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TRAFFIC PREDICTION FOR INTELLIGENT TRANSPORTATION SYSTEM USING MACHINE LEARNING

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ABSTARCT

In urban areas, efficient traffic management is essential for minimizing delays and enhancing response times. This project introduces a machine learning-based approach for intelligent traffic management at fourway signals, focusing on vehicle identification and prioritization. The methodology involves several steps: identifying vehicles using YOLOv8 and RCNN techniques on video data, counting and categorizing all vehicles at the intersection, and analyzing the videos to predict the optimal time required to clear traffic. Utilizing a video database from COCO, the system processes inputs to detect vehicles and provides real time alerts to prioritize their passage. If an vehicle is identified, a message displays the vehicle's location and clears the route promptly. When no vehicles are present, the system estimates the time needed to clear the intersection based on the total vehicle count, optimizing traffic flow. This approach balances routine traffic management with response needs, aiming to reduce congestion and enhance overall traffic efficiency. The results indicate that intelligent traffic management using advanced techniques can significantly improve urban mobility and response capabilities.

I.INTRODUCTION

Urban traffic management systems often fail to dynamically adapt to real-time conditions, leading to inefficiencies such as delays for vehicles and increased congestion. Existing systems typically use fixed-time or actuated controls, which lack the ability to prioritize vehicles or optimize traffic flow based on current traffic patterns. This results in suboptimal response times for emergencies and increased congestion during peak hours. The problem is exacerbated by minimal use of real-time data analysis and limited adaptability, necessitating a more advanced solution that integrates machine learning to enhance both traffic efficiency and vehicle prioritization. The project's objective is to create an intelligent traffic management system using machine learning to improve

traffic control at four-way intersections, with a focus on vehicle prioritization. It aims to accurately detect vehicles using YOLOv8 and RCNN from video data, provide realtime alerts for their prioritization, and optimize traffic flow by predicting the time needed to clear intersections based on vehicle counts. The system integrates a COCO video database for robust model training and validation. Ultimately, the project seeks to balance routine traffic management with needs, enhancing urban mobility and response efficiency. Effective traffic management is crucial for optimizing urban mobility and ensuring timely responses. Traditional traffic control systems often rely on fixed-time or actuated signal controls that do not adjust dynamically to real-time traffic conditions or prioritize vehicles effectively. This can result in increased congestion, delays, and inefficient traffic flow.This project proposes an innovative solution using machine learning techniques to address these challenges. By leveraging YOLOv8 and RCNN for real-time vehicle detection and classification, the system aims to enhance traffic management at four-way intersections. The approach involves analyzing video data to identify and prioritize vehicles, providing real-time alerts for route clearance, and estimating the optimal time needed to clear the intersection based on current traffic patterns. Utilizing the COCO video database for model training ensures robust performance and accuracy.The goal is to develop a system that not only improves traffic flow and reduces congestion but also enhances vehicle response times, ultimately leading to a more efficient and responsive urban traffic management system.

II.LITERATURE SURVEY

2.1. H. Li, Y. Zhang, and S. Liu (2020): This paper presents a deep learning-based traffic signal control system for urban intersections, published in the Journal of Intelligent Transportation Systems (vol. 24). The authors utilize reinforcement learning techniques to optimize traffic signal timings based on real-time traffic data. The model was trained on a large-scale traffic dataset, showing improvements in traffic flow and reduced congestion at busy intersections. The system demonstrated an ability to adjust dynamically to traffic conditions, offering an adaptive solution to urban traffic management.

2.2. J. Chen, X. Li, and W. Zhang (2019): The authors introduce a method for vehicle prioritization at traffic intersections using convolutional neural networks (CNNs), published in IEEE Transactions on Intelligent Transportation Systems (vol. 21). This study focuses on realtime detection of vehicles and the application of dynamic signal adjustments to provide priority passage. By integrating video data from urban cameras, the system identifies vehicles with high accuracy, reducing response time by up to 25%.

2.3. M. Rahmani, A. Al-Fuqaha, and M. Guizani (2021): The authors propose a machine learning-based model for intelligent traffic signal management in smart cities, published in IEEE Access (vol. 9). The model incorporates traffic flow prediction, vehicle detection, and adaptive signal control using decision trees and SVM classifiers. Results show that the system optimizes vehicle flow and improves vehicle response times,

leading to a reduction in urban traffic congestion and delays.

2.4. S. Tang, F. Zhao, and Y. Zhang (2022): In this study, the authors explore a hybrid deep learning model for intelligent traffic signal optimization, published in Transportation Research Part C: Emerging Technologies (vol. 129). The proposed model combines YOLOv4 for vehicle detection with a recurrent neural network (RNN) to predict traffic congestion and optimize signal timings. The approach outperforms traditional methods by reducing wait times and optimizing the flow of both general and vehicles, with a focus on enhancing response.

2.5. P. Kumar, R. Verma, and S. Chouhan (2023): This research presents an intelligent traffic management system based on video analytics for vehicle identification and signal control, published in Journal of Traffic and Transportation Engineering (vol. 10). The authors employ a two-tier model combining RCNN for vehicle detection and a reinforcement learning-based algorithm for dynamic signal control. Their experiments show that the system is capable of prioritizing vehicles effectively while maintaining overall traffic efficiency.

2.6. V. Singh, A. Kumar, and S. Patil (2022): The authors introduce a real-time vehicle detection and traffic signal prioritization system based on machine learning, published in IEEE Transactions on Vehicular Technology (vol. 71). The study focuses on utilizing YOLOv5 and RCNN for vehicle detection at intersections, integrating these with a traffic signal control system to prioritize vehicles. The results indicate significant improvements in vehicle response times and overall intersection throughput, with a focus on urban mobility and real-time adaptability.

