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INTEGRATED ROAD LANE AND VEHICLE DETECTION SYSTEM

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ABSTRACT

In Urban traffic system becomes more complicated nowadays and it raises demand for detecting the right lanes and vehicles in real time to improve driving safety. Most of what it does has been done before, but this is a complete solution that includes deep learning based lane detection and vehicle detection YOLOv8 pose. Drivers can use the system to keep them centred in their lane and provide alerts about vehicles with active safety, which can be activated by the driver on the highway drives and if a driver is drowsy. By integrating a powerful lane detection algorithm with YOLOv8, we demonstrate accurate localization of lanes and vehicles in all the driving conditions.

Keywords: Computer Vision, Lane Detection, Tensor Flow, Vehicle Detection, Yolov8.

I. INTRODUCTION

The automobile industry is incorporating automated solutions for road safety as a result of recent technological developments in automated driving assist systems. Two of the most crucial functions of these systems are vehicle and road lane detection, which aid drivers in keeping a safe distance from other cars and staying in their lanes. Autonomous mobility requires an accurate actual time road lane and vehicle identification system because of the difficulties posed by complex driving situations and heavy traffic.

The lane detection is relatively more complex than the above-mentioned applications though, as the commonly used edge detection and transformation techniques using Hough Transform to get lines were unreliable around difficult environment conditions, such as low-light, environmental occlusions and bad weather situations. Similarly, traditional vehicle detection systems usually utilize simple ML algo classifiers, such as svm, and may experience difficulty in real-time detecting vehicles especially in high-speed traffic scenarios.

In the past couple of years, with the advancements of (Deep learning) techniques, CV came a long way and now there are pristine methods in almost object or lane detection. Within these advancements, the YOLO family of object detection algorithms has achieved top-level real-time performance for detecting vehicles. For quick inference and high accuracy, YOLO models can perform object detection as a single combined task.

This paper aims to combine two important tasks which are road lane detection and vehicle detection to an online usable system for videos. System information dynamics are intended to aid drivers with constant, in-time position segmentation and close proximity delineation of environmental vehicles. The system uses the newest version of YOLO model for vehicle detection (YOLOv8) and a robust detecting lanes algorithm based on computer vision(deep learning) this reduce accidents due to lane drifting or car collisions, improving driving safety.

Detected lanes is need and curtail aspect for highway safety, however because of different scenarios like occlusions, fading markings, sharp curves or poor visibility in adverse conditions make it more challenging to provide an adaptive system that would return reliable performance.

Vehicle detection is critical for collision avoidance, and YOLOv8 can be used to speed up the accuracy of vehicle detection in multiple scenarios by optimizing anchor boxes, improving bounding box prediction performance, and increasing efficiency.

The proposed system combines deep learning-based lane and vehicle detection (with YOLOv8) to immediately warn the driver in case of a vehicle invasion or lane departure for a safer road experience.

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II. LITERATURE SURVEY

1. Vehicle Detection and Recognition research paper.

Vehicle Detection and RecognitionThis research work was done by Sriashika Addale and team in the year 2020. who has taken key lead in the development of traffic intelligent surveillance systems. In this paper, we deal with the machine-learning- based applications for automatic vehicle detection using both static image data sets and live CCTV surveillance (Fig. Work on a proposed system is done with the help of leading in its field algorithms, which detect and count moving vehicles for visual approval their permit. It has been well complemented for its better accuracy and efficiency than the existing models(as mentioned by Tang Y. Zhang) in vehicle detection algorithm.

2. Road lane lines detection in Instantaneous Liav Road lane lines detection for real time advanced driving asistance Nishimoto 2012.

In a year 2018 research was created on Recognition of Road Lane Lines for(ADAS) in Real Time by an effective team of researchers: Wael A. Farag, Zakaria Saleh. We propose, This research presents a fast and robust approach for tracking and detecting lane lines. The technique described in this paper is suitable to be used in (ADAS) and for self drivings cars. The central theme of the highlighted approach is simple and efficient computations in order to be implemented into low cost consumer-grade CPUs used by ADAS systems. Details, implementation and performance evaluation of each used algorithm over real road images are explained and clips recorded by the vehicle's dashcam.

3. Lane Detection and Tracking Algorithm Research Based on Improved Hough Transform.

Detecting lanes and Algorithm for Monitoring Based on Hough Transform, 2018 – This is a research made by an efficient team of researchers: Xianwen Wei, Zhaojin Zhang, Zongiun Chai, Wei Feng. Driverless technology has been advancing at a rapid clip in recent years. However, when it comes to automatic driving, unmanned vehicles must learn how to see the road and specifically identify lane lines. This includes determining which lane line, solid or dotted, the car is closest to. Lane detection is an essential aspect of ADAS. In this article, based on the characteristic of this article, we propose using enhanced Hough transform for getting straight tracks detection results for lane detection and tracking algorithm to fit curved sections detection.

