Modified Gabor Filter based Vehicle Verification

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ABSTRACT
Vehicle identification based on image processing is the basic key behind this paper.This technology has been obtained world wide attention nowadays due to low cost,flexibility,ease of access,potential towards collision avoidance and accuracy.In most cases the vehicles are identified on the basis of colour,texture,histogram,hue,saturation,contrast etc.Gabor filter obtained from Gaussian filters are mainly used in image processing due to its better performance.But the main drawback of Gabor filters is related to the frequency response.The bandwidth is limited to reduce the DC noise components.Moreover filter banks have to be used.So a novel idea called Log Gabor filter has been suggested to overcome the drawbacks.Log Gabor filters are designed as Gaussian functions on log axis, which is in fact spatial frequency response of visual neurons.The result expected is that the frequency response concentrates on both lower and higher frequencies It helps to represent uneven frequency content of the image and redundancy of lower frequencies will be reduced.In this paper,a comparison between Gabor and Log Gabor filter is proposed.The classification is done using SVM and neural networks.

General Terms
Image processing,Gray to binary scale,segmentation.

Keywords
Gabor filters,Log gabor filters,SVM ,Neural networks

1. INTRODUCTION
Nowadays the number of vehicles have increased tremendously and hence it is not easy to control the traffic by mere human assistance. Driver assistance system is the emerging technology .The main aim is to reduce accidents. The main advantage of the system is low cost,flexibility,increased processing capabilities etc.Image processing is the basic key behind this idea. There are two stages in this. The first step is hypothesis generation and the second step is hypothesis verification. The first step is based on color,texture,edge etc.In the second stage we are testing whether the hypothesis is true or not. In dealing with the system, the processor speed determines the efficiency.

The system is a real time vehicle identification system .The vehicles and non-vehicles are trained .The widespread descriptors include Gabor filters principal component analysis [2],and histograms of oriented gradients[3],[4].Gabor filters are general purpose filters and is mainly used for image based vehicle identification[5-6].The feature extraction technique uses a 2D Gabor filter bank and produces robust 3D face vector[5].A video based traffic monitoring system[6] ,automatic parking management system[7],licence plate recognition system[8-14],toll collection system[15-16]vehicle orientation detection[17] etc. are some of the works related to this field.In the licence plate recognition system,[15],neural network based classification is done.The system will apply error back propagation algorithm to analyse vehicle image.Lotufo[20],uses optical character recognition technique.E.R.Lee *e.t.al*.[21] used neural network for color extraction and template matching to recognize character.Yoshimura *e.t.al*.,[22],used Gabor jets propagation to form a feature vector for recognizing low resolution gray scale character.

2. GABOR AND LOG GABOR FILTERS
Gabor filter is a linear filter used for edge detection,image compression,browsing,retrieval of data,segmentation,texture classification,object tracking and feature extraction.. Frequency and orientation representations of Gabor filters are similar to those of the human visual system. Its impulse response is defined by a sinusoidal wave multiplied by a Gaussian function. These filters are band limited and have DC component. The amplitude of natural images fall by 1/f.There is redundancy of data at lower frequencies. Gabor filters are mainly general purpose filters and many authors resort to four scale and six orientation[18] for texture retrieval. Daugman[19] describes well the 2D receptive field of simple cells in mammalian visual cortex.It provides a localized frequency description.But to capture all frequencies a bank of filters is needed(x,y) be the generating function.It is converted to

$$g_{m,n}=a^{-2m}\mathrm{g}(x',y'),$$

by making use of the scaling and rotating property of Gabor filters,where

$$x'=a^{-m}(\mathrm{xcos}\emptyset+\mathrm{ysin}\emptyset)$$

$$y'=a^{-m}(-\mathrm{xcos}\emptyset+\mathrm{ysin}\emptyset),$$ and a>1.Let N denotes scales and K denotes orientations,m =0,1,....N-1and n=0,1....K-1..The Log-Gabor functions, by definition, always have no DC component, and secondly, the transfer function of the log Gabor function has an extended tail at the high frequency end.So, there is no redundant data in lower frequencies. Similar to Gabor filters the frequency response is concentrated at the centre.It is symmetrical in the log axis instead of linear frequency axis.It is more efficient and effective.