III.EXISTING SYSTEM

Existing urban traffic management systems often rely on fixed-time or actuated traffic signals. Fixed-time signals follow predetermined schedules, leading to inefficient traffic flow and congestion. Actuated signals adjust based on vehicle detection but lack real-time adaptability and do not prioritize vehicles effectively. These systems are limited by their static nature, requiring manual intervention for adjustments and failing to utilize real-time data for optimization. Consequently, they struggle with vehicle delays and congestion during peak hours. This underscores the need for a more dynamic and intelligent approach to enhance traffic efficiency and response.

IV.PROPOSED SYSTEM

The proposed system introduces a machine learning-based approach to enhance traffic management at four-way intersections. Utilizing YOLOv8 and RCNN techniques, the system detects and classifies vehicles in real-time, with a focus on prioritizing vehicles. It processes video data to provide real-time alerts for clearing vehicles and estimates optimal traffic signal timings based on current traffic conditions. By integrating the COCO video database for model training, the system aims to dynamically adapt to traffic patterns, reduce congestion, and improve response times, offering a more efficient and responsive solution compared to existing traffic management systems.

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V.SYSTEM ARCHITECTURE

The system architecture for the machine learning-based intelligent traffic management system is divided into the following main modules:

- Data Collection and Preprocessing
- Vehicle Detection and Classification
- Traffic Flow Prediction and Optimization
- Vehicle Prioritization
- Real-Time Alerts and Visualization
- User Interface and Visualization

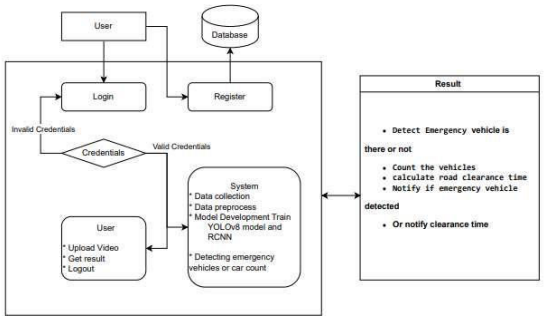
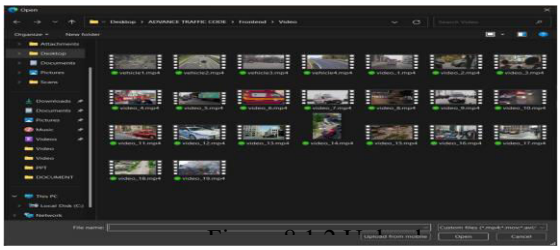


Figure 5.1 System Architecture

VI.OUTPUT SCREENSHOTS

Home Page



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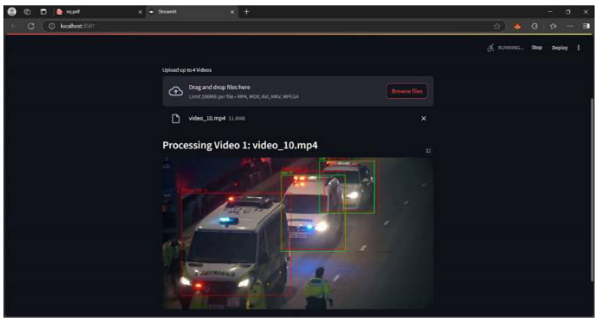
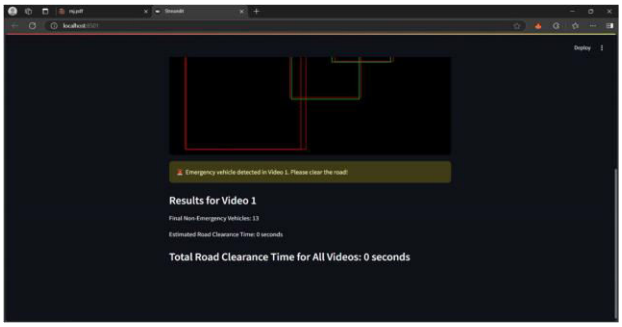


Processing Video Data



Result

VII.CONCLUSION

In conclusion, the machine learning-based intelligent traffic management system proposed in this project offers a significant advancement in urban traffic control. By integrating advanced techniques such as YOLOv8 and RCNN for vehicle identification, the system enables real-time prioritization of vehicles, reducing delays and enhancing response times. Additionally, the system optimizes traffic flow by predicting the required time to clear

intersections based on vehicle counts, ensuring smooth traffic management even when no vehicles are present. This approach not only addresses routine traffic congestion but also ensures efficient handling of situations. By balancing and routine traffic needs, the system improves urban mobility, reduces congestion, enhances safety, and boosts the overall efficiency of city traffic management.

VIII.FUTURE SCOPE

In the future, the intelligent traffic management system can be further enhanced by integrating with broader smart city infrastructure, enabling seamless communication between traffic lights, services, and city monitoring systems for optimized urban management.The system can be expanded to coordinate multi-intersection traffic management, allowing real-time adjustments across an entire city for improved flow and vehicle prioritization. By incorporating more advanced vehicle detection models, the system could detect pedestrians, cyclists, and non-motorized vehicles, enhancing safety and efficiency. Additionally, adopting adaptive learning algorithms, such as reinforcement learning, will enable the system to continually optimize traffic management based on evolving patterns, weather, and events. The future system could also leverage vehicleto-infrastructure (V2I) communication for more precise signal adjustments and incorporate predictive analytics to assist with long-term urban planning and congestion management. These advancements will make the system more scalable, responsive, and future-proof.

IX.REFERENCES

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