Vehicle Verification Using Log Gabor Filter Based On Video and Number Plate Recognition

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Abstract—Vehicle verification has very importance in this year because of its efficiency to avoid collision and less cost. Vehicle verification is difficult since the vehicle is similar in its color, shape and pose.log Gabor filter is used here as the algorithm to perform this task. Previously Gabor filter had been used. But since it has some drawbacks log Gabor filter introduced. Energy feature is choosing for feature extraction and three moments like mean, standard deviation and skewness is calculated. Gaussian function on the log axis is the design of the log Gabor filter. For vehicle and nonvehicle classification SVM is used. In number plate recognition Neural Network is used. For perform this, number and number plate training is required License Plate Recognition consists of three main phases namely, License Plate Detection/Extraction, Character Segmentation and Character Recognition

Index Terms- Log Gabor filter, support vector machine (SVM), Neural Network.

1. INTRODUCTION

Robust and reliable vehicle detection in images acquired by a moving vehicle is an important problem with application to driver assistance systems or autonomous, self-guided vehicles. The Advanced Driver Assistance System (ADAS) is an essential section of ITS aiming to assist the driver in the execution of driving tasks; it attempts to help the driver in complex driving tasks, and may even take over the control of car driving as the driver wish. Vehicle accident statistics disclose that the main threats drivers are facing are from other vehicles. Consequently, onboard auto motive driver assistance systems aiming to alert a driver about driving environments, possible collision with other vehicles, or take control of the vehicle to enable collision avoidance and mitigation.

Most of the reported methods reveal that, vehicle detection is mainly in two stages, namely hypothesis generation and hypothesis verification. As shown in fig 1, a hypothesis Generation is a search performed so that potential locations of the vehicles are hypothesized. The search is based on some expected feature of vehicles, such as shadow or color etc. The aim of the second stage is to verify the presence of the vehicle by the hypothesis generation stage.



Fig 1: Two step vehicle detection strategy

In vehicle verification, two sets of database are collected of both vehicle and nonvehicle. Each set of database containing images by fixing camera in four different poses namely, front, and left, right and far. In particular, this 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 nonvehicle classes. Energy feature is used in log Gabor filter and three moments like mean standard deviation and skewness is calculated for each database.

Mean and standard deviation is both for characterization of vehicles and other objects. Log-Gabor filters are designed as Gaussian functions on the log axis, which is the standard method for representing the spatial frequency. Symmetry on the log axis results in an effective representation of the uneven frequency of the images: redundancy in lower frequencies is reduced. Furthermore, log-Gabor filters do not have a DC component, which allows an increase in the bandwidth, and hence fewer filters are required to cover the same spectrum.

2. RELATED WORKS

Vehicle detection using Kalman filter plays an important role in the vehicle detection approach. The Kalman filters are mainly used in the three dimensional based vehicle tracking. The extended Kalman filter and Kalman filters are mostly used in the visual tracking system. Motion tracking will make use of the extended Kalman filter. This Kalman filters are helpful in visual traffic surveillance system. That is, it smoothly tracks the vehicle in traffic scenes and analyse the behaviour of vehicle. But this model only suitable for the gray scale image and in bad weather condition it will not give the good performance. Kalman filter estimate state of the process. This is done by time update phase and measurement update phase The variables that are integrated into the Kalman filter are the centre point, (x,y) and area, A of the detected vehicle in the image plane. The determination of these variables is based on symmetry detection and the analysis of the projection maps from the vehicle's horizontal and vertical edges. Canny edge detector used for edge detection.it generates enough edges for symmetry detection.[2]

In moving Vehicle Detection for Automatic Traffic Monitoring, The background of the scene is estimated adaptively. Then, the image is divided into many small non overlapped blocks. By subtracting the current image from the background, the blocks with an intensity change can be found as the candidates for vehicle parts. After that, a low-dimensional feature vector is extracted from each candidate. In order to detect moving vehicles, we need to estimate the background of the scene first. Adaptive background extraction algorithm based on Kalman filtering is used. Histogram is invariant to translation and rotation and it is compared with the original image. Histogram is preferred for feature extraction.it shows that it can deal with shadows perfectly in the daytime (the accuracy is better than 99%) and at night the accuracy is 91.8%[3].

