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Vehicle Detection System Using Machine Learning

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Abstract:- This project focuses on developing a vehicle detection system using OpenCV, a real-time computer vision library in Python. The project aims to create a vehicle counting and detection system that works effectively forvideos using OpenCV for image processing. The system will utilize OpenCV's computer vision capabilities to identifyvehicles and count the number of vehicles along with addinga unique id for each vehicle in the video. The system has potential applications in traffic monitoring, parking management, and transportation planning. The results of the project demonstrate the capabilities of OpenCV in creating efficient and accurate vehicle detection and classification systems.

Keywords:- *Vehicle Detection, Object Detection, Opencv, Image Processing, Computer Vision.*

I. INTRODUCTION

Road accidents not only cause a tragic loss of human lives, but also lead to significant financial and infrastructure damage. According to a study conducted by Bosch, road accidents resulted in a loss of nearly $14 billion to $40 billion in the year 2019. To address this problem, it is necessary to observe the movements of vehicles using advanced implementations of object detection systems. Vehicle detection systems can help in overcoming the challenges of locating vehicles in images collected from a moving platform.

A vehicle detection system is an application of an object detection system that focuses on tracking vehicles using their coordinates in images or videos. These systems can be implemented using various tools, and in this research article, we will be implementing a project using the OpenCV library. Our computer vision system will use a combination of object detection and object tracking to identify cars in a video stream at different waypoints. We will leverage OpenCV Machine Learning and image processing techniques to develop a vehicle detection system that can improve road safety and prevent accidents.

Our proposed system has several potential applications, such as traffic monitoring, parking management and transportationplanning. By accurately detecting and tracking vehicles, our system can enhance road safety and mitigate the risk of accidents. We believe that the implementation of such asystem can led to significant improvements in road safety and help reduce the number of road accidents worldwide.

This research article aims to present a detailed account of thevehicle detection project using OpenCV.

II. LITERATURE REVIEW

- "Vehicle Detection and Tracking in Video Surveillance: A Review" by H. Khan et al. (2018) This literature review provides an overview of vehicle detection and tracking techniques in video surveillance. The authors explore the various approaches used for vehicle detection and tracking, including feature-based methods, background subtraction,and deep learning-based approaches.
- "A Survey of Vehicle Detection and Tracking Techniques" by S. Singh and S. Singh (2020) This literature review provides a comprehensive survey of vehicle detection and tracking techniques, including traditional techniques and deep learning-based approaches. The authors evaluate the performance of these techniques and discuss the challenges associated with each approach.
- "Vehicle Detection and Tracking: A Review" by R. P. Kumawat and N. Bhatia (2019) This literature review provides an overview of vehicle detection and tracking systems, including the various techniques used for feature extraction, object detection, and object tracking. The authors discuss the challenges associated with vehicle detection and tracking and highlight the potential applications of such systems.
- "Vehicle Detection and Tracking: A Review of Recent Literature" by A. K. Jain et al. (2021) This literature review provides a detailed analysis of recent developments in vehicle detection and tracking techniques. The authors explore the various approaches used for feature extraction, object detection, and object tracking and evaluate the performance of these techniques on different datasets.
- "A Comprehensive Review of Vehicle Detection and Tracking in Intelligent Transportation Systems" by M. S. Khan et al. (2018) This literature review provides a comprehensive overview of vehicle detection and tracking techniques in intelligent transportation systems. The authors explore the various approaches used for feature extraction, object detection, and object tracking, and discuss the challenges associated with each approach. They also highlight the potential applications of vehicle detection and tracking systems in intelligent transportation systems.

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III. METHODOLOGY

- Data Collection: The first step in our methodology is to collect a dataset of videos containing vehicles. We will use publicly available datasets such as the Caltech dataset, which contains around 250,000 images of vehicles in differentscenarios.
- Preprocessing: Before feeding the videos into our system, we need to preprocess them to ensure uniformity in the videoframes. We will resize the frames to a standard size, convert them to grayscale, and apply normalization techniques to ensure that our system can work with varying lighting conditions.
- Object Detection: The next step is to detect vehicles in the video frames. We will use a pre-trained classifier to identifythe presence of vehicles in each frame.
- Object Tracking: Once we have detected the presence of vehicles in each frame, we will track their movements. Object tracking will help us identify the trajectory of each vehicle and its speed.
- Vehicle Counting and Classification: We will use the tracked vehicle data to count the number of vehicles in the video and assign a unique ID to each vehicle for classification purposes. The classification will help us distinguish between different types of vehicles, such as cars,trucks, and buses.
- Implementation: Finally, we will implement our system using Python and the OpenCV library. We will create a user-friendly interface that allows users to input a video file and view the results of our vehicle detection system in real time.

