Performance Analysis of Vehicle Detection and Verification Using Resolution Transform

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Abstract
Vehicle detection based on image analysis has been attracted increasing attention in recent years due to its low cost, flexibility, and potential toward collision avoidance. Vehicle classification information is one of the important measurements that need to obtain in practice, which is valuable for various aspects of transportation including engineering and planning. Vehicle detection and vehicle classification is challenging on account of the heterogeneity of vehicles in color, size, pose, etc. Image based vehicle classification is usually addressed as a supervised classification problem. Specifically, descriptors using Gabor and log gabor filters superior to Gabor filter have been reported as a good performance ,but the functions using gabor and log gabor have a number of drawbacks relating to their frequency response, very costly for real-time operation. The main contribution of this project is to detect the moving objects in a real time video environment .The second contribution is to classify the vehicle & Non vehicle based on its templateMatching Algorithm. Finally, the performance of our classification approach is illustrated and discussed with the parameters.

Keywords
Vehicledetection, Vehicle Classification

Most of the accidents are caused by other cars, and also for the improvement of road safety vehicle detection arises as the key challenge for ADAS(advanced driver assistance systems). Most of the methods address vehicle detection in two stages, namely hypothesis generation and hypothesis verification. In the first stage to detect the vehicle based on some expected feature of vehicles, such as color, shadow, vertical edges , or motion. The aim of the second stage is to verify the correctness of the vehicle candidates provided by the hypothesis generation stage. The objectives of the project includes, [1]Detect the moving object in a real time video environment. [2] Classify the vehicle type based on its templates. [3] Analyze its performance. In practical applications, however there are many factors that make the problem complex such as illumination variation, appearance change, shape deformation, partial occlusion, and camera motion. Moreover, lots of these applications require a realtime response. Therefore the development of realtime working algorithms is of essential importance.

Traditionally, fixed or deformable models have been used for vehicle verification. Vehicle verification plays an important role in many applications, such as video surveillance, humancomputer interface, vehicle navigation, and robot control. It is generally defined as a problem of estimating the position of an object over a sequence of images. Therefore the development of real-time working algorithms is of essential importance. The use of learning-based methods has enabled for realtime vehicle verification in the last years. Image based vehicle verification is usually addressed as a two-class supervised classification problem in which a set of samples are trained in search of specific feature descriptors of the vehicle and the non vehicle classes. Some widespread descriptors include, principal component analysis (PCA) [4], histograms of oriented gradients (HOG) [5] ,Reduced HOG [6], Gabor filters[7] and Log Gabor Filters[8].

[4] PCA features have been extracted by selecting the dimensionality d of the principal subspace yielding the maximum performance for each image region. These are d = 40 for the front close/middle region, and d = 60 for the left and right close/middle region and the far region.

[5] HOG features are extracted according to the original Proposal by also selecting the parameters, i.e., the cell size s, and the number of orientation bins β, which maximize the performance: (s, β) = (4, 8) for the close/middle region, and (s, β) = (8, 12) for the other regions.

[6] In Reduced HOG the number of cells and/or orientation bins must be reduced in order to also reduce the feature vector and thus the classification time. For instance, the performance of using HOG with (s, β) = (32, 8) in the front close /middle region and (s, β) = (32, 12) in the other regions.

[7] The bandwidth of a Gabor filter is typically limited to one octave (otherwise it yields a too high DC component), thus a large number of filters is needed to obtain wide spectrum coverage.

[8] Log-Gabor based approach (LG) outperforms PCA in all image regions. In turn, although HOG show an excellent performance, the computational requirements are very costly for real-time operation and also the HOG and PCA has an average accuracy less than that of Gabor filters. As can be observed, the time required by HOG for classification is 8.04 ms, 17 times greater than that of LG.

Overall the drawbacks of this descriptors are High classification time (CT), Low Average Accuracy.

A. SVM for Classification

SVM is a useful technique for data classification. The goal of SVM is to produce a model which predicts target value of data instances in the testing set which are given only the attributes . Classification in SVM is an example of Supervised Learning. A step in SVM classification involves identification as which are intimately connected to the known classes. This is called feature selection or feature extraction.

