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Real Time Object Detection for Traffic Analysis using YOLOv8

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ABSTRACT: In modern transportation systems, real-time monitoring and analysis of traffic scenarios are important for efficient traffic management and safety enhancement. This paper give out a novel approach to real-time object detection tailored for traffic analysis, with a focus on speed detection and lane change detection. Our system utilizes state-of-the-art deep structural learning techniques to accurately detect and track vehicles in live video streams from traffic cameras. Through the integration of advanced algorithms, our system is capable of not only identifying vehicles but also determining their speeds and detecting lane changes in real time. Experimental results demonstrate the effectiveness and efficiency of this approach in various traffic scenarios, showcasing its potential for deployment in intelligent transportation systems for enhanced traffic management and safety enforcement.

KEYWORDS: YOLOv8, Speed Detection, Object Detection, Vehicle Counting, Computer vision.

I. INTRODUCTION

Modern urban environments are experiencing unprecedented growth in population and vehicular traffic. As our cities expand, so does the complexity of managing and optimizing traffic flow. It's really important to understand and study traffic patterns effectively and quickly. Accurate and real-time information about traffic patterns can lead to smarter urban planning, improved safety, and enhanced overall quality of life. Traditional methods of traffic analysis often fall short in providing the speed, precision, and scalability required for today's dynamic traffic scenarios. This is at which the integration of cutting-edge technologies becomes indispensable.

Our project mainly focused on utilizing the YOLO (You Only Look Once) for object detection to revolutionise the way we analyse traffic. The selection of this problem stems from a convergence of technological advancements and societal needs. YOLO, a state-of-the-art real-time object detection algorithm, has demonstrated the exceptional work in different fields, that includes computer vision and image processing. Its capability to analyze images in real-time with great accuracy makes it a standout choice for numerous applications, including traffic analysis. The decision to apply YOLO for traffic analysis is rooted in the recognition that traditional methods often face challenges in handling diverse and dynamic traffic scenarios. YOLO's unique approach of dividing an image to a grid and simultaneously forecasting the bounding boxes and class probabilities for each divided cell offers a nimble and efficient solution. Our aim is to harness the power of YOLO to precisely detect and track vehicles, pedestrians, and other relevant objects in a traffic scene. By doing so, we aim to give valuable perception into traffic patterns, congestion, and potential safety hazards, empowering urban planners and traffic management authorities to make informed decisions.

II. LITERATURE REVIEW

- The study referred from paper[1] authors proposed a model using “YOLO and SORT for the estimation of traffic flow”. The purpose of this paper is traffic flow approximation using low-quality CCTV video footage in real-time. They primarily concentrated on multi-lane road. They trained the novel YOLOv4 algorithm for five object classes such as car, truck, van, bike and bus . They developed an algorithm using a sort tracker to count vehicles based on their movement direction like Northbound and Southbound
- In this paper[2] the authors proposed a model using “Computer vision and Deep Learning for the lane and vehicle detection”. This paper gives a lane-vehicle detection and tracking system. The authors divided this project into two steps they are vehicle detection and Lane detection. For vehicle detection they used YOLO Framework. For the lane detection they use many Image manipulation methods using color spaces.

- In this paper[3] authors introduced a **“Efficient Roundabout Supervision: Real-Time Vehicle Detection and Tracking on Nvidia Jetson Nano”**. They installing a smart camera on the primary route connecting the two cities. They implemented the system using the YOLOv7 tiny object detection model to detect and classify the different kinds of vehicles crossing the main road.
- In this paper[4] authors proposed a **“Object detection and tracking using deep learning algorithm”** Detection and identification of smaller objects. To generate a boundary boxes around the vehicles sliding window and roll polling methods are used. COCO dataset is used for object classification. It shows the name of the each and every object. Consumes more time to detect and classify the object
- In this paper[5] author proposed a **“Image manipulating methods and challenges”**. Noise reduction, image enhancement, object recognition, and segmentation. Techniques: Image pre-processing, Rotation, Image restoration, Image analysis.

III. PROPOSED WORK AND OBJECTIVES

To develop an effective object detection system for a traffic analysis using YOLO algorithm.

The block diagram in Fig.1 The system works by first capturing the video of the road. This video image is then supplied into a detector, which was referred to identify lane markings in the picture. The detector may use a variety of techniques to do this, such as edge detection or image segmentation. After the lane markings identifications had done, the system can then track the movement of the lanes over time. This information can be used to count the vehicles on the road, or to detect rate of change of movement of the vehicles.

