (ALPR) system powered by Convolutional Neural Network (CNN). The system focuses on license area and character verification, employing advanced techniques like YOLOv5 and EasyOCR. Addressing the impracticality of manual monitoring, the paper introduces the significance of ALPR as a foundational transportation automation tool. The literature survey highlights YOLOv5 integration and EasyOCR usage, emphasizing the need for ongoing technology integration. The proposed methodology outlines ANPR system steps, utilizing YOLO for object detection and character segmentation via bounding box methods. Results showcase an 84 percent accuracy in predicting license plates, with real-time snapshots confirming an 86 percent accuracy. The conclusion acknowledges ALPR success but suggests improvements in speed and handling diverse license types, proposing advancements in camera technology and template generation. Limitations are recognized, with calls for further algorithm enhancements.[1]

The paper entiled "Automated License Plate Detection and Recognition using YOLOv8 and OCR With Tello Drone Camera" presents an Automated License Plate Recognition(ALPR) system utilizing YOLOv8 and Optical Character Recognition for efficient traffic management and law enforcement. The system, developed in Python with OpenCV and Pytesseract libraries, employs a DJI Tello Drone camera for capturing vehicle images. YOLOv8 is utilized for license plate detection, exhibiting a 100% success rate in 50 photo samples. Following detection,

images undergo preprocessing based on plate color, improving OCR performance. Pytesseract achieves a 66% success rate in character recognition. The system aims to address challenges in ALPR systems, including accuracy in detection, character recognition robustness, real-time processing, adaptability to diverse environments, and cost-effectiveness. The proposed ALPR system demonstrates high accuracy, efficiency, versatility, cost-effectiveness, and scalability, contributing to traffic management and law enforcement technologies. The research acknowledges limitations related to image quality and suggests potential enhancements for future developments.Despite the 66% success rate in character recognition, the system's overall efficiency, adaptability to diverse environments, and cost-effectiveness make it a valuable contribution to the field. The paper emphasizes the need for ongoing improvements, hinting at the potential for future enhancements to address challenges and further refine the system's performance.[2]

The paper entitled "Vehicle Detection and Counting using Deep Learning based YOLO and Deep SORT Algorithm for Urban Traffic Management System" explores an innovative solution for estimating traffic density in urban areas using real-time video analysis. The authors emphasize the growing challenges in urban traffic management, where the rapid increase in the number of vehicles surpasses the available infrastructure. While existing traffic management systems address issues like speed detection and signal violations, the focus on traffic density estimation remains limited. The proposed system aims to contribute to intelligent transportation systems by introducing a video-based vehicle counting and tracking method. The integration of the You Only Look Once (YOLO) algorithm and the Deep SORT algorithm forms the backbone of the system. YOLO is employed for the detection, counting, and classification of vehicles, while Deep SORT facilitates multi-vehicular tracking in video frames. The model is trained for six different classes, including cars, motorbikes, buses, trucks, bicycles, and persons, using datasets specific to Indian road environments. The authors discuss the challenges faced by automated traffic analysis systems, such as shadows, environmental variations, and obstacles, which can degrade performance. They highlight the limitations of current methods that focus on steady videos from fixed cameras under simple conditions. The proposed system overcomes these challenges by employing advanced algorithms for object detection, classification, and tracking. The paper provides detailed insights into the software and hardware requirements for implementation, utilizing Python for programming and Google Colaboratory for cloud-based execution. The design and implementation involve the initialization of parameters, accessing input video datasets, and employing various OpenCV functions for object detection and tracking. Performance metrics such as precision, recall, accuracy, and F-score are introduced for evaluating

the effectiveness of the model. The authors present simulation results and analysis for three different videos, showcasing the detection and counting accuracy of the system. The model demonstrates an average counting accuracy of 86.56% and an average precision of 93.85%. The paper concludes by discussing assumptions, constraints, and challenges encountered during real-time implementation. The authors suggest future directions for the research, including the integration of the model with existing traffic management systems, addressing the need for specific Indian road datasets, and exploring edge computing solutions using FPGA and NVIDIA hardware boards. This research contributes a robust solution for urban traffic management, leveraging deep learning algorithms for accurate vehicle detection and counting. The proposed system holds promise for applications in smart city projects, traffic signal optimization, and overall infrastructural development.[3]