IV. RESULTS

- After implementing and running the program using visual studio, we used a pre-recorded video as input, and we have the following results:

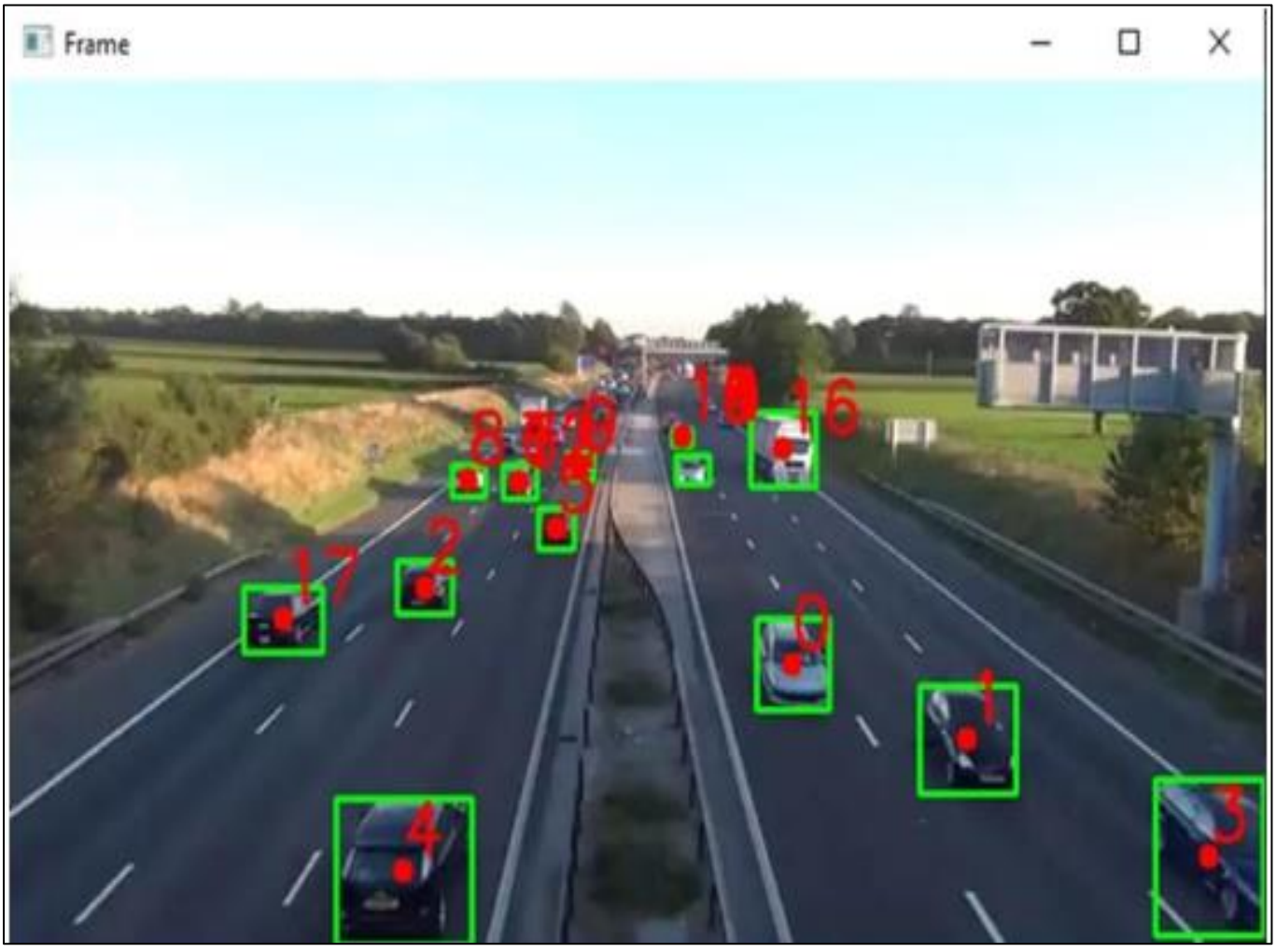

Fig 1: Program output

In Fig-1, we can see that the program is working properly, where the vehicle count can be shown as numbers on each vehicle.

