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VEHICLE MONITORING AND SPEED RECOGNITION SYSTEM

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Abstract: Road safety is a critical aspect of modern transportation systems, with speed limits playing a crucial role in accident prevention. Traditional speed cameras have evolved over time, and this research project focuses on the development of a speed camera without sensors, relying solely on image processing techniques using OpenCV in Python. OpenCV is a comprehensive open-source library widely utilized for image processing, computer vision, and machine learning tasks. By combining OpenCV with other libraries like NumPy, this study aims to track objects and estimate vehicle speeds through video analysis. Compared to conventional vehicle detection methods, the proposed sensor less speed camera offers advantages such as cost-effectiveness, simplified installation and maintenance, and wider monitoring coverage. Additionally, it can be deployed in real-time while the vehicle is in motion. The research involves steps such as video input capture, object detection using pre-trained models, object tracking employing various algorithms, speed estimation based on tracked object positions, and speed limit violation detection. The results are visualized by overlaying tracked objects with speed information, allowing for efficient identification and alerting of speed violations. However, it is important to note that the development of an accurate and reliable speed camera system requires addressing challenges related to camera calibration, lighting conditions, occlusions, and precise speed estimation. The research leverages the capabilities of OpenCV and Python to provide a comprehensive framework for creating a sensor less speed camera based on image processing techniques.

Index Terms **-**vehicle detection and tracking, computer vision, OpenCV, deep learning.

I. INTRODUCTION

These days, someone has to keep an eye on all the traffic. It can often take a lot of manpower to spot any odd behavior, and the person has to search through all the information to pinpoint a specific incident. Consider the following now. If the program could monitor the activities and let us know about it. similar to a traffic management system, where the system automatically monitors the traffic. This technique makes it simple to keep track of vehicles and greatly reduces the need for labor. This endeavor is comparable to the situation.
Image processing has been extensively used in traffic analysis. As the subject of traffic research is quite diverse and has various objectives, some of which include queuing detection, incident detection, vehicle classification, and vehicle counting. The estimation of a vehicle's speed is one of the most significant of these objectives. Numerous issues are caused by traffic congestion for humans. As a result, several accidents take place. A new method of assessing the speed of the vehicle has been devised to lessen this issue. Speed on roadways was measured using radar technology. But its expensive price is a drawback. After that, a lidar detector was created to identify law enforcement agencies' infrared emissions. devices that detect speed using lidar.

Doppler shift is the name for the process through which the RADAR technology operates. We commonly encounter the doppler shift phenomenon in our daily lives. Whenever moving vehicle produces sound, it will produce a loud bang. When the sound wave returns to the wave generator, the frequency of the sound will change, and the scientists will use the frequency variation to determine the vehicle's speed. However, the tools needed to use this procedure are expensive. So it's imperative to locate alternative equipment to lower the price. Technology that processes images well can help with this. The Objective of this project is to create a system with image processing feature which is used to monitor and track the speed of the vehicle. This will also give the count of vehicles and the report that shows the status of the vehicles whether they exceed the speed limit or not.

II. LITERATURE REVIEW

The mentioned studies propose various approaches for vehicle speed estimation based on video analysis using different techniques and algorithms. Here is a summary of each study:

Alexander Grents et al. used the Mask R-CNN architecture for vehicle detection and utilized masking to identify areas accessible to vehicles. However, they did not classify specific vehicle types. The study mentions using 750 photos from over 52,000 objects captured by traffic cameras.

Alexander A. S. Gunawan et al. employed camera calibration and projection methods to determine vehicle position and speed. They used background subtraction and a mixture of Gaussian (MoG) cameras for vehicle localization and estimated speed. The study claims high accuracy but recommends placing the camera above the road.

Saleh Javadi et al. focused on intrusion detection using virtual lines and estimated vehicle speed based on the distance traveled when crossing these lines. The study did not mention the dataset used but mentioned the ability to detect driving in the wrong lane and tailgating.

