Vehicle Detection and Tracking of Speed Using Computer Vision

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***Abstract* - This project is intended to develop a system which can track it and its speed estimation with the help of image processing technology. Therefore, this project has used a video input for the flow of the project. This system is designed to track the moving vehicle and estimate its speed. There are many methods to estimate the speed of moving vehicles like RADAR (Radio Detection and Ranging), but the RADAR method requires high technologies, which increases the cost of the system. Therefore, an alternative way is needed. This proposed method is using OpenCV to detect and track vehicles. Machine and Computer vision majorly used in many areas, hence they provide with less budget.**

***Index Terms* - OpenCV, Dlib, Convolutional Neural Network.**

1.INTRODUCTION

Road accidents are very common in the present scenario with the main cause being careless driving. The necessity to check this has been very essential and for these different methods have been proposed so far. This will keep a check on speed of the moving vehicle on highways and could control the problem of over speeding.

Also, not only on highways, but this system can also be implemented on the college campus, so to track student's speed while parking their vehicle on campus. There is a need to develop a system that can check the speed of moving vehicles on highways to avoid violation of crossing speed limit and to avoid further consequences. So, the main agenda of this intermediate Python Project is to build a Vehicle's Speed Checking System that can check the speed of a vehicle that moves on highways.

2.METHODOLOGY

2.1CNN Architectures Used

AlexNet is considered the pathfinder of CNN networks, even after the work of Yann LeCun. It is the best model used for classification of image. It has 8 layers which can classify an image into 1000 object categories.

The dataset is collected and the model is trained accordingly to the model in which we want to train the model. The pre-trained model is loaded and image transformation is specified, the input image is loaded and is pre-processed as per the required model.

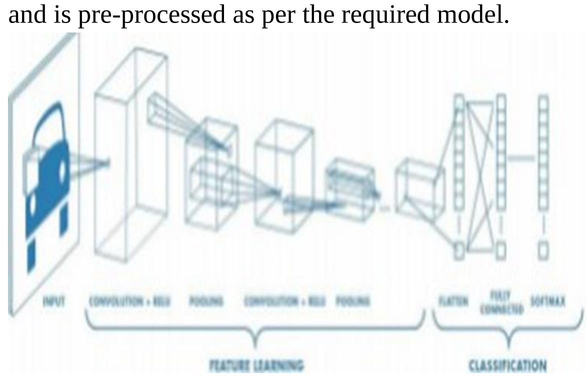

Fig. 1. Neural network with many convolutional layers

To build a smart model using CNN we need to follow a step-by-step process which includes data elicitation, data processing, data cleaning, data normalization, splitting into train and test data, building model, training model and testing and validating model.

2.2. Detection and Classification

The first step is to select the ROI (Region of Interest), which allows the user to select specific areas for analysis. This process helps to reduce the area for testing which eventually reduces the time and hence enhances the performance and speed up the classification approach. The model, AlexNet, was used for detecting vehicles and classification in this system.

```
coord=[[180,100],[450,100],[70,252],[632,250]]
```

2.2.1.Tracking of Vehicle

Tracking is defined as the project trajectory of the image of the object which is tracked. This means that the tracked object is then assigned with labels at the different frame of the video.

Object tracking is the basic necessity in the computer vision of this era of high technology. Computers have become a very common device in this era, and availability of high-density cameras are very easy which is inexpensive. All these factors with increase in the demand of video analysis has developed the demand of people in tracking of objects.

Detection of required moving objects, tracking that objects frame by frame, and analysis of object which is tracked to identify their behavior are the main procedure in video analysis.

```
car_cascade = cv2.CascadeClassifier('myhaar.xml')
```

The ease in tracking will differ due by each domain. Tracking an object can be complex due to:

- Loss of data due to less clarity.
- Image Noise
- Moving of objects in a complex manner.
- Shape and Size of the object which may be non-rigid.
- Partial or full object obstruction
- Site of illumination differ
- Real-time processing necessity.

2.2.2 Difficulty in tracking

The factors like Illuminating, overlapping of the objects, noise in image and size of the objects, are some factors which may influence the tracking of the object.