3. PROPOSED SCHEME
The initial phase is to obtain images. Electronic devices such as optical camera,web cam etc.can be used.Generally,the camera is placed in the front top end of the vehicle to capture the image .Many factors like illumination ,speed of the vehicle ,weather conditions,type of vehicle,distance between vehicle and camera etc. effect the image.The images are mainly in .JPEG or .PNG format.

Fig.1:Input image and gray scale converted image

The image enhancement is done to increase the clarity of the obtained image. This can be done by histogram equalization The RGB is converted to gray scale and binary image represented as 0 or 1 is obtained by thresolding. The image is made of pixel and each pixel have a brightness value. Image segmentation plays an important role in analysis of the processed image. In order to extract the characteristic, the image is divided to many parts that will have a strong correlation with the object. The edge detection is done using the Gabor filter. The convolution technique is done using the predetermined values for the Gabor filter parameters. In the segmentation, three main steps are done. The first step is filter bank generation. The second stage is feature extraction. The image description have external and internal representation. The external representation is based on shapes whereas the internal representation is based on texture. The feature extraction have two steps-the sigmoid function generation and smoothening. The third step in the segmentation is pixel adjacency. The main processes in this are adding coordinate information to involve adjacency and clustering. K-means clustering is generally used. It makes use of Euclidean distance. Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group ,called a cluster, are more similar to each other than to those in other groups .The algorithm is based on finding the cluster centers and assign the objects to the nearest cluster center, such that the squared distances from the cluster are minimized. So, calculating the distance between each code word and sample is done and then assign each sample to the centroid so that we will obtain the segmented image. This segmented image is used for vehicle verification. In this paper ,the segmentation is done using both Gabor and Log Gabor filter. The next stage,i.e. the vehicle identification is done using the Log Gabor filter only. The training and classification is done on both SVM and neural networks.SVM stands for Support Vector Machine. The first half set of data is set as vehicle and the next half as non-vehicle. The solution to an SVM is global and unique. Two more advantages of SVMs are that that have a simple geometric interpretation and give a sparse solution. The computational complexity of SVMs does not depend on the dimensionality of the input space. SVMs use structural risk minimization. SVMs are less prone to overfitting. But neural networks are mainly used for pattern recognition. In this the training is done by back propagation. The training is done in order to make the input lead to a specific output. The initial weight is randomly selected and modified using the error between the corresponding output with the desired output. Neural networks learn by their weights and adjusting the weights make the output close to the desired output. But compared to SVM ,neural networks are not commonly used.