Feature selection and SVM classification together have a use even when prediction of unknown samples is not necessary.In machine learning, support vector machines (SVMs, also support vector networks) are supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis.

SVM is a classifier, then given a set of training examples, each marked as belonging to one of two categories, an SVM training

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algorithm builds a model that predicts whether a new example falls into one category or the other.

II. Proposed System

All the images (time vs Ampli) acquired by camera unit is in Spatial Domain Mode. The Fourier Transform is used to convert the spatial domain mode in to frequency domain mode(Single Resolution Mode–freq vs Ampli).

A. Video Camera Recording

For video, we need the image in Multi Resolution mode-freq vs time).For this multi Resoultion mode ,we need Wavelet Transform instead of FT.

B. Pre Processing

Preprocessing consists of each image pixel in fixed rows and columns.

C. Transform

This project contains multiresolution (time, freq, amp) transforms such as Gabor, Log Gabor, SIST transforms.

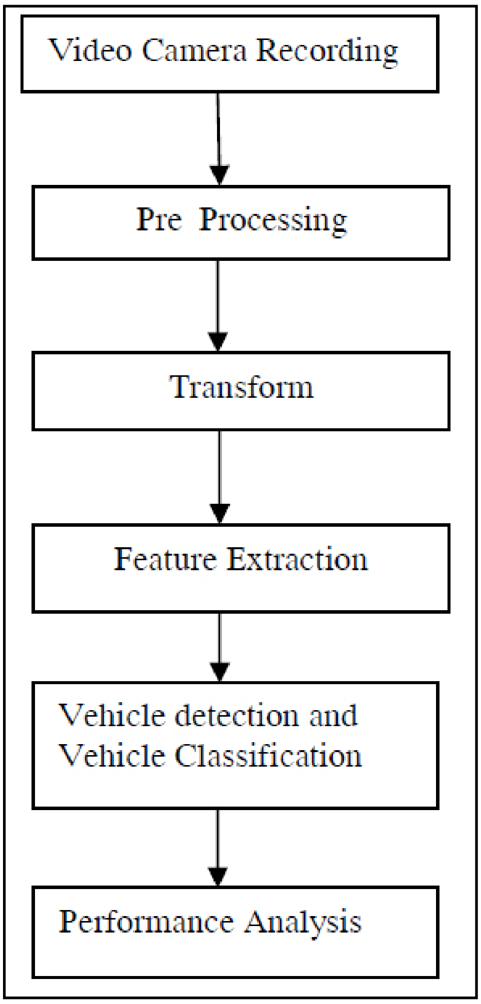

Fig. 1: Functional Block Diagram of Proposed System

D. Feature Extraction

Features are extracted from the transform.

E. Vehicle Detection and Classification

Using multi resolution transform we have to verify the vehicle and using classifier to classify the vehicle.

F. Performance Analysis

Performance Analysis of various transforms using the parameters like processing time in seconds per frame, false negative rate, Accuracy.

The Gabor and Log Gabor Filter are used in existing state of arts, as feature descriptors for supervised vehicle classification with the GTI Database. Even though they yield the better performance in terms of accuracy, they provide poor response in multi-resolution mode for real-time vehicle detection and classification. The template matching methodology is proposed to overcome such drawbacks in a real time video environment. The proposed method of vehicle detection and classification based on its templates which in turn can be very useful for traffic analysis and survey. The Parameters used in this method are Processing time, No of frames, Video Height, Video Width and Accuracy.