2.2.2.1 1Illuminating

Tracking objects might view differently on different illustrations. The examples of illuminating are:

- Climate – The object might be hard to track on the rainy days, as the environment will be dark.
- Sunlight - Sun Rays may cause the camera hard to focus, as at noon-time, the sunlight is strong.
- Thunder - The environment may be dark on rainy days due to bad weather, which will cause vehicles to switch on the head-lights. This also might cause the camera difficult to focus.
- Shadow - The shadow of the objects, such as poles or trees, on the road, might impact the result of tracking.

2.2.2.2 Overlapping

Overlapping happens when more than two cars intersect lanes. The car in front might block the front view of the car beside, which might cause the car to be difficult to track.

Moreover, when the vehicle of bigger size comes in front of the vehicle of smaller size, it might block the trajectory of the smaller one. For example, a truck which is moving on the road might block a small car.

```
ret, img = cap.read()
gray = cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
cars=car_cascade.detectMultiScale(gray,1.8,2)
```

2.2.2.3 Noise in the Image

Noise in the Image happens when the lighting conditions are not good, or the camera quality is bad. These might cause noise in the image, which will eventually result in the tracking of the object.

2.2.2.4 Size of the Object

Different sizes of objects are tracked either big or small. Big objects are easier to track as they are big in size and can be easily distinguished from other images in the background.

But on the other hand, smaller objects might be difficult to track as they cannot be easily distinguished from the background.

Also, tracking depends on the angle from where we view. Shape of the objects might look different from the different viewing angles.

2.3 Vehicle Speed Detection System

This paper consists of 4 different divisions, that are Image enhancement, Image segmentation, Image analysis and Speed calculation.

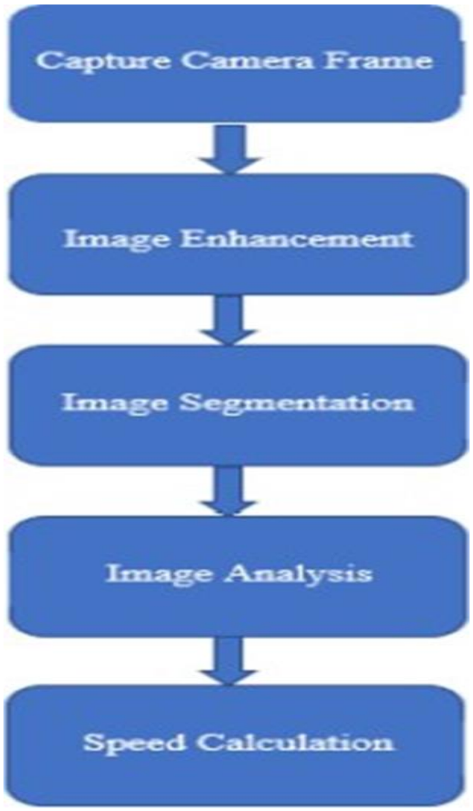

Fig.2

2.3.1 Image Enhancement

Image Enhancement is basically a procedure of improving the quality of the image. Here, two types of process are used, that are Image scaling and Gray scaling. Image scaling handles the possibility of different sizes in the input. Whereas gray scaling is used in converting coloured images to gray level images.

2.3.2 Image Segmentation

It is a process of partitioning the image of objects into different segments which is easier to train. Here the input images are divided into pixels with each frame. The gray scale image is selected as a reference image. Then all the images in the background are subtracted from the reference image, which will result in binary form.

2.3.3 Image Analysis

Here the set of training data is used to find the coordinates of the in the mark point in the reference area.

```
if(x>=coord[0][0] and y==coord[0][1]):
    print(x,coord[0][0],y,coord[0][1])
    for i in range (0,2):
        cv2.line(img, (coord[0][0], coord[0][1]), (coord[1][0], coord[1][1]), (0, 255,0),
        cv2.imwrite("NewPicture"+str(i)+".jpg",img)
    t1= time.time()
    print("Car Entered.")
```

2.3.4 Speed Detection

In this stage, the speed of the moving vehicle is detected by following various methods. Here is the speed calculation formula below:

Distance Covered by the vehicle will depend upon the position and angle of the camera located.

Time that vehicle took to cover the distance is measured by the difference between the exit time and the entry time of the car.