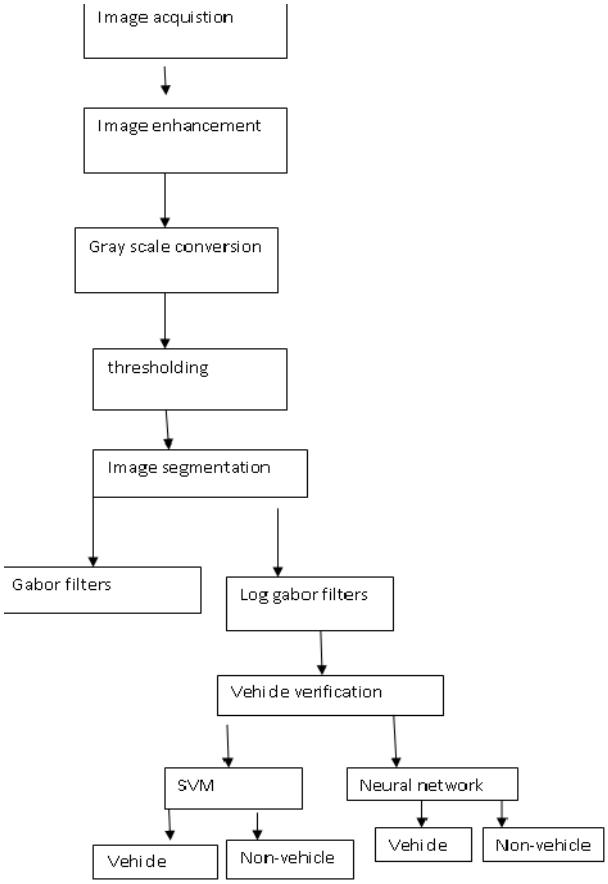

Fig 2:Flowchart of the proposed scheme

4. OUTPUT OF THE EXPERIMENT

The tool we make use in this paper is MATLAB. It is because, it is the simplest code and is compatible with other software and easy to set up while dealing with hardware and processor kits. The figure below shows the obtained output for the Gabor filter for the various orientations and the segmented output. Similarly ,the modified code is used for Log Gabor filter to obtained the Log Gabor filter output for various orientation and verification is done using SVM and neural networks to obtain the results.

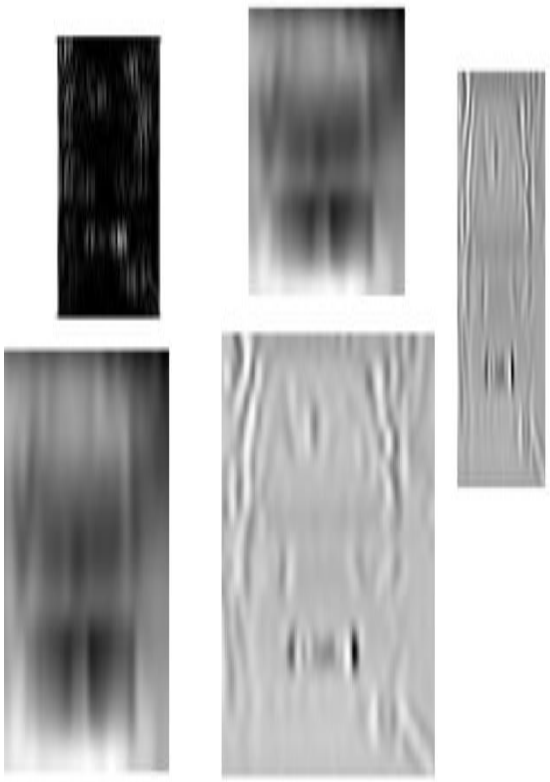

Fig 3: Gabor filter output for various orientations

Fig 4: Segmented output for gabor filter

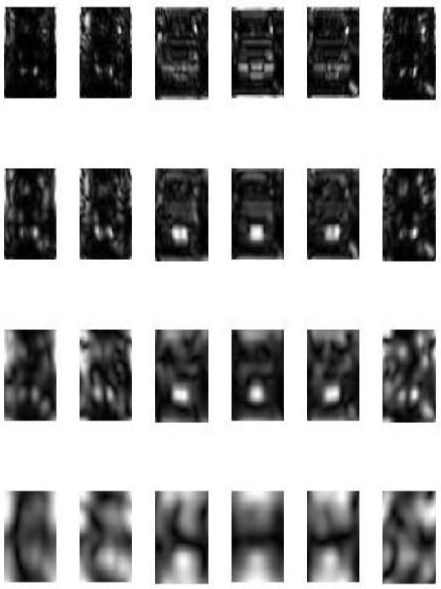

Fig 5: Log Gabor filter output for various orientations

Fig 6: Log Gabor filtered image

Fig 7 : Image output after verification

5. CONCLUSION

The Log Gabor filter is better than the Gabor filter due to increased bandwidth and reduction in DC components. The Log Gabor filter functions have better theoretical properties than traditional Gabor filters, but they had not been previously used for vehicle identification. They adapt better than Gabor functions to the inherent frequency content of natural images and are able to cover large spectrum with same filters. Moreover, the cost can be reduced by reducing the filter bank. The major applications of this system is that this can be used for license plate recognition, face recognition or any image processing technique for getting better outputs. In vehicle verification system, this can be implemented as a real time system to identify the license plate which can be used in toll collection system. The system can be also used in surveillance .If sensors and microcontrollers are attached, we can calculate the distance between vehicles so that accidents can be avoided. It can be used in parking system also. Hence ,in brief ,we can recue human supervision in this area. The main highlight is that the cost is less since it make use of image processing. A real time system working based on this technique can be expected in our traffic system in near future.

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