Chapter 3

System Design and Workflow

3.1 Proposed System

The proposed system aims to accurately detect, count, and recognize vehicles within a monitored area while identifying and extracting license plate information.[4] Vehicle Detection is performed by Utilizing advanced object detection models (YOLOv8) to accurately detect and localize vehicles within captured frames. Vehicle Tracking is done by applying object tracking algorithms to maintain continuity and track the movement of detected vehicles across consecutive frames. Counting mechanisms are implemented to accurately count the number of vehicles entering and exiting specific zones or lanes. [5]It Utilizes machine learning models trained on license plate datasets to recognize and interpret license plate numbers accurately. Optical Character Recognition (OCR) algorithms specific to license plate recognition are employed to extract text information from detected license plates. This proposed system integrates vehicle detection, counting, and license plate recognition technologies to create a comprehensive and efficient solution for traffic monitoring, security, and data analysis purposes.

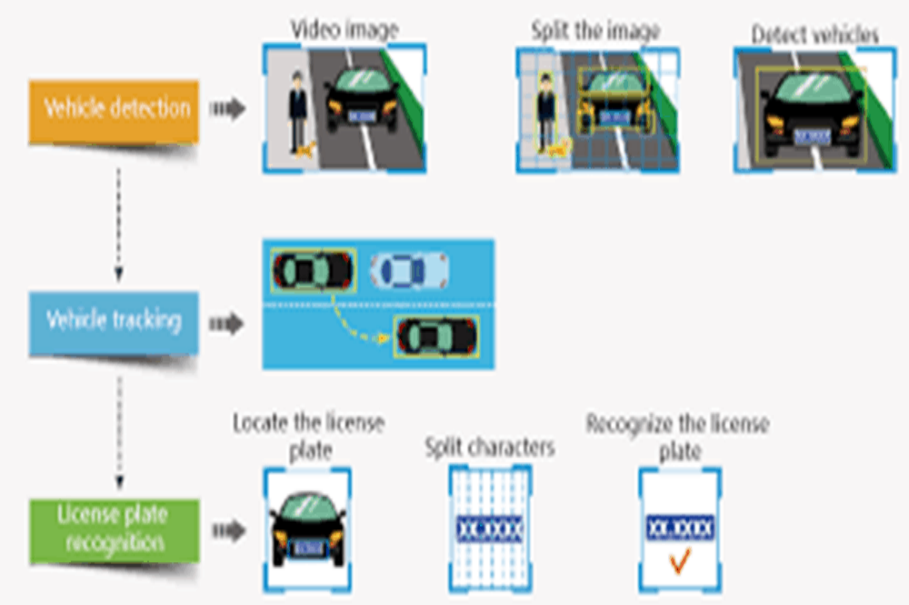

Figure 3.1: Automatic Identification system of Vehicles License Plates

3.2 Dataset Description

- **Vehicle Detection Dataset:**
  - Content: High-resolution images and video clips capturing road scenes, intersections, and highways.
  - Annotations: Bounding box annotations outlining vehicles' positions in each frame/image.
  - Diversity: Datasets include varying weather conditions (daytime, nighttime, rain, fog) and traffic densities.
- **Vehicle Counting Dataset:**
  - Content: Continuous video footage capturing vehicle movement through specific zones or lanes.
  - Annotations: Frame-level annotations indicating accurate vehicle counts for training and evaluating the system.
- **License Plate Recognition (LPR) Dataset:**
  - Content: Images and videos portraying vehicles with visible license plates.