III. Performance Analysis

Table 1:

Trained vehicle and Non vehicle set	Trained and tested patterns	Database
Number of Trained Vehicle Images	100	GTI
Number of Trained Non-Vehicle Images	100	GTI
Number of tested Vehicle Images	100	GTI
Number of tested Non-Vehicle Images	100	GTI

A. Sample Vehicle Images

Fig. 2: Database Image of Vehicle

B. Sample Non-Vehicle Images

Fig. 3: Database Image of Non Vehicle

C. Tested Images

Fig. 4: Tested Image of Both Vehicle & Non Vehicle

D. Extracted Feature Set

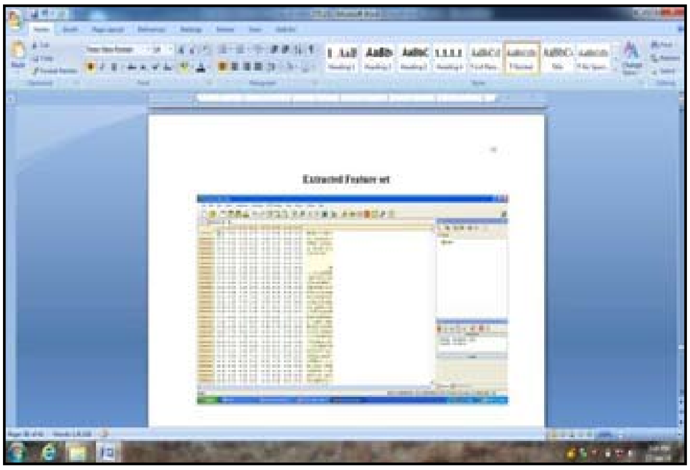

Fig. 5: Feature Set of Images

E. Simulation Screenshot for Traffic.avi Video

Fig. 6: Video of Vehicle

F. Simulation Screenshot for Input2.avi Video

Fig. 7: Video of Non-Vehicle

G. Performance Comparison on Different Videos

Table 2: Performance Analysis of Vehicle and NonVehicle

Video Type	Number of frames	Video width	Video Height	Processing Timein Sec per frame	False Negative Rate
Traffic. avi	120	160	120	0.2519	0.2083
Input2. avi	79	352	288	0.2401	0.0001

H. Performance Analysis Graph

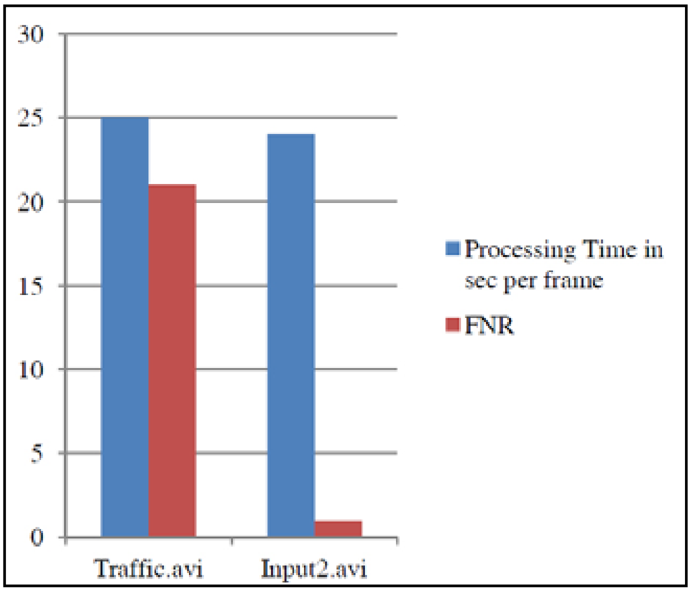

Fig. 8: Processing Time and False Negative Rate

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IV. Conclusion and Future Enhancement

The Gabor and Log Gabor Filter are used in existing state of arts, as feature descriptors for supervised vehicle classification with the GTI Database. Even though they yield the better performance in terms of accuracy, they provide poor response in multi-resolution mode for real-time vehicle detection and classification. Hence, template matching methodology is proposed to overcome such drawbacks in a real time video environment. The proposed method achieves the average success rate of 80% in both vehicle detection and classification which in turn can be very useful for traffic analysis and survey.

To further improve the classification, accuracy for vehicle detection and classification system, ANFIS classifier based SIST (Shift Invariant Shearlet Transform) is proposed in future.

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