4. Literature lane detection and associated works reviewed.

Review of Weiyu Hao's lane detection and associated techniques 2023 The detection of roads will forever be a sweet-spot and necessary part of all forms of autonomous driving. This research paper presents a comprehensive examine of recent progresses in road lane detecting, an essential module to autonomous driving. Despite several methods are proposed that either enhance accuracy and hence slow speed or decrease velocity, what ultimately makes this an inevitably robust system include lane marking variation, illumination changes, shadowy condition etc., Model-based methods generally provide high computational speeds but lack the richness to handle varieties which can be dealt by learning algorithm. This article explores the technology of lane detection and provides forecast trends. Overall, this review provides a solid basis for future road lane detection-related studies.

5. Vision-based vehicle detection and counting system using deep learning in highway scenes.

In the year 2019, a research on this topic was made by an efficient team of researchers: Huansheng Song and team with the progress of highway management, real-time intelligent vehicle detection and counting has been paid more and more attention. But because of different vehicle sizes, detecting a count of cars there is still an issue which results in poor counts. In view of this situation, The study suggests a vehicle identification and counting system based on vision. In this work, a new high-resolution highway vehicle dataset has been released, containing some number of images. As opposed to the previously available public datasets, and because it has annotated tiny objects in the picture, this dataset is whole sufficient for deep learning based vehicle detections. The approach suggested for vehicle recognition and counting initially treats the road surface in the image of highway as the whole area, segmenting it into some area using a newly developed method for better car detection. After that, the above two regions hit YOLOv3 network to decide which class of vehicles is detected in what position.

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6. A Detailed Review of the Detection of Lane Markings Using DNN.

A detailed Review on Lane Marking Detection Using Deep Neural Networks (2022) By Abdullah Al Mamun and members. Lane marking recognition is a basic feature, and one of the most critical components of automotive vehicles, as it is one of minimum requirements for all ADAS (Advanced Driver Assistance Systems) autonomy capabilities. Lane Marking Detection (LMD) is an area where researchers have recently made some substantial headway. This research article has made an attempt to work on lane marking detection, particularly with the deep learning methods. This paper first briefly reviews works that introduce lane marking detection methods with deep neural networks and traditional methods. Phase can be divided into single-stage framework and two-stage framework for line marking detection. The architecture of the network and how a loss function should optimize at different levels from categories. This paper proposes approximately 50 different architectures, each structured in the form of object detection, classification, and segmentation.

7. A Method of Enhancing the Quality of Image Processing By Vehicle Detection and Tracking Using YOLOv8 with Deep Learning.

Year 2012 : In the paper, the recognition of cars is also an important function in traffic surveillance systems, which assists greatly in the management and control of traffic flow while ensuring driver and passenger safety. The research will be focusing only on the major object, which is localizing vehicles and tracking them in an environment. The creation of a system that can recognize cars in images and videos automatically is the goal of this research. DL is a way that includes techniques such as fuzzy logic, neural networks, and evolutionary algorithms to achieve the following: Detection and tracking of automobiles For this project, we will use deep learning for YOLO v8 and the use of the Kalman filter to follow cars between scenes in a film. As such, it starts with a training process, i.e. that of learning from photographs in the available dataset of photos taken on public roads by road vehicles (beginTransaction). In this part, we are using the vehicle identification model and after that, YOLOv8 and the DeepSORT algorithm to trackthem, which shows how powerful they can be. One of the interesting facts that stands out is to figure where each dstl returns while we measure detection rates on different types of cars.

8. Vehicle detection research using enhanced YOLOX_S.

A happy News research in 2023 year with the paper To resolve the issue that the minimal target missed easily for distant-range vehicles, a new detection model YOLOX_S is added when detecting other vehicles in traffic scenes. Thus, the model compression strategy quickly screens out the unnecessary portion of the initial YOLOX_S network architecture to increase performance without sacrificing detection precision; on the other hand, adding a coordinate attention module into residual blocks, constructing a Resunit_CA. On the one hand, through the SS-Loss and, the head framework of small targets is separated from large targets, It decreases the absence of attribute information and enhances Snapchat on small Adjustable features for objectives; on the other hand, in addition to using PAFPN as an improvement structure that solves TCFPN gradients after entering saturation (Guo et al., 2020), in order to obtain richer small targeted meta-learning features Faulty snap special Adaptive snap union module AF improves Detection Room Ti Model detection accuracy;-finally back projection head structured regulation loss performance Focal Loss Loss reduces Problems with mirror image Unbalanced distribution.