In vehicle classification based on soft computing algorithms, Moving objects (e.g. vehicles) are detected in every video frame acquired from a camera. The algorithm based on background modeling method utilizing Gaussian Mixtures is used for this purpose. Movements of the detected objects are tracked in successive image frames using a method based on Kalman filters. And in vehicle Image Descriptors Luminance images are used. Three sets of vehicle image descriptors are computed; two of them are based on SURF (Speeded Up Robust Features) The last set is derived from gradient images using Gabor filters. Four different classifiers have been examined Nearest Neighbors algorithm (KNN), Artificial Neural Network (ANN), Decision Tree (DT), Random Forest (RF). The disadvantage of the paper was using Gabor filter and accuracy is poor when test with four classifiers and time consuming.[4]

In Boosted Gabor Features Applied to Vehicle Detection paper, It perform boosting task on a large set of Gabor features using AdaBoost algorithm. Where each boosting round find one Gabor features.so for T iteration T Gabor filter for each sub window so total 36 filter combined and only mean and standard deviation is verified. Boosted Gabor Features Using AdaBoost BGF Algorithm Description is explained as, Two set of training examples and Gabor filter will take as input and Computation will do with each sub window, each Gabor filter and for each training example. It also has the problem of Gabor filter. The experimental results show the Average Right Rate (ARR) of a no-boosting Gabor feature approach is 90% that of BGF approach is 96%.[5]

3. METHODOLOGY

1. VEHICLE VERIFICATION

A Gabor filter provides a localized frequency description. Hence, in order to capture all the frequency content of a certain texture pattern, a bank of filters in different frequencies is needed. Let g(x, y) be the mother generating function for the Gabor filter family. Then, we shall create a set of functions, denoted $g_{m,n}(x, y)$, by appropriately rotating and scaling g(x, y).

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

An alternative to the Gabor filters is the log-Gabor. The frequency response of log-Gabor filters in polar coordinates is,

$$\begin{split} LG_{m,n}(f,\theta) \\ &= \begin{cases} \exp\left\{-\frac{(\log(f/F_{00}))^2}{2(\log\beta)^2}\right\}\exp\left\{-\frac{(\theta-\theta_0)}{2\sigma_{\theta}^2}\right\} & f \neq 0\\ 0 & f = 0. \end{cases} \end{split}$$

Their corresponding expression in the log axis is represented as,

$$LG_{m,n}(\rho,\theta) = \exp\left\{-\frac{(\rho-\rho_m)^2}{2\sigma_\rho^2}\right\} \exp\left\{-\frac{(\theta-\theta_n)^2}{2\sigma_\theta^2}\right\}$$

Usually, the input space is discrete, therefore in order to transfer the image and the filter to the frequency domain, the Discrete Fourier Transform (DFT) is required. The filtered image in the input space is eventually obtained by applying the Inverse DFT (IDFT) to the product of the image and the filter in the frequency domain. At this point it is interesting to recall that the product of DFTs is equivalent to the circular convolution of the corresponding functions in the spatial domain. Thus, the discontinuity between the intensity in the different borders of the original image affects the filtering and produces artifacts in the output image contour.in order to avoid this, enlarge the original image by replicating its boundaries.