- Annotations: License plate region annotations and corresponding text for OCR algorithm training.
- Variety: Datasets encompass varied angles, distances, lighting, and include multiple license plate formats and languages.

3.3 Workflow

1. **Data Collection and Preprocessing:**
   - Collect Diverse Data: Gather diverse datasets including vehicle images, video clips, and annotated data for vehicle detection, counting, and license plate recognition.
2. **Vehicle Detection:**
   - Object Detection Models: Employ advanced object detection models (YOLOv8) to identify and localize vehicles in each frame.
   - Annotation Integration: Apply annotations of bounding boxes outlining detected vehicles.
3. **Vehicle Tracking and Counting:**
   - Object Tracking: Implement object tracking algorithms (SORT) to maintain vehicle continuity across frames, enabling accurate counting.[6]
   - Counting Mechanism: Develop algorithms to count vehicles entering and exiting specific zones or lanes.
4. **License Plate Recognition (LPR):**
   - Region Extraction: Identify and extract license plate regions from vehicle images/videos.[7]
   - Optical Character Recognition (OCR): Apply OCR algorithms to recognize and extract license plate numbers or text from the identified regions.
5. **Data Integration and Analysis:**
   - Dataset Integration: Combine outputs from vehicle detection, counting, and license plate recognition for comprehensive data analysis.
   - Traffic Reports Generation: Analyze collected data to generate traffic reports, including vehicle counts, traffic flow analysis, and license plate information.[8]