9. A Few Notes on Vehicle Detection and Tracking Methods.

In 2014, they conducted a comprehensive review of vehicle identification and tracking techniques. For both public and military purposes, vehicle identification and tracking are essential components. The implementation of vehicle detection processes on the road varies based on the environment and is used for traffic analysis, vehicle counts, average speeds of individual vehicles, vehicle tracking, and vehicle classification. We will give a quick overview of the image processing methods and analytic instruments utilized in the development of the previously described application systems, including traffic monitoring systems, in this review. In contrast to previous studies, we more correctly categorized the processing methods into three groups, which makes it easier for us to show how the traffic systems operate.

10. Vehicle Target Detection and Recognition Method Research Based on Infrared Image and Feature Extraction.

This study researched on detecting automobile and acknowledgment is the safest inter-carriage distance warning system has been the current research focus Intelligent transportation system. In these applications, vehicle detection and identification are one of the key elements in scientific research, and it is also an important part of transportation safety. Rear-end crashes and other harmful traffic incidents can be successfully avoided with present vehicle current sensing. Since the infrared image contrast is poor, both border blur and clatter, this paper will principally study about treatment related to spatial domain of elements of image shades and pre-treatment methods using Separation of thresholds technique of vehicle images on business segmentation. In other words, the results of image analysis based on infrared image taken by infrared CCD, The experimental image and analysis fact data proved the research purpose to be achieved with the study restricted in processing technology of images acquired without photo influences.

11. Detecting vehicle and recognition technology was preferably analyzed in.

Bo Yang et all., "Researched on Vehicle Detecting and Recognitions technology based on AI in AUVSI Unmanned Systems, Washington, DC, USA, 2023. The automatic vehicles recognition and finding technology have gained projected interest of the researchers. This artical addressed the intelligent recognition of autos and suggested AI based Tracking of transporters and identification technologies. A synopsis of the most recent advances in vehicle detection and recognition technology. This conclusion has a significant guiding relevance for finding and inspection of vehicles in the contemporary transportation sector.

12. Vehicle Detection and Identification Using Computer Vision with YOLOv8 Deep Learning Algorithm.

Detecting vehicle and Identify Using Computer Vision Technology in 2023 with YOLOv8 Method A Team of Agustritus Pasrah Hati Telaumbanua1, Tri Putra Larosa, INTRODUCTION Vehicle identification Ability to identify a vehicle and detect if it is same as another plays an important role in build intelligent transportation. This field has proposed Many methods but one of the most low loss rate a Recently YOLOv8 Model has been applied in Various fields. In this reimaged dataset, a grap and YOLOv8 model based approach is provided to detect 9 vehicle classes.

III. OBJECTIVES

A. Develop a robust algorithm for real-time lane detection

The task is to develop an algorithm for lane boundary detection of road in real time with the help of advanced computer vision techniques and machine learning. The algorithm should handle many difficulties, such as lane markings, bright sharp curves, diverse road conditions and bad weather situations. Real-time processing is key to provide prompt feedback to drivers.

B. Integrate vehicle tracking within the detected lanes

This task is meant to orient lane detection with vehicle detection and tracking, making sure each vehicle is properly placed within their lanes. Using a model YOLOv8 for vehicle detection, the system will scan vehicles in the vicinity with respect to lanes and also if they are within adequate boundaries.

C. Implement alert mechanisms for drivers when lane discipline is violated

Drivers of the fully loaded SUVs are warned in real time should their vehicle wander from its lane and if there is an impending risk of collision with other vehicles. Those alerts may take the form of visual, auditory, or haptic feedback prompting the driver to make a correction in their course to remain safely on the road.

D. Test and validate the system in Indian road conditions

On select Indian roads In this environment, unique traffic patterns, road conditions and driving behaviors of India need to be extensively tested by the system. For testing the system against Indian roads, also the lack of lane markings and clear craziness in traffic for an objective analysis is on the list. It is to ensure that a system works when these very bad conditions are at play.