Tarun Kumar and Dharmendar proposed an approach that only utilizes the road portion for speed estimation. They did not mention the dataset used and highlighted the importance of placing the camera on top of the road for better results.

Indrabayu et al. emphasized vehicle detection as the initial stage and explored various techniques such as Viola Jones, Histogram of Oriented Gradient (HOG), and Gaussian Mixture Models (GMM) for speed estimation. They found that Viola Jones and HOG outperformed GMM in terms of accuracy.

Ahmed Abdulwahab Tayeb et al. used background subtraction and centroid tracking to estimate vehicle speed based on the distance traveled. They employed the Gaussian mixture model for foreground detection and utilized the Kalman filter and optical flow for tracking.

Jozeh Gerat et al. discussed the combination of optical flow and Kalman filter methods for speed detection. They improved the optical flow method with Kalman filter tracking to handle static foreground objects and improve speed detection. They also combined Gaussian mixture model foreground detection with DBSCAN clustering for more precise object representation.

D. Bell, P. James, and Wen Xiao developed a workflow for vehicle counting and speed estimation from monocular camera footage. They utilized detection, tracking, and mapping techniques to measure vehicle distances and estimate speeds.

Salesh Javadi, Mattias Dahl, and Mats Pettersson focused on employing multiple intrusion lines for vehicle speed measurement. They used data collected from cameras monitoring a highway with various vehicle types and speeds.

In summary, these studies employ various techniques such as deep learning, background subtraction, clustering, and tracking algorithms to estimate vehicle speed from video footage. The choice of techniques depends on factors such as dataset availability, camera placement, and the specific requirements of the system.

III. PROPOSED METHODOLOGY

In this paper we proposed computer vision technology to detect vehicles, identifying the moving vehicles and for speed recognition. The System consists of the following steps :Vehicle detection, Vehicle Tracking Speed Recognition ,Displaying Speed Report .One of the best and simplest ways to identify and extract items from photos or movies is by background elimination. Background Subtraction is used for creating foreground mask. By subtracting the current frame from a background model that contains the static portion of the scene or, more generally, everything that can be regarded as background given the features of the observed scene BS produces the foreground mask. Vehicle tracking is done based on the change of pixels from one frame to another frame. Generally a video is collection of images. Those images are considered as frames. The images will contains pixels. The change in the pixels of the collected images in a particular time is known as video. Based on the difference of pixels the vehicles are differentiated and the id numbers are given. Speed is calculated as distance / time in our calculation.

In this study, we construct a system for real-time vehicle categorization and speed prediction, and we use it to analyse footage from traffic cameras positioned along highways. In this method, we: a) Use background-foreground segmentation techniques to find moving vehicles. b) Evaluate various supervised classifiers (such as artificial neural networks) for categorising vehicles into the following groups: cars, motorcycles, vans, and buses/trucks. c) Use a calibration technique to use satellite photos to georeferenced vehicles. d) Calculate the speed of each class of cars by utilising feature tracking and closest neighbour methods.

The execution of the process will be explained clearly with the help of the continuous screenshots. The whole process in the execution is uploading a video after uploading video the system will automatically detect the vehicle and its speed and finally display the speed report of the vehicles. This whole process is done in four simple steps. Each figure mentioned below are the simultaneous process of screening outputs.

Fig 1 – The video of moving vehicles is uploaded first

Description : Fig 1, describes the video of the moving vehicles is taken from the online and uploaded.

This video is randomly taken from online. After uploading the video, the further steps such as vehicle detection and speed detection will be started. This is not the collection of any data set. In this method there is no trained model and data set. The OpenCV contains the functions which can perform object detection and speed recognition. So, no model need to be trained and tested like machine learning. Here, just the characteristics of the vehicles are given based on that it will identify the vehicle if that matches the parameters/characteristics.