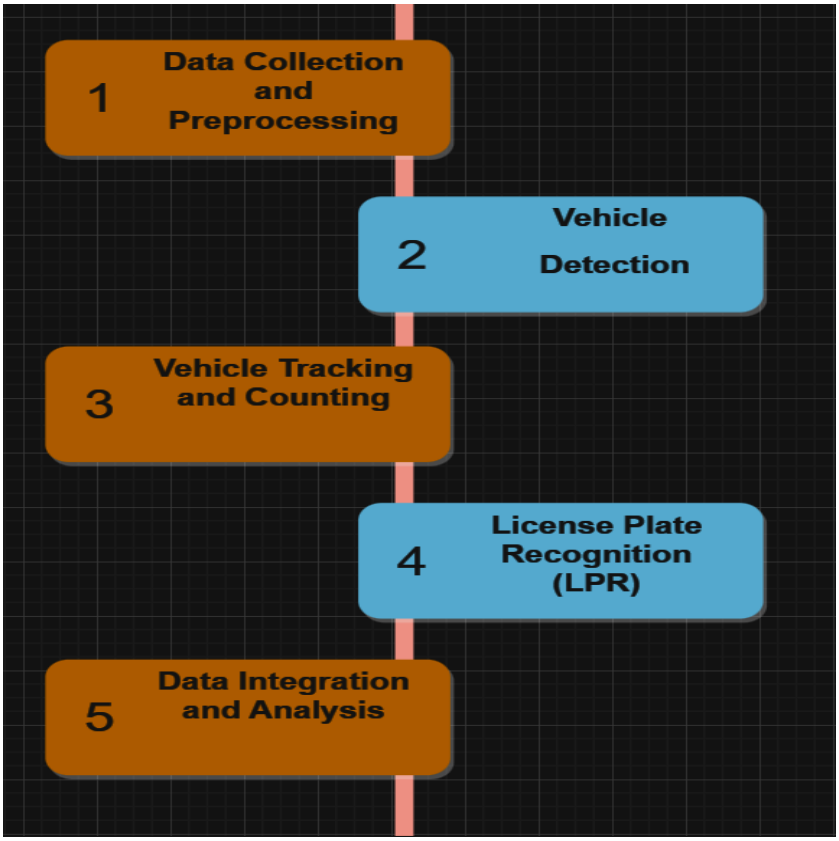

Figure 3.2: System Design WorkFlow

Chapter 4

Implemention

4.1 System Modules

1. **Data Collection Module:**
    - Objective: Collects diverse datasets including images, videos, and annotated data for vehicle detection, counting, and license plate recognition.
    - Functionality: Gathers data from various sources ensuring diversity in lighting conditions, weather, and traffic densities.
2. **Preprocessing Module:**
    - Objective: Cleans, preprocesses, and augments collected data for training and testing purposes.
    - Functionality: Resizes, cleans noise, and augments data for improved model training and robustness.
3. **Vehicle Detection Module:**
    - Objective: Identifies and localizes vehicles in images or video frames.
    - Functionality: Employs advanced object detection models (Yolov8) to detect vehicles and generate bounding box annotations.
4. **Vehicle Tracking and Counting Module:**
    - Objective: Tracks detected vehicles and counts their movement through specific zones or lanes.[9]
    - Functionality: Utilizes object tracking algorithms to maintain continuity, enabling accurate vehicle counting.

5. **License Plate Recognition (LPR) Module:**

   - Objective: Recognizes and extracts license plate information from vehicle images or videos.[10]
   - Functionality: Applies Optical Character Recognition (OCR) algorithms to extract license plate text from identified regions.

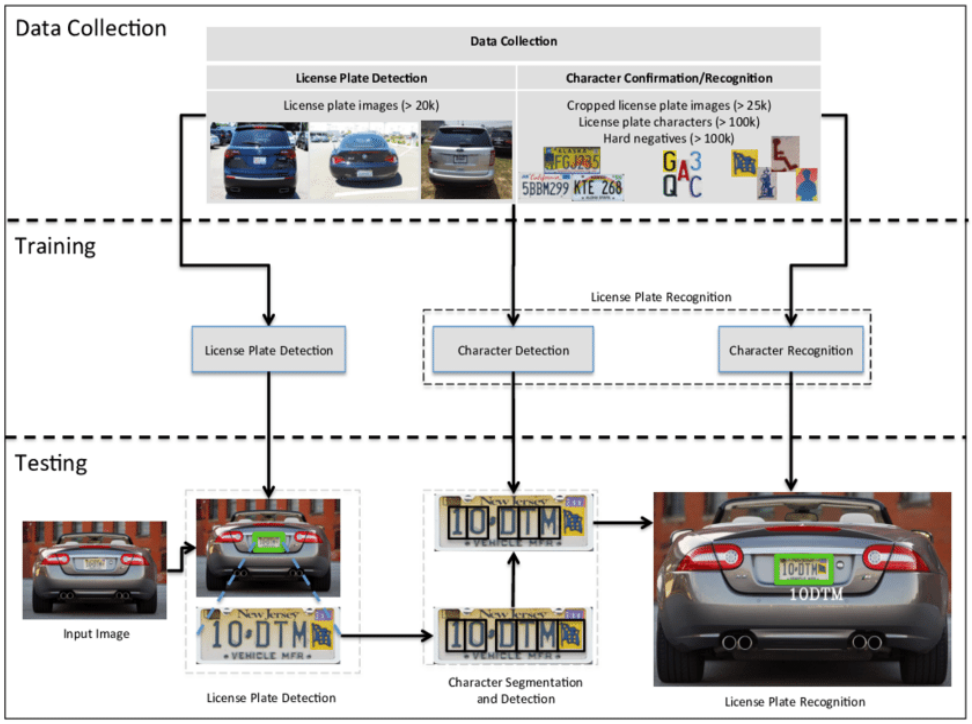

Figure 4.1: Licesne Plate Recognition

4.2 Algorithm

1. **Vehicle Detection Module:**

   - Algorithm: YOLO (You Only Look Once)
   - Description: This algorithm is utilized to detect and localize vehicles within images or video frames. They employ deep learning architectures for accurate bounding box generation around detected vehicles. YOLO is an object detection algorithm known for its speed and accuracy. It divides an image into a grid and predicts bounding boxes

and class probabilities for each grid cell. It Utilizes a single neural network to perform detection directly on the whole image, generating bounding boxes and class probabilities simultaneously.

