Volume 3, Issue , 2024
PP 321-328

International Journal of Futuristic Innovation in Arts, Humanities and Management (IJFIAHM)

VEHICLE DETECTION AND TRACKING USING MACHINE LEARNING TECHNIQUES AS SUPPORT VECTOR MACHINE

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ABSTRACT: Machine learning can be used to detect and classify objects in images and videos. Vehicle detection, is basically the scientific methods and ways of how machines see rather than human eyes. Vehicle detection is one of the widely used features by companies and organizations these days. We can use computer vision to detect different types of vehicles in a video or real-time via a camera. Vehicle detection and tracking finds its applications in traffic control, car tracking, creating parking sensors and many more. Python programming language is very user friendly language that have been utilized as the development language for the creation. The Support VectorMachine (SVM) and Decision tree are the two algorithms have been developed, trained, tested, and compared to each other, although suggest the best model among these two.

Keywords: Vehicle detection; Vehicle Tracking; SVM; Decision Tree; Image detection

INTRODUCTION: Recent advancements in artificial intelligence, specifically in computer vision and image processing fueled vision-based research and commercial applications in many fields such as medicine, agriculture, automotive, education, marketing, security and smart transportation.Vehicle or object detection is a technique for recognizing the type of target objects and locating them on a video frame. The detection algorithms are usually divided into conventional machine learning and modern deep learning methods . Tracking is a technique of re-identifying the detected target vehicles .Vision based tracking approaches utilize pixel, shape, color, and bounding box features to trace the detected objects and extract the trajectories.

Machine learning is a branch of Artificial intelligence, which is basically concerned with the development of algorithms .The data obtained is then processed by the algorithm is designed to identify complex relationships thought to be features of the underlying mechanism that generated the data, and employ these identified patterns to make predictions based on new data.It is the machine learning task of concluding a function from labeled training data .This function should predict the correct output value for any valid input object. The training data contains training examples or training values

In supervised learning the training data consist of the input object and the Output object(Supervisory signal). It is defined by its use of labeled datasets to train algorithms that to classify data or predict outcomes accurately.
Unsupervised learningis used when the data is unlabeled or we have to find out the hidden structure. Since the examples given to the learner are unlabeled, there is no error to evaluate a potential solution.
Reinforcement Learning works on reinforcement from the outside. Reinforcement learning is also called supervised learning, because it requires a teacher. The teacher may be a training set of data or an observer who grades the performance of the network results.

Support vector machines (SVMs) are a set of related supervised learning methods used for classification and regression.

Decision tree:It enables developer to build high accuracy models with having a good simplicity in compare to other ML models. The basic outcome in decision tree is whether “YES” or “NO”.

IMPLEMENTATION: Here we are counting, tracking, and calculating the speeds of the cars.

Dataset:We have made our own custom dataset consists of local vehicles information of our country. Data Collection: Because we are going to recognise and track local automobiles, the dataset must be solid and have quality characteristics. As a result, we gathered data by taking video photos from various perspectives that included accurate vehicle information.

Data Preprocessing:Took films of traffic on several highways and then produced graphics from those videos. Images are chosen with automobiles in the frame, in plain view, and without blurry things in mind. And the size is lowered to about 40kb for training efficiency. Images aresorted in numerical order to keep track of them.

Data Annotation

More than 10000 frames have been annotated with vehicle bounding boxes indicated. Our dataset includes films with a wide range of size, position,lighting, occlusion, and background clutter. We have introduced a total of five classes, which include:Bus, Bike, Cycle, Car, Truck and Van.

Fig No.1 Implementation Process

Classifiers

There are two classifiers that have been used

1. Support vector machines (SVMs)

Decision Tree

Support vector machines (SVMs) are a set of supervised learning methods used for classification, regressionand outlier's detection.

Decision Tree is also a supervised machine learning algorithm which is mostly used to classify the data.

Train and Test Split

The StandardScaler() function assumes data is normally distributed within each feature and will scale them such that the distribution is now centred as 0, with a standard deviation of 1. 'x' values are transformed using the function and get the output scaled_X.There are some libraries to split the dataset. 'train_test_split' funtion from 'sklearn' is oneof them which help to split the dataset into train and test data for the classifier.

Following steps are used

1.Feature Extraction from image:

The first and foremost thing is feature extraction from an image. There are many features in an image which can be extracted and can help in training our classifier. One of the important F**eature descriptor** which is used for Vehicle detection is **HOG**:

2.Histogram of Oriented Gradients(HOG):

. HOG is a feature descriptor which is used to characterize objects on the basis of their shapes. This technique calculates histogram of each **gradient orientation**. Below is the step by step process of feature extraction which includes HOG also:

a.Extracting spatial features of the image:

Here we resize the image, as with the help of this, our code will run a bit more fast with no loss of information. This can be done with the help of open cv function cv2.resize().

b. Image Colorspace Conversion:

Converting the image to a particular **colorspace** to extract information from the selected color channel:

c. Color Histogram Extraction :

We take color histogram of the image with the help of function numpy.histogram() . **4d HOG:**

As described above, HOG is the last step which i used in feature extraction process. Function used for HOG is hog(). Below is the visualization of hog feature of an image:

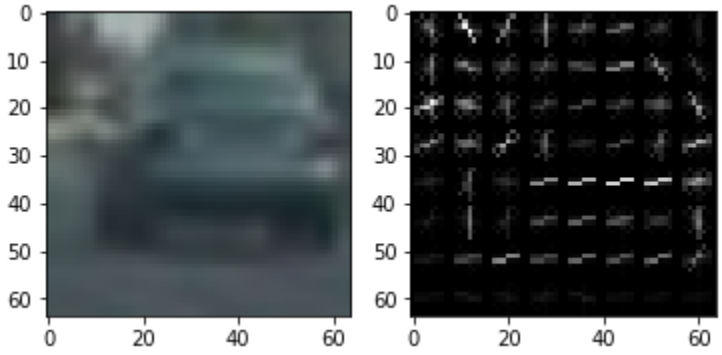

Fig No.2 Hog feature of a car

After the feature extraction is done, now We can used rbf SVM(Radial basis function in Support Vector Machine). Earlier i tried using Linear SVM model, but there were many areas where my code was not able to detect vehicles due to less accuracy. Using rbg SVM increased my accuracy to 99.13 %.

2.Using Sliding Window to detect cars:

Fig No.3 Sliding Window to detect cars

a.Too many windows for a single car image:

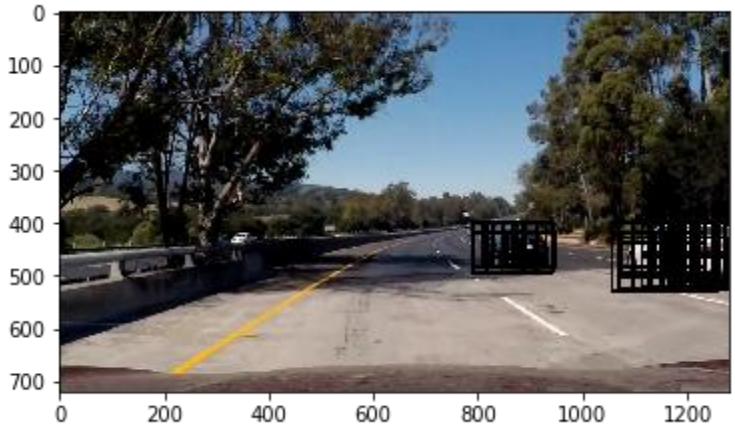

Fig No.4Multiple windows

b. False Car detection(False Positive)

Fig No.5 False positive

Now comes the last part of the project, Heat MapHere we can creat**e** heat map of all the car detection and for every detection, and increased heatmap[window_img] by 1. Now with the help of heat map, there will be keeping only 1 window instead of multiple windows for one car. Also it is possible to reject some windows on the basis of some thresholded values. This is how my heatmap looks for the image having multiple(overlapping) windows:

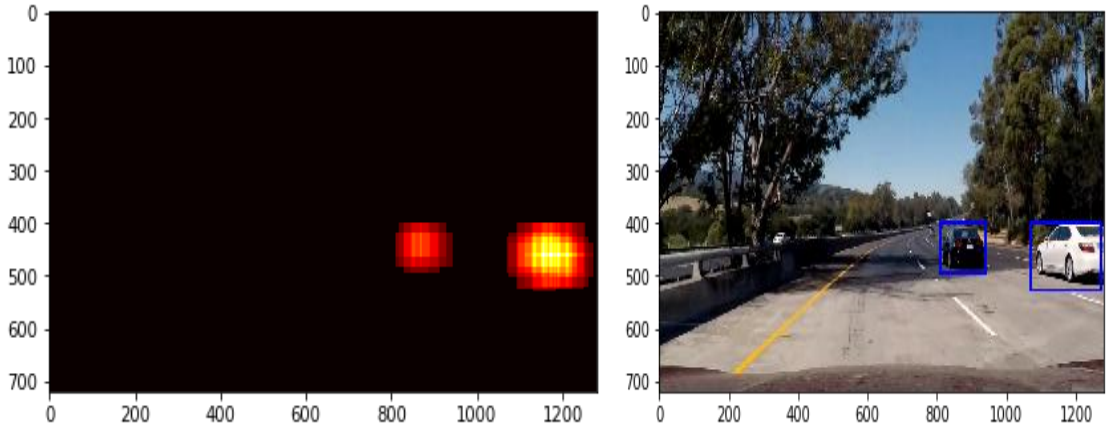

Fig No.6 Resultant Image

Above is the resultant image, after applying heatmap:

Tools Used: Python,Numpy,Matplotlib,Jupyter Notebook

CONCLUSION

Vehicle detection plays an important role in modern surveillance and security applications. Many earlier methods have used Artificial Neural Network (ANN) with Histograms of Oriented Gradients for detecting the vehicles.However this study has been successful by implementing Python with OpenCV method. Further this study considered heavy vehicle detection (bus) using

Support Vector Machine(SVM) with Histograms of Oriented Gradients (HOG) has been successful with good classification accuracy when compared to the earlier method achieved through ANN. In general, it can be observed that high accuracy level can be attained using HOG based SVM. Further study can be considered for the classification of truck and other heavy vehicle with more complex features.[6]

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