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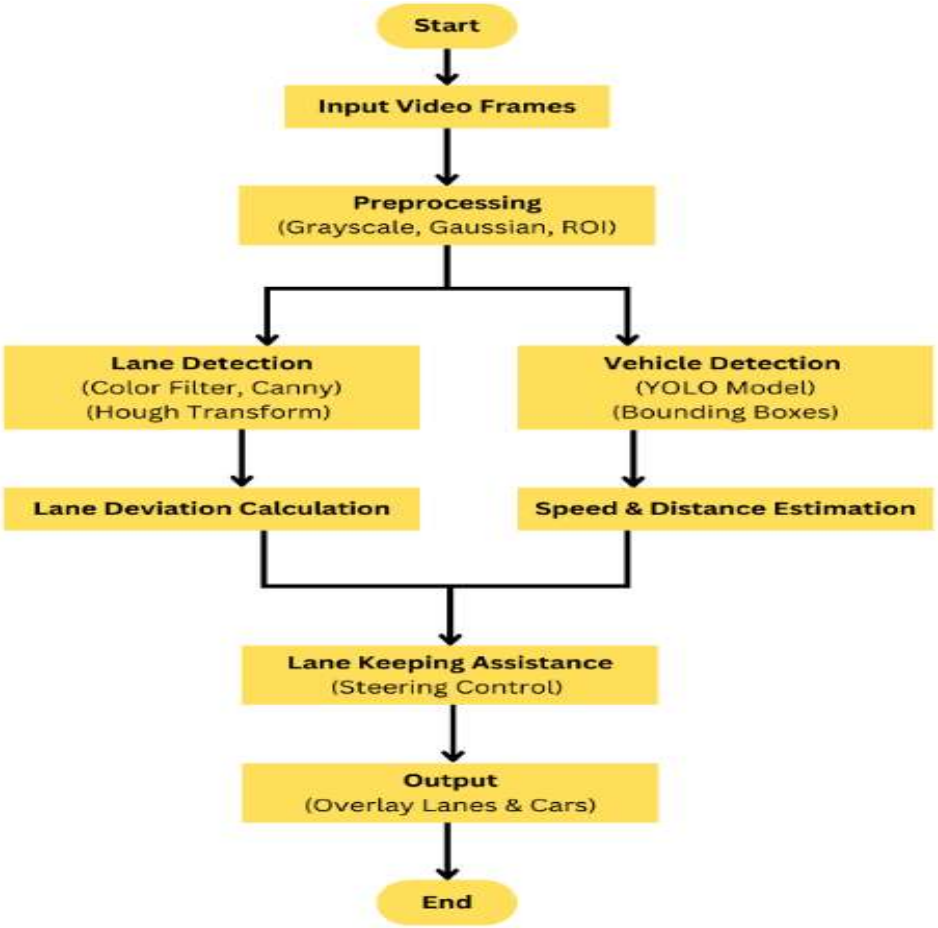
IV. PROPOSED METHODOLOGY



A. Lane Detection Methods.

Some papers employ techniques like Canny Edge Detection and Hough Transform to make the lane lines detectable. These more real-time approaches focus on preprocessing steps, for instance color filtering or region of interest extraction which help increasing the lane visibility.

- For lane detection, in [3], [4] and [2] it was used Canny Edge Detection to find edge lanes and then the Hough Line Transform to detect straight lines from the edges.
- Paper [10] and paper[14] proposed the regression based curve fitting tools, i.e., RANSAC Regression to enhance lane detection for road with curves.

B. Vehicle Detection Techniques.

Many recent papers apply deep learning approaches, specifically YOLO and SSD, to vehicle detection because of their real-time execution.

- Yolo [8] and yolohierchialsystem[15] used YOLOv5 and YOLOv8 models to detect vehicles which produce highly accurate results with greater speed.
- The SSD-based approach used by Paper [5] showed comparable performance, but it was computationally more expensive.

C. Distance and Speed Estimation

Some papers improved the algorithms to estimate distance and speed, using traditional vision- based approaches for some cases, and deep learning for others.

- The papers [6,7] also estimated the speed of vehicles by tracking movement between successive frames via optical-flow.
- In [12], the vehicle inter-distance is detected by the depth between vehicles from stereo cameras.

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D. Challenges and Innovations

Nearly all papers mentioned problems posed by lane detection in different lighting and weather conditions. This issue has been recently tackled by adaptive thresholding and deep learning-based segmentations models (like for example in Paper [1]).

V. EXPECTED OUTPUT

VI. CONCLUSION

The paper outlines the key improvements in vehicle detection and lane detection methods, especially focusing on ADAS and traffic surveillance. In particular, using deep learning and computer vision algorithms have managed to keep real-time performance consistent regardless of the type of driving environment or conditions it may encounter, while also maintaining high accuracy/reliability in recognizing vehicles and lane lines. It is even possible to strengthen the detection capabilities using techniques such as YOLOv8. Nevertheless, problems including extreme weather performance and computational demands remain. The combined results suggest high potential for further system optimization in the future, towards more intelligent traffic management and self-driving scenarios.

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