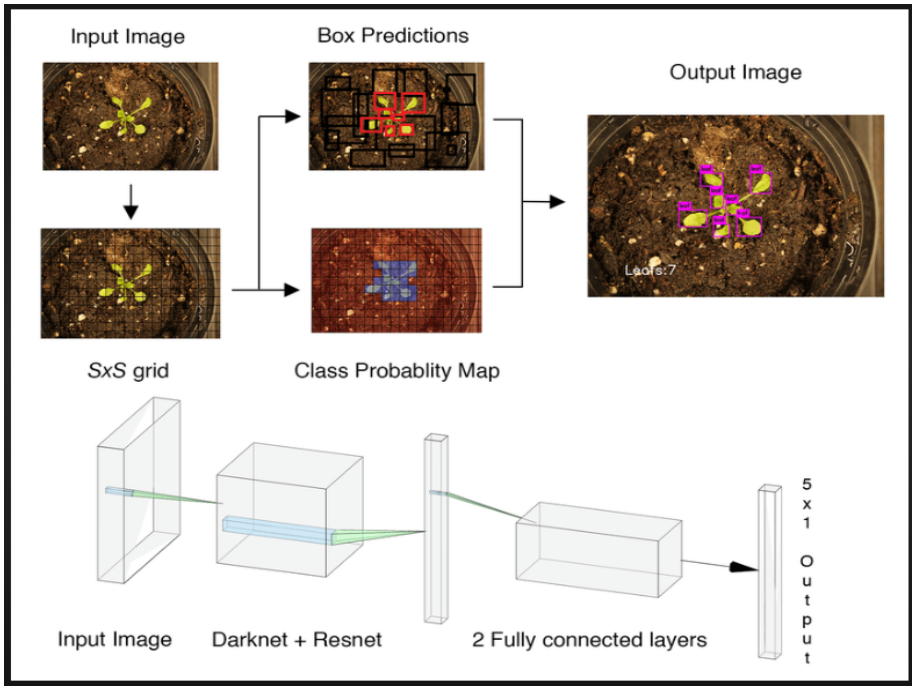

Figure 4.2: YOLO Framework

2. **Vehicle Tracking and Counting Module:**

   - Algorithm: Deep SORT (Simple Online and Realtime Tracking).
   - Description: Object tracking algorithms used to maintain vehicle continuity across frames, enabling accurate vehicle counting by tracing and monitoring the movement of detected vehicles. Deep SORT is a tracking algorithm that combines deep learning with the SORT algorithm (Simple Online and Realtime Tracking). It uses a deep appearance descriptor network to create embeddings of object appearances, allowing for robust matching between object detections across frames. Deep SORT also employs the Kalman Filter for state prediction and data association, enhancing the tracking accuracy and maintaining object identities across frames.

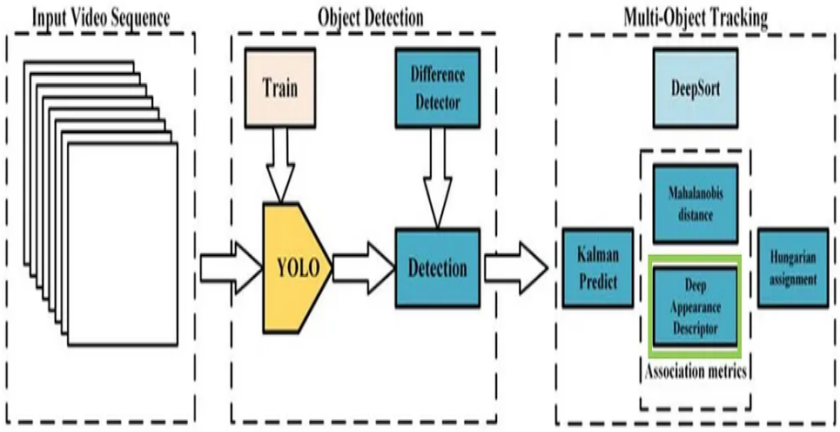

Figure 4.3: SORT:Simple Online Real-time Tracking.

