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Smart Vehicle Tracking System using Number Plate Recognition System

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Abstract

Nowadays in almost all the metropolitan cities CCTV cameras are installed in traffic light signals to effectively monitor the traffic from a centralized control room. Using manual inspection it is hard to track a theft vehicle and difficult to chase vehicles involving in traffic violation. Here a new vehicle tracking system is proposed using optimized image processing technique that will track the vehicle by extracting the number plate of vehicle. Whenever a vehicle crosses the traffic light signal the camera placed on the traffic signal captures the image of the vehicle. Using optimized Image processing algorithms captured image is processed and the corresponding vehicle number is extracted and stored along with the timing information in a log register which is unique for particular vehicle. By manually inspecting the log register the vehicles can be tracked easily. Using some web enable services the particulars about the vehicle can also be made available to other regions as well. These feature will helps us to track the vehicle in wider area.

Keywords: Image processing, morphology.

1. Introduction

The Automatic number plate recognition (ANPR) is a mass surveillance method that uses optical character recognition on images to read the license plates on vehicles. They can use existing closed-circuit television or road-rule enforcement cameras, or ones specifically designed for the task. They are used by various police forces and as a method of electronic toll collection on pay-per-use[1-5] roads and monitoring traffic activity, such as red light adherence in an intersection. ANPR can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. Systems commonly use infrared lighting to allow the camera to take the picture at any time of the day. ANPR technology tends to be region-specific, owing to plate variation from place to place [6-8]. The objective of the paper is to successfully locate standard number plate, segment characters and recognize them given a car image. The system must deal with different angles, distances, scales, resolutions and illumination conditions. The existing system uses following techniques like Histogram processing, Optical character recognition& Template matching to recognize the number plates. Histogram processing &template matching application recognize the character of number plate; however they fail to achieve accuracy. But optical character recognition has good accuracy. So that vehicle tracking using number plate recognition system was recognized with the help of optical character recognition technique. The vehicle enabled with GPS facility can alone be tracked. In order to overcome the existing system the number plate recognized using an optimised optical character recognition algorithm. A new system is proposed that will recognize the number plate from the captured images taken at different location. The system is optimized image processing algorithm and

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store the number in a centralized server along with the help of web enabled services such as wifi or through internet. Number plate identification is helpful in finding stolen cars, car parking management system and identification of vehicle in traffic.

2. Number plate recognition system

The process involved in recognizing the number plate is shown in the block diagram. It has four main stages, they are Preprocessing, License plate localization, Character segmentation and Character recognition

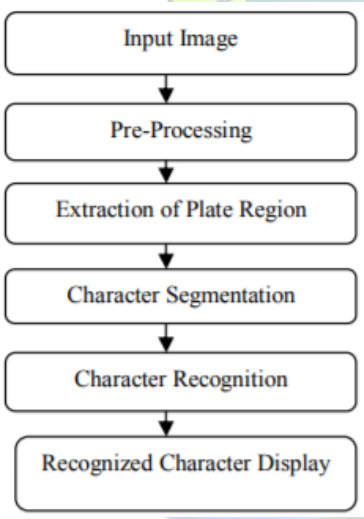

Figure 1: Block Diagram

3. Preprocessing

As mentioned before, the system of automatic number plate recognition faces many challenges. So, this step is essential to enhance the input image and making it more suitable for the next processing steps. The first step done in the preprocessing is to apply median filter to the image in order to enhance the image [9-12]. This is mainly done to make the characters and the plate edges bold, and to remove the effect of the light diagonal strips that appear in the characters and edges of the number plates. Then the image is converted to grayscale (taking the luminance component [8].

4. License Plate Localization

In this stage, the location of the license plate is identified and the output of this stage will be a sub-image that contains only the license plate. This is done in two main steps [13].

4.1 Locating a large bounding rectangle over the license plate.

In this step a rectangle that contains the license plate is located (this rectangle may also has some extra parts from the four sides), and this rectangle is the input to the next step for further processing (removing the extra parts, character segmentation then recognition). First, Sobel vertical edge detection is applied to the image. Then a threshold of 36 (This value is determined using trial and error) is applied, Such that every edge with magnitude less than 36 is considered false edge and is set to 0. Then a vertical projection (projecting on the Y-axis) of the edge detected image is taken and smoothed using an average filter with width equals 9. It's obvious that the characters of the plate along with the plate's vertical edges will have very strong vertical edges. Moreover, these edges will sum up horizontally in the vertical projection and a strong peak will appear in the rows of the plate (These row will be called band). So, the approach is to take some number of

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peaks in the vertical projection and processing each of them individually in the next steps and when a successful band is found, the processing of the following bands is canceled. The width of the average filter is taken to be the height of the band. Relating the height of the band with the width of the average filter is very important since over-smoothing of the projection will merge the plate peak with the other main peaks in the band like the peak got from vehicle lamps for example (and it already explained why the width shouldn't be very small). Now, a predefined number of peaks (It's already explained why we take more than one candidate peak not just the strongest one) will be selected from the smoothed projection. For each peak, a sub-image is taken according to the range of current peak. So, the bounding rectangle of the license plate is located. This is will be the input to the next step.

4.2. Determining the exact location of the license plate.

Using the sub-image from the last step which contains the license plate with some extra parts (if any), the following processing is applied to this sub-image. The license plate may be skewed because of the angle of the camera while image acquisition process. And it is very important to de-skew the plate to its original orientation, thus making the plate aligned with the X and Y axes (The reason behind its importance will be clear below). So a Hough transform is applied to the horizontally edge detected image in order to find the shear parameters by which the image can be de-skewed to retrieve the standard orientation. After this operation we have a plate with its axes aligned with the X and Y axes. Then a Gaussian smoothing filter is applied to smooth the image and remove noise. Then a morphological operation consists of subtracting the bottom-hat of the image from the image itself is done using a structuring element of a horizontal line of length 150. The next stage is to segment characters from the plate that passed all the measures tests.

5. Character Segmentation

This stage is meant for segmentation of the characters from the plate