**PROJECT REPORT**

**VEHICLE DETECTION AND SPEED ESTIMATION**



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**ABSTRACT:**

This project targets to predict the speed of a vehicle concerning the data from a recorded video source. Serving as the hypothesis, the project portrays the various important procedures such as vehicle detection, speed estimation, tracking, and capturing image & all of these features carried through by Python (IDE - Pycharm), OpenCV, and Numpy. The type of vehicles, the nature of driving, and the vehicle’s position at the time of video capture are taken into consideration.

**INTRODUCTION:**

Road accidents have been very common in the present world with the prime cause being careless driving. The necessity to check this has been very essential and different methods have been used so far. However, with the advancement in technology, different governing bodies are demanding some sort of computerized technology to control this problem of overspeed driving. In this scenario, we are proposing a system to detect the vehicle which is being driven above the given maximum speed limit that the respective roads or highway limits.

The overall project is divided into four categories;

1. Vehicle Detection

2. Tracker

3. Speed Estimation

4. Capturing Images and saving data.

**EXISTING SYSTEM:**

In recent years we can see there been a vast increase in the number of vehicles all around the globe. Along with the increase in the number of vehicles increases the number of accidents. Therefore, it is important to limit the speed of vehicles in certain zones or areas. Radar speed measurement tools are commonly used for this purpose which can be inaccurate in certain cases such as in sensing smaller vehicles with weaker echoes which are generally used by traffic police on a large basis. Also, it is difficult for these tools to detect vehicles changing in speeds too often or fast. Therefore, there is a need for a better technique to detect the speed of moving vehicles. In place of using expensive sensors such as radars, vehicles video streaming could be used for this purpose. The video stream of the moving vehicle is given as an input, then it is passed through the filter for detecting its speed.

**SOFTWARE REQUIRED FOR PROPOSED SYSTEM:**

* Python IDE (we have used Pycharm and Visual Studio Code)
* Python libraries:
* OpenCV
* Numpy

**PROPOSED SYSTEM:**

The below shown figure demonstrates the block diagram of our vehicle speed detection system. The block diagram below explains that firstly, a video is given as input to the system. The given input video is at first pre-processed according to the requirements. From the processed video sample, the vehicle is detected using the filters. This vehicle is then tracked and analysed to find its speed.

**VIDEO:**

Our important need is to get the video stream of the moving vehicle using a camera. For this purpose, we make use of OpenCV. The video captured is converted to gray scale for further processing.

**DETECTION:**

* **Background Subtraction** –Background subtraction is a way of eliminating the background from image. To achieve this we extract the moving foreground from the static background.
* **Region of Interest-**A region of interest is a place on an image where we want to search for something.
* **Masking** –Masking is a technique used to highlight a specific object from the image. It can be defined as setting certain pixels of an image to some null value such as 0 (black colour) so only that portion of our image is highlighted where the pixel value is not 0.
* **Thresholding-** **Thresholding** is a technique in OpenCV, which is the assignment of pixel values in relation to the threshold value provided. In thresholding, each pixel value is compared with the threshold value. If the pixel value is smaller than the threshold, it is set to 0, otherwise, it is set to a maximum value (generally 255). Thresholding is a very popular segmentation technique, used for separating an object considered as a foreground from its background. A threshold is a value which has two regions on its either side i.e. below the threshold or above the threshold.   
  In Computer Vision, this technique of thresholding is done on grayscale images. So initially, the image has to be converted in grayscale colour space.

Kernel**-** A Kernel tells you how to change the value of any given pixel by combining it with different amounts of the neighbouring pixels. The kernel is applied to every pixel in the image one-by-one to produce the final image (this operation known as a convolution)

* **Morphology**-. Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations are simple transformations applied to binary or grayscale images. Morphological operations apply a structuring element to an input image, creating an output image of the same size. More specifically, we apply morphological operations to shapes and structures inside of images.

Erosion – Erosion is one of two fundamental operations (the other being dilation) in morphological image processing from which all other morphological operations are based. The erosion operation usually uses a structuring element for probing and reducing the shapes contained in the input image.

* **Contour** – Contours are defined as the line joining all the points along the boundary of an image that are having the same intensity. Contours come handy in shape analysis, finding the size of the object of interest, and object detection. OpenCV has findContour() function that helps in extracting the contours from the image.

Bounding Rectangle- cv2 boundingrect() is a function used to create an approximate rectangle along with the image. This function's primary use is to highlight the area of interest after obtaining the image's outer shape. With proper markings, the you can easily highlight the desired aspect in an image.

**TRACKING:**

Object tracking is the process of locating a moving object in a video. To calculate the co-ordinates of center of bounding box of vehicle we will need the parameters that is the x and y co-ordinates, width and height of the bounding box. Applying center point formula we find the x and y co-ordinates of center point. Giving id to the vehicle by computing distance between center point of same vehicle through the frames(conditions are specified).Updating the array with ID given to each bounding box and other parameters of bounding box.

**SPEED ESTIMATIION:**

When a vehicle passes the first reference point, it automatically starts the timer. When the vehicle passes the second point, the timer is stopped. The speed of the vehicle is computed based on distance(already measured from the video) upon time.  With the help of cv2.putText(), speed will be displayed above the bonding rectangle.

**SAVE DATA:**

We have created folder named TrafficRecord, in which all the captured images and vehicle data are saved. Then according to the parameters of bounding box we have cropped the image and save with the name ID\_speed.jpg (26\_speed\_328.jpg).Vehicle data gets updated simultaneously while the program is running. In this file we record the ID and speed of the vehicles that are stored in the array. We have set the speed limit to 80. if a vehicle exceeds this limit it is displayed with the exceeded indicator in front of the speed and the images of these vehicles are saved in a separately in folder named exceeded. At the end, we count the elements in array count and array exceeded which are the number of cars passing on the road and total number of cars exceeding speed limit respectively and update it in the bottom of the text file.

**PROBLEMS FACED:**

* When two vehicles are close, program detected this two vehicles as same object. So, to overcome this we used erode operation two distinguish between them.
* When two vehicles approaches the lines at same time, program was not able to detect speed of vehicles accurately. To solve this we come up with the solution of four timer lines.

**FUTURE SCOPE:**

Looking back to the limitations of the project, there are tasks and options which can be added to this research or possibly to work on it separately. The topic is under the attention of researchers and improves day by day. Since we had this project done on a very few numbers of software, and this project could have been more accurate in terms of detecting, estimating, and tracking if we could indulge the knowledge of AI(Artificial Intelligence & Machine learning). Hence the researchers could utilize those concepts practically using algorithms to improve the accuracy level of the detection and tracking process. The dataset could be built & improved, the future work can be done by testing these models using a better and larger dataset with a massive number of vehicle and non-vehicle images from different places, angles, cars, roads, cameras, distances, etc. Furthermore, other models can be added to the comparison list of models to make the comparison more reliable and vast.

**CONCLUSION:**

By rapid development in car and traffic industries, at the same, the growth of population in the world brought the need for different tools and techniques especially technology solutions to manage traffics in cities and populated areas. Meanwhile, object detection can be used in various fields to help humans live easily with comfort and make the world a better place to live in. Object detection can be used in industries, digitized cities, government, research, academia, environment, etc. Vehicle detection and tracking is part of the object detection that is used in traffic, cities, etc. the importance of the topic is growing larger. That being said this research is intended to contribute to the improvement of the accuracy by adding AI(Artificial Intelligence) and ML (Machine learning) and improving their algorithms and models via available techniques and tools. **The proposed system is more efficient than the traditional speed radars which use sensors that are expensive.**