3. **License Plate Recognition (LPR) Module:**

   - Algorithm: Convolutional Neural Networks (CNNs) for character recognition, such as Tesseract OCR.
   - Description: Description: These algorithms are employed for Optical Character Recognition (OCR) to extract and interpret characters from license plate images or regions, thereby recognizing license plate information. Tesseract OCR is an open-source OCR engine capable of recognizing various text characters from images. It uses LSTM (Long Short-Term Memory) networks and employs a combination of CNNs and RNNs for character recognition. Tesseract is versatile and can be trained on specific datasets to improve recognition accuracy for license plate characters.

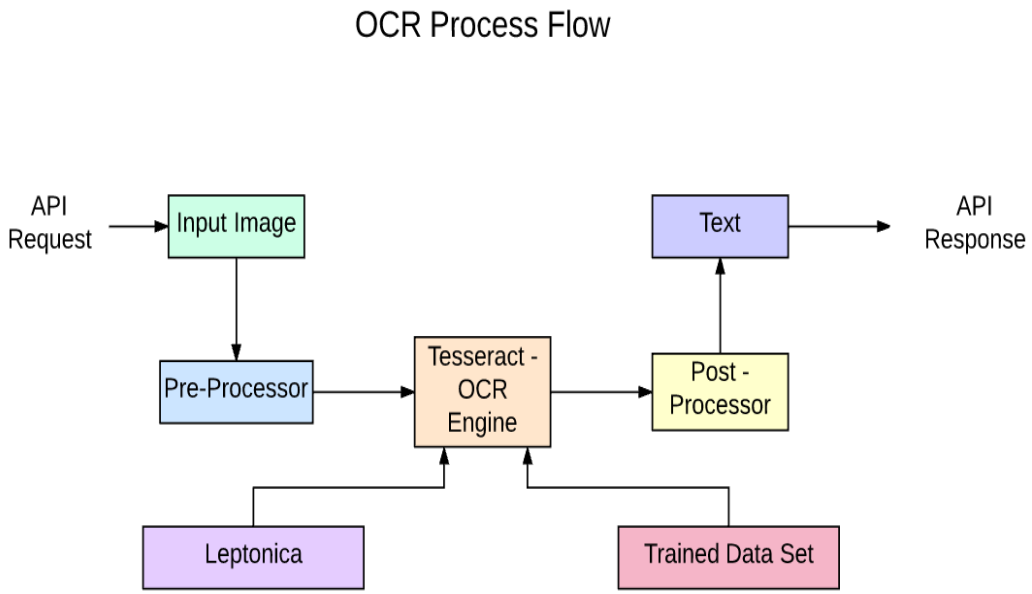

Figure 4.4: OCR Process Flow

Chapter 5

Results and Discussions

5.1 Experimental Results-1

Figure 5.1: Vehicle Detection

Figure 5.2: Vehicle Counting and Tracking

Figure 5.3: License Plate Recognition

Actual License Plate	Predicted License Plate	Accuracy
OLA1208	OLA1208	100%
OYJ9557	OYJ9557	100%
PJG0783	PJG0783	100%
OUP9563	OUP9563	100%
OLC4728	OLC4728	100%
ODJ1599	ODJ1599	100%
GWT2180	GWT2120	86.0%
OKV8004	QKV8004	86.0%
PJB2414	PJB2414	100%
AYO9034	AYO9034	100%
JSQ1413	JSQ|413	86.0%
OKS0078	OKS0078	100%
NTK5785	NTK5785	100%
PJD2685	PJD2685	100%
NZW2197	NZW2197	100%
PJB7392	PJB7392	100%
NYY1710	NYY1710	100%
OCX4764	OCX4764	100%

