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Advanced Vehicle Tracking and Model Recognition in Rural Areas using SURF Method

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Abstract
One of the contemporary issues in today's world is increase in the number of vehicles. This makes the traffic surveillance a tedious job and leads to various issues of traffic congestions, parking problems, vehicle theft, traffic accidents etc. So the model and license plate of the vehicle has to be identified to track and recognize the vehicles. The proposed system consists of the vehicle model identification and license plate recognition which can be identified and can assist in real-time applications. The system would be capable of working in rural areas where rural field surveillance is limited.

Keywords
Surveillance, Congestions, License plate, Model identification, Real-time applications

I. Introduction

Automobile has become one of the most significant modes of transportation. The increase in the number of vehicles causes traffic monitoring and surveillance difficult. The objective of this project is to build a robust Vehicle Model Identification System tries to a give a solution to some of these problems. The classification of vehicles is a crucial task of all recognizing systems but Vehicle Model Recognition system is an advanced method which uses pattern recognition system and identifies the model of a vehicle from the input image. License plate is unique for every vehicle and can be used for distinguishing them. In the License Plate Recognition system, the license plate detection is the most important step. The parameters which affect the plate detection are varying environment, like license plate distortions, size of the license plates, illumination changes and multi-plate detection, etc.

In our method, vehicle model identification is done by detecting the logo of the vehicle. Locating the logo of the vehicle is the valiant step in the model identification process. In model recognition phase the model of the particular vehicle is recognized. The Speeded-Up Robust Features are used to recognize the vehicle model which involves feature descriptors called keypoints. The main application of vehicle model recognition is vehicle theft prevention. Nowadays, thieves tend to forge the license plate when the car is stolen. So the model of the vehicle can be identified only detecting the logo of the vehicle. The vehicle model identification method can also be used to identify number of vehicles or vehicles which are popular in certain locations.

II. Our Methodology

Our method involves the pre-processing, identifying the location of the logo, logo extraction, identifying the license plate location and license plate extraction. Finally matching is done to identify a particular vehicle.

A. Vehicle logo Localization

The location of the logo present in the vehicle has to be found and is the crucial phase in vehicle recognition system. The information about the number plate is also needed for vehicle logo localization. A set of rules are used for extracting the logo and for edge detection. Once the license plate information is obtained then coarse logo area is detected by using a set of heuristics. The noise and background is identified by using the edge detection or the Sobel operator. The sobel operator is applied on the pixels of the image both vertical and horizontal manner for edge detection.

The position of the vehicle logo in the coarse logo area shows only the vertical variations.In license plate detection phase the gradient magnitude and the local variance of the image is computed. Generally the license plate has the high contrast in an image to enhance its visibility. So the regions with high magnitude and high edge variance are detected License plates. A disadvantage is that edge-based methods alone can hardly be applied to complex images, since they are too sensitive to unwanted edges which may also show high edge magnitude or variance.

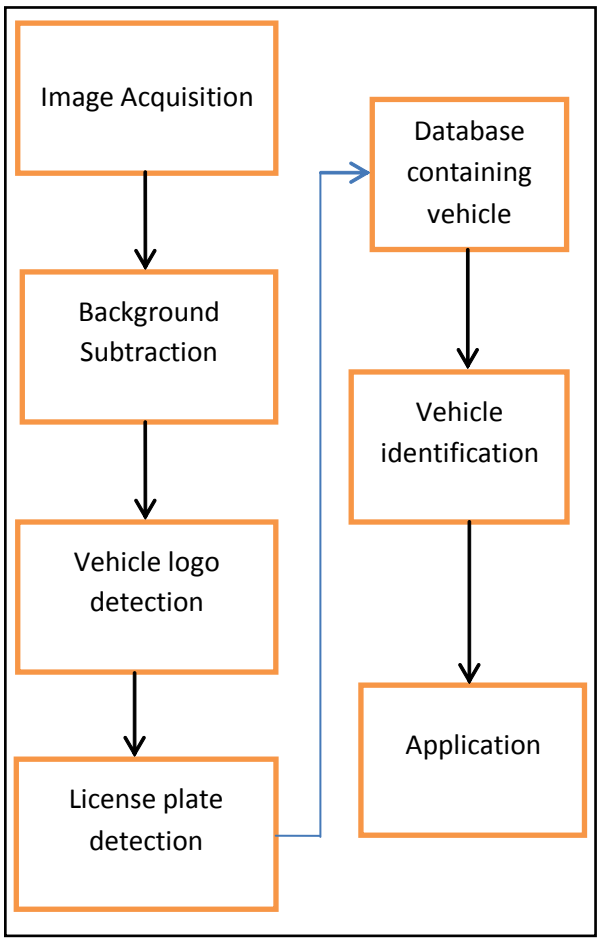

Fig. 1: Vehicle Model Identification System

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B. License Plate Extraction

After finding the location of the logo the license plate region is extracted. Prior to this, the preprocessing has to be done on the image which includes conversion of the colored image into gray scale image. The contrast of the image is enhanced by using the histogram equalization. The edges are found by using the image gradient and laplacian method. The gradient uses the intensity of the pixel to identify the maximum and minimum derivative. The canny edge detection operator is used for finding the edge of the car image. The resulting gradient image is used for contour finding which is in the shape of rectangular box. The contours are stored in a sequence and a set of heuristics are used identifying the license plate.