To keep tracking all vehicles that are in the video, the program provides a tracking log for all vehicles, as in the following output photo:

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Fig 2: Tracking Log for the Moving Vehicles

And as the number of vehicles is changes, while the video isrunning and vehicles are moving, and new vehicles show upin the video, the program detects the new vehicles and provides a new count for each one as well as a new trackinglog, as in the following results:

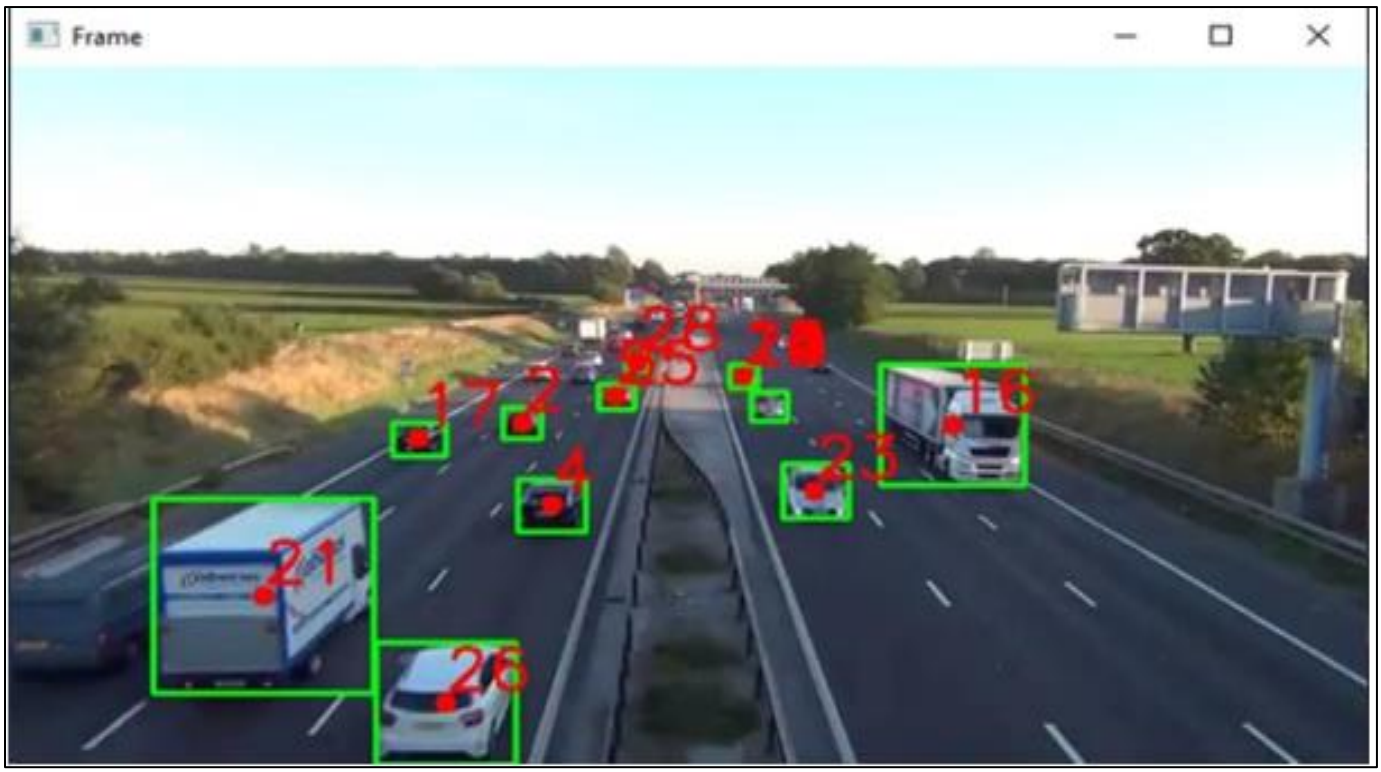

Fig 3: Program Output

A new tracking log is done as new vehicles are there, as the following:

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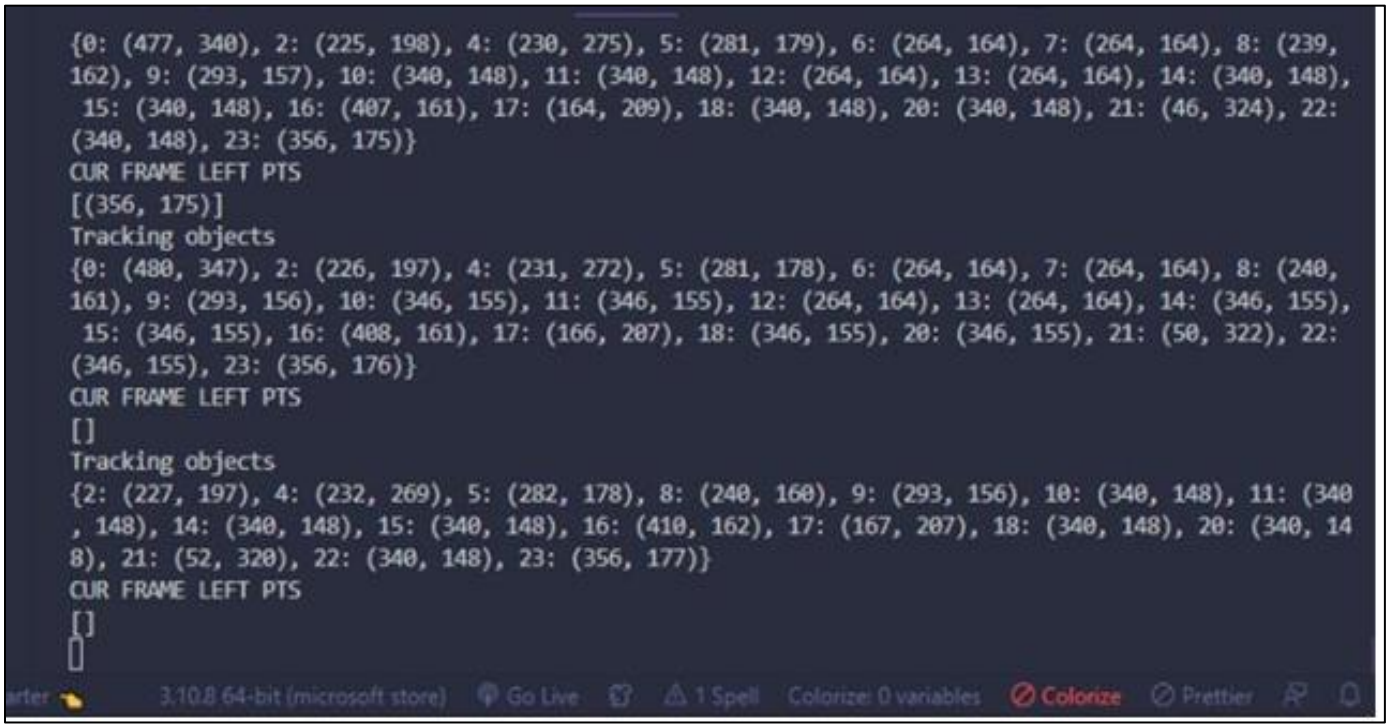

Fig 4: Tracking Log for the Moving Vehicles

V. CONCLUSION

In this project, we developed an advanced vehicle detection and classification system using OpenCV. Our system iscapable of detecting and tracking vehicles in real-time video streams, estimating their speeds, and storing evidence in thecloud. We achieved this by combining object detection and object tracking techniques, which allowed us to accurately detect and track vehicles in various lighting and weather conditions.

Our research contributes to the growing body of literature onvehicle detection and tracking systems, providing a detailedanalysis of the techniques used in our system and their potential applications. Our results demonstrate the effectiveness of our approach and highlight the importance of implementing such systems for improving road safety and reducing the economic and human costs associated with road accidents.

Future research could explore further enhancements to our system, such as improving the accuracy of speed estimation and incorporating more advanced machine learning algorithms for object detection and tracking. Overall, our study emphasizes the value of utilizing computer vision technologies to enhance road safety and reduce the impact of road accidents on society.

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