Figure 5.4: License Plate Recognition Analysis

Chapter 6

Conclusions and future works

6.1 Conclusion

The Automated Vehicle Counting System marks a significant leap forward in the realm of modern transportation management. Its innovative approach, leveraging state-of-the-art video analysis techniques, allows for precise monitoring and counting of vehicles in diverse scenarios. The system's ability to extract multiple frames, accurately estimate backgrounds, account for shadows, and employ advanced frame subtraction sets it apart from conventional methods.Moreover, the incorporation of advanced license plate detection adds a layer of sophistication to the system, enabling comprehensive traffic estimation. The system's unique feature of sending detected number plates in an Excel sheet enhances its practicality for traffic management applications, facilitating seamless integration with other systems. This interoperability underscores its potential as a comprehensive solution for traffic monitoring and analysis.The integration of advanced object detection, tracking algorithms, and license plate recognition represents a substantial stride towards efficient transportation management. Not only does this technological innovation address current challenges in traffic management, but it also holds promise for future advancements in urban mobility.By providing accurate vehicle counts and detailed license plate information, this Automated Vehicle Counting System emerges as a pivotal tool for effective traffic management and congestion alleviation. In the rapidly evolving landscape of urban mobility, this system stands as a beacon of progress, offering a sophisticated and adaptable solution to meet the dynamic challenges of transportation in the modern era.

6.2 Future Scope

The Automated Vehicle Detection and Counting System holds promise for future advancements, including real-time traffic analysis and integration with smart city infrastructure. Continuous refinement of machine learning algorithms will enhance accuracy, while enhanced security features may include real-time vehicle identification. Expansion into multimodal transportation and environmental impact assessment through emissions monitoring are potential avenues. GPS integration for geospatial insights and collaboration with autonomous vehicles represent further opportunities. These developments position the system as a key player in shaping the future of intelligent transportation management, offering a comprehensive and adaptable solution for dynamic traffic scenarios.

Bibliography

[1] A. M. P. M. S. B. A. K. K. U. C. P. K. W. S. S. Sheetal S. Patil, Suhas H. Patil, "Vehicle number plate detection using yolov8 and easyocrs," *IEEE Access*, 2023.

[2] A. R. H. A. A. F. H. B. N. I. Hanif Fakhrurroja, Dita Pramesti, "Automated license plate detection and recognition using yolov8 and ocr with tello drone camera," 2023.

[3] A. A. M. Rahul Kejriwal, Ritika H J, "Vehicle detection and counting using deep learning basedyolo and deep sort algorithm for urban traffic management system," 2022.

[4] S. Luo and J. Liu, "Research on car license plate recognition based on improved yolov5m and lprnet," *IEEE Access*, vol. 10, pp. 93692–93700, 2022.

[5] C. K. Gomathy, "Vehicle counting and number plate detection," *International Research Journal of Engineering and Technology (IRJET)*, vol. 08, pp. 200–210, 2021.

[6] M. A. Bin Zuraimi and F. H. Kamaru Zaman, "Vehicle detection and tracking using yolo and deepsort," pp. 23–29, 2021.

[7] J. Shashirangana, H. Padmasiri, D. Meedeniya, and C. Perera, "Automated license plate recognition: A survey on methods and techniques," *IEEE Access*, vol. 9, pp. 11203–11225, 2021.

[8] Z. Dai, H. Song, X. Wang, Y. Fang, X. Yun, Z. Zhang, and H. Li, "Video-based vehicle counting framework," *IEEE Access*, vol. 7, pp. 64460–64470, 2019.

[9] M. Al-Smadi, K. Abdulrahim, and R. Abdul Salam, "Traffic surveillance: A review of vision based vehicle detection, recognition and tracking," *International Journal of Applied Engineering Research*, vol. 11, pp. 713–726, 2016.

[10] A. G. Hanit Karwal, "Vehicle number plate detection system for indian vehicles," *IEEE Access*, pp. 8–12, 2015.