• Normally the shape of the license plate would be a rectangle, so the obtained contour should have 4 edges to be a license plate.

• The contrast of the rectangular plated is found and it would be either 1 or 0 as the image is converted to gray scale.

C. Background Removal

The logo of a vehicle would be present in the hood or the grill of the vehicle. So the background texture would be horizontal or vertically oriented. The background has to be removed to identify the logo properly. The background is suppressed by using the edge testing operators. The common edge testing operators are laplacian operator, sobel operator, Roberts's operator, Peewits operator. Sobel operator basically measures the gradient of intensity at a pixel in an image. The edge testing operation is completed by using a neighborhood convolution method of two direction templates and image in image space. Before the background suppression, texture recognition is carried on the vehicle logo background. The background texture is equivalent to noise so we must suppress it. Hence for vertical texture we use Vertical template of Sobel operator which does horizontal edge detection and for horizontal texture we use Horizontal template of Sobel operator which does vertical edge detection. This suppresses the background and highlights the vehicle logo.

III. Vehicle Logo Recognition

The second phase of the vehicle model identification system is the vehicle logo recognition. The obtained logo and the license plate have to be matched and image matching is the most crucial part in image processing. The interest points or keypoints has to be identified or chosen and then those pixels are compared with the descriptors to find the matching image. The database has to be maintained which consists of sample images and images that are converted into gray scale. Several algorithms are used on the templates stored and the exact match is found.

A. Application of SURF

SURF is the Speeded up Robust Features which involves detecting the keypoints which are generally edge pixels. It is the advanced version of Scale Invariant Feature Transform (SIFT) and several times faster and also much faster. SURF is scale invariant, translation invariant and rotation invariant. The three stages involved in our method are keypoint recognition, keypoint description and template matching. Interest points or keypoints are points of maximum variance which is calculated by finding the local maxima of Hessian determinant operator applied to the scale space environment followed by application of a given threshold.

Once the key points are detected SURF creates descriptors of (16*4) dimensional vector around each interest points to store the features. Once features are stored, the last stage matches the descriptors of both the images performing exhaustive comparisons by calculating Euclidean distance of all potential matching pairs. For this project the SURF algorithm was modified a bit to suit my purpose of comparison with a set of template images in the database of standard logos.

• Choose the keypoint or the image descriptor from the sample images stored in the database.

• Choose the descriptor of the input image.

• Compare the descriptors of both input image and images in the database.

• The Euclidean distances between the descriptors are found and the lowest distance identified is stored. Then the new descriptor is chosen and the previous steps are repeated again and all lowest Euclidean distances are stored.

• Then all the nearest Euclidean distances are added and the average distance is calculated.

• The same procedure is followed for every image in the storage.

• Then the distance of the test image and the database image is compared and the model with the lowest Euclidean distance is the exact match.

IV. License plate detection

In this stage the license plate region is extracted. Quality of the image plays an important part hence prior to this stage pre-processing of the image is necessary. Pre-processing of the image includes conversion of the color image into grey scale followed by histogram equalization to enhance the contrast of the image. Now edges are obtained in the image using either Gradient method or Laplacian method. Gradient method finds the maximum and minimum of the derivative of the intensity function to detect edges whereas Laplacian method finds the zero point in the crossing of the second derivative function. In the algorithm followed, the operator used for finding edges in the car image is Canny Edge detection operator which basically follows the gradient method. Now, the Canny Edge image is sent for contour finding and these contours are stored in a sequence. They are approximated to quadrilaterals because generally License plates are rectangular in shape. In order to speed up the process, the concept of bounding boxes is used. Bounding boxes are rectangles with minimum area required to close in the contours. In license plate detection phase the gradient magnitude and the local variance of the image is computed. Generally the license plate has the high contrast in an image to enhance its visibility. So the regions with high magnitude and high edge variance are detected License plates. A disadvantage is that edge-based methods alone can hardly be applied to complex images, since they are too sensitive to unwanted edges which may also show high edge magnitude or variance.

V. Conclusion

Several challenges related to the airborne moving vehicle detection from urban traffic stream. The system makes the following contributions a new framework for fast and reliably detecting vehicles in airborne video is proposed based on a Bayes' model; a new salient region extraction module is designed to quickly detect the potential vehicle regions using the visual saliency; and the classification algorithm can focus on much smaller regions for faster computation and accurate detection. The experimental

results show that the method can achieve better performance in detection rate, false alarm rate and detection speed compared to other existing methods. Our future work includes: Designing an automatic parameter setting algorithm using learning techniques. The accuracy of logo recognition by SURF on internet downloaded images and self-acquired image were 62% and 60% respectively which is slightly better than the original paper followed which showed a recognition accuracy rate of 58% and 65%. Some of the constraints for the experiments were that image was not of a complex scene i.e. image were not blurred. High illumination, sharp edges and shadows were as low as possible. Variation in light, size and color of the logo significantly reduces the robustness of feature detection.

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