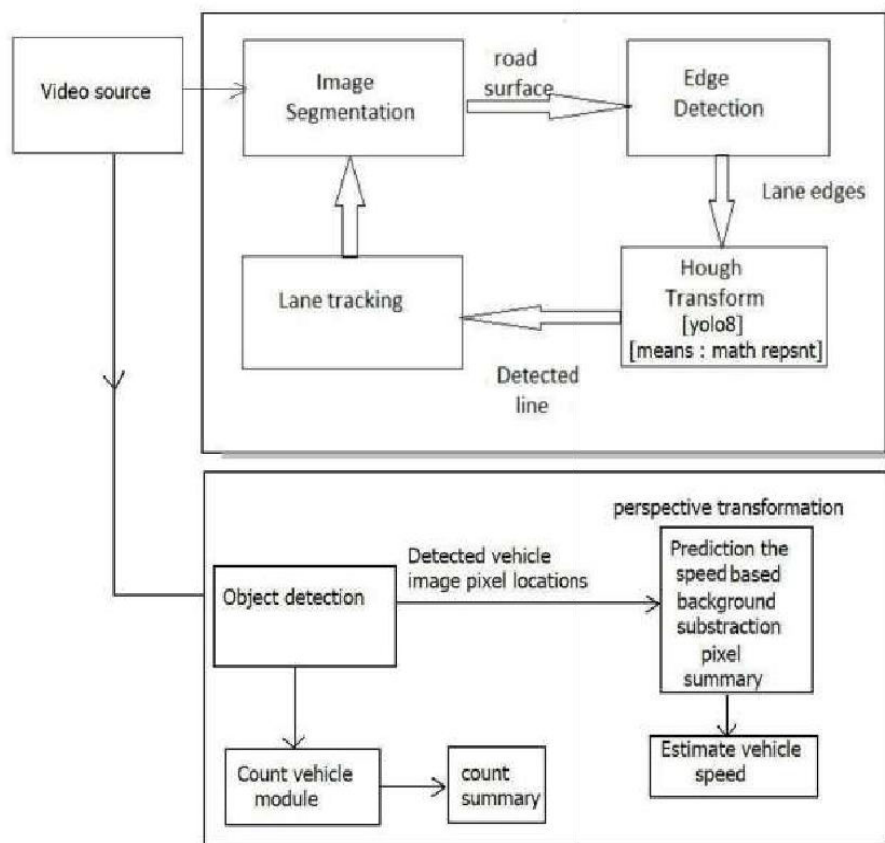


Fig 1: Block Diagram of object detection using YOLOv8 Algorithm

Video source: The video footage provides the raw data for traffic analysis, capturing real-time information about vehicles and their movements on the road. **Image segmentation:** By segmenting the image, the system can isolate vehicles from the background, allowing for accurate vehicle detection and tracking.

Edge detection: Detecting edges helps identify lane markings and boundaries, which are difficult for understanding lane configurations and vehicle positioning within lanes.

Hough transform: Detecting lane lines using the Hough transform enables the system to determine the layout of the road and monitor lane occupancy, which is essential for analyzing traffic flow and congestion. **Object detection (YOLOv8):** Detecting vehicles using YOLOv8 provides data on vehicle presence, spatial distributions, count and offering insights into traffic density and congestion levels.

Lane Tracking :Tracking lane lines over time helps monitor lane changes, merge behaviours, and lane occupancy rates, providing valuable information for traffic flow optimization and congestion management. **Perspective transformation:** Adjusting for perspective distortion ensures accurate measurements and analysis of vehicle speeds, distances, and trajectories, essential for understanding traffic dynamics and behaviour. **Background subtraction:** By isolating moving vehicles from the background, background subtraction enables the system to give importance to dynamic vehicles of the scene, such as vehicles in motion, facilitating accurate traffic flow analysis.

Detected line and detected vehicle: Outputs from the system, such as detected lane lines and vehicles, serve as the basis for traffic analysis, providing data on lane occupancy, vehicle distribution, and traffic patterns.

Count vehicle module: Counting of vehicles on road facilitates traffic volume estimation, helping quantify traffic flow rates and congestion levels at specific locations and times.

Estimate vehicle speed: Enables the system to analyse traffic dynamics, identify areas of congestion, and assess the effectiveness of traffic management strategies, such as speed limits and lane configurations

IV. RESULTS

The YOLO Algorithm for Traffic Analysis provides comprehensive results like vehicle counting, speed detection, bounding box coordinates and class labels. It accurately detects and counts vehicle in give frame.



Fig 2: Before Segmentation



Fig 3: Vehicle count and Speed detection



Fig 4: Lane change detection of vehicles on road

V. CONCLUSION

YOLOv8 is a deep learning algorithm with object detection and tracking capabilities. It makes counting and tracking automobiles simple. YOLOv8's strong ability to detect and track objects makes it a handy tool for keeping an eye on traffic. Advantages

1. It can detect the small objects.
2. By monitoring the density of the vehicles in different areas, traffic authorities can better manage and optimize traffic flow.
3. Object detection is not limited to vehicles, it can also identify pedestrians.

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