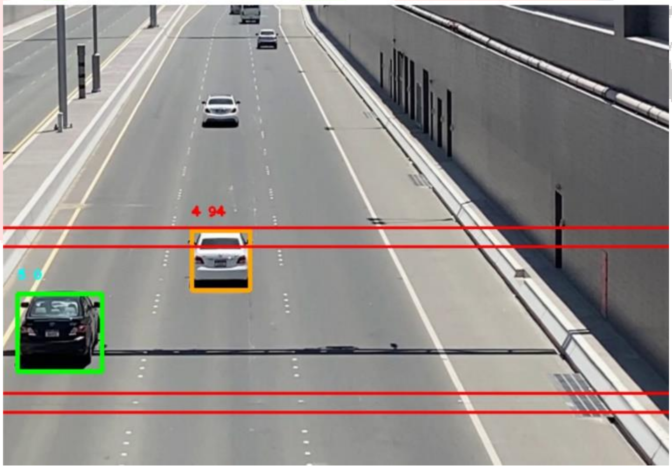

Figure 2 – Detecting vehicles and giving id numbers and also recognizing its speed

Description : The above fig 2 represents that the vehicle is detected by the bounding box.The bounding box is nothing but a rectangular/square box that is given if the object matches the particular characteristics.In this figure the value that is present on the left side is the id number and the number that is on the right is the speed of the vehicle.The green color bounding box represents that the speed of the vehicle is within the speed limit and the orange color bounding box represents that the vehicle croses the speed limit.The red lines represents particular frame which distance is known by which speed is calculated.

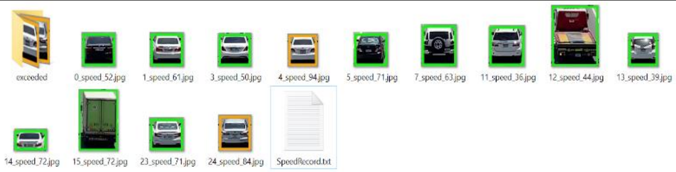

Figure : 3 – Crop images of the vehicles are stored along with their id numbers and speed

Description : Above fig represents the crop images of the vehicles that are in the video. It stores the images of the car along with the bounding box color. It not only gives the bounding box but also shows the id numbers and speed of the vehicles. This record will be updated every time when the video is played.

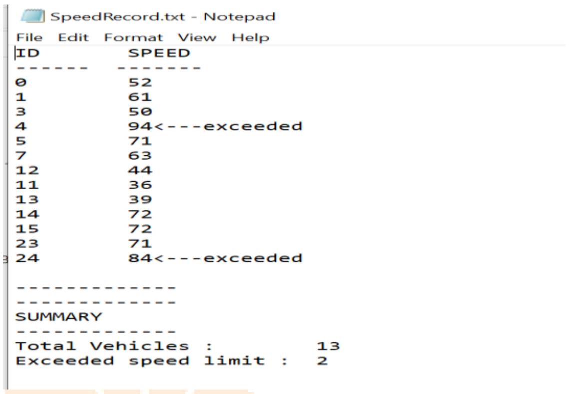

Figure : 4 – Speed Report of the vehicles

Description : Above fig represents the report displays speed of the vehicle. Also displays the total vehicle count and also shows the vehicles that exceeded their speed and also gives the count of the vehicles that exceeded the speed limit.

IV. CONCLUSION

In this project we have detected, tracked and determined the speed of the vehicles using Python ,OpenCV Library. First, we have to upload a video of moving vehicles which is taken from online. Then the vehicle is detected and the speed is tracked using the methods that are present in OpenCv. After detecting the speed the crop images of vehicles will be stored in separate folders along with vehicle id number and speed. Report Analysis is also generated, in which the data of total no. of vehicles along with the information of speed exceeded vehicles will be given. This is very helpful to track the speed of the vehicle quickly and efficiently without using any manpower.

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