Vehicle Speed measured in format of metre per second is calculated by

Speed = Distance / Time (m/s)

```
print("Speed in (m/s) is:", dist/((t2-t1)))
```

3.RESULTS

Following are the snapshots of the car when entered and exited the region of interest. Then by using the function (time.time()), the entry and exit time of the vehicle are printed out, through which the total time a vehicle took to cover the predefined distance, is calculated and hence the speed of the vehicle is detected.

CAR 1

Fig 2.a. Entry Time

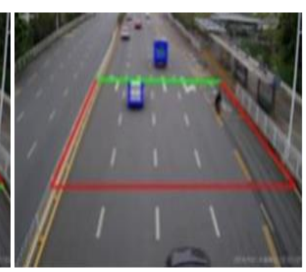

Fig 2.b. Exit Time

Time Taken = Exit time - Entry time

= 1608805029.166616 - 1608805021.301156

= 8.134540

Speed = Distance / Time

= 100 / 8.134540

= 12.29 m/ s

CAR 2

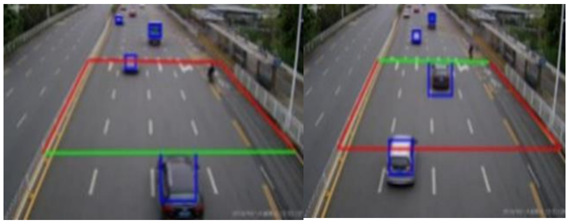

Fig 3.a. Entry Time Fig 3.b. Exit Time

Time Taken = Exit time - Entry time
= 1608805029.147244-1608805022.541457
= 6.605787
Speed = Distance / Time
= 100 / 6.605787
= 15.1 m/s

CAR 3

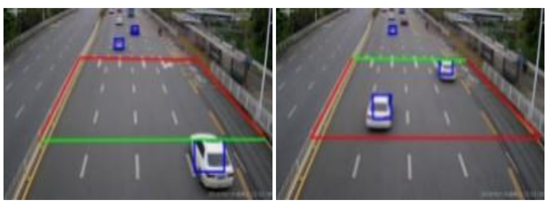

Fig 4.a. Entry Time Fig 4.b. Exit Time

Time Taken = Exit time - Entry time
= 1608805045.587517-1608805037.784325
= 7.803192
Speed = Distance / Time
= 100 / 7.803192
= 12.81 m/s

CAR 4

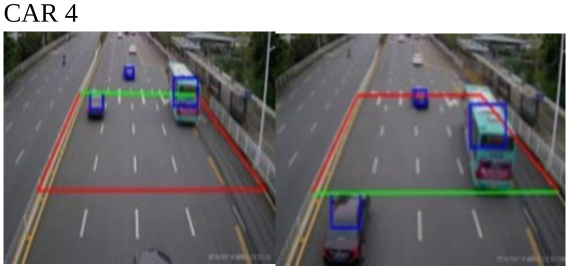

Fig 5.a. Entry Time Fig 5.b. Exit Time

Time Taken = Exit time - Entry time
= 1608805075.875451 - 1608805067.458424
= 8.417027

Speed = Distance / Time
= 100 / 8.417027
= 11.88 m/s

CAR 5

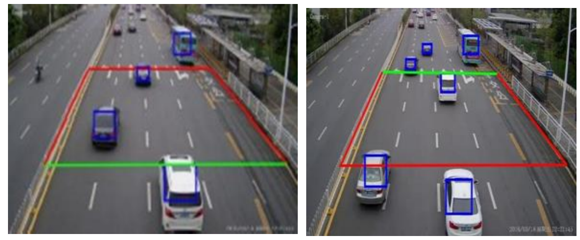

Fig 6.a. Entry Time Fig 6.b. Exit Time

Time Taken = Exit time - Entry time
= 1608805093.144687 - 1608805087.147514
= 5.99
Speed = Distance / Time
= 100 / 5.99
= 16.6 m/s

4.CONCLUSION

Objective of this research paper is to come up with the evaluation in the current traffic handling scenario, it is a technique which could run as a speed control implementation system or directly we can say, a Speed Track. Thus, this project has tracked the cars that have crossed the region of interest and their speed has been calculated.

5.FUTURE WORK

To make this project into vast advancements and applications, we can future add Vehicle's Number Plate Recognition System into it, which can detect the vehicle's number plate that has crossed the speed limit. By detecting the number plate of a vehicle, we can track the record of its owner and can take necessary actions against them.

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