Gabor energy features selected in this paper. Which combine the response of symmetric and antisymmetric Gabor filter. Three moments are analysed: the mean, μ , the standard deviation, σ , and the skewness, γ , of the data distribution:

$$\mu_{m,n} = \frac{1}{R \cdot C} \sum_{x} \sum_{y} |J_{m,n}(x,y)|$$

$$\sigma_{m,n} = \sqrt{\frac{1}{R \cdot C} \sum_{x} \sum_{y} (|J_{m,n}(x,y)| - \mu_{m,n})^2}$$

$$\gamma_{m,n} = \frac{1}{R \cdot C} \sum_{x} \sum_{y} \left(\frac{|J_{m,n}(x,y)| - \mu_{m,n}}{\sigma_{m,n}} \right)^3$$

Where Jm,n(x, y) represents the input image I(x, y) filtered by one of the filters in the log-Gabor bank, $LG_{m,n}$.



Fig 2: Example of training images of vehicle



Fig 3: Example of training images of non-vehicle

The experiments are done with different scales and orientation. These parameters are obtained from previous experiments done with the Gabor filter.

A. Performance with number of scales

The number of scales ranges from 0 to 4 The maximum frequency, F0, and the scaling between center frequencies, a, are also adjusted so that the same range of frequencies [0.05,0.5] is covered. to increase the bandwidth of log-Gabor filters is applied for $N \leq 3$ by decreasing β from 0.65 (approximately 1.5 octaves) to 0.55 (2 octaves).

	N = 4	N = 3	N = 2	N = 1
Accuracy	95.84	95.39	94.91	93.34

B. Performance with number of orientation.

Number of orientation is analysed in a similar manner to that of the Gabor filters. N = 4, a = 2 for all regions; $\lambda 0= 2$ for the front close/middle range, $\lambda 0= 2.5$ for the right close/middle region, and $\lambda 0= 3$ for the left close/middle and far regions.

Region	K = 9	K = 6	K = 4	K = 2
Front	97.48	98.00	97.88	92.18
Left	97.10	97.18	95.90	83.40
Right	96.90	96.96	96.56	83.58
Far	91.22	91.60	88.68	83.94
Mean	95.67	95.94	94.75	85.77

C. Experiment with videos.

GTI database is used here. It has open access. All images in the database will be trained and while verification to with the trained image we use a video of length three or four second. Because lengthy video has taken long time to read since even one second video has twenty one frames. If the given video has any vehicle images it will go to next step i.e., number plate recognition else it will not.

2. NUMBERPLATE RECOGNITION

A. Number plate detection

Alphabet from A to Z and numbers from 0 to 9 is used here as the input. We will collect images of these and trained with neural network. Sobel Operator is used for edge detection. After edge detection series of morphological operations are performed in order to detect the license plate. Then character segmentation is done using line scanning technique, scanning is done from left to right of the plate. After Character Segmentation, feature extraction is performed to obtain the unique features of every character.

B. Character segmentation

The License plate obtained from Plate Extraction has characters is gray-scale. To obtain segmented characters, first plate image is converted into binary image. Then 'Lines' Function is used to divide text on the number plate into lines, which uses "clip"function.

"Clip" function crops black letter with white background. After cropping image, resizing is done and same operation is repeated on the cropped image



D. Character recognition

This step is the main part of the system and is called as Character Recognition step, where segmented characters are recognized. Character Recognition is also called as Optical Character Recognition.

4. EXPERIMENTAL RESULTS AND ANALYSIS

The superiority of the proposed log-Gabor filter based approach with respect to the traditional approach has been proven. However, it is also interesting to compare the performance of this method with respect to the other not Gabor-related state of the

art approaches. The methods for vehicle verification, apart from Gabor filters are Principal Component Analysis (PCA) and Histograms of Oriented Gradients (HOG).

5. CONCLUSION

Video based vehicle detection is well performed with log Gabor filter and the number plate also recognized from the detected image of video. The extensive experiments enclosed in this paper confirm the theoretical superiority of these filters over Gabor filters in this field. In particular, log-Gabor filter banks are proven to yield better results than Gabor filter banks using the same number of filters due to their more effective coverage of the spectrum, and to scale better as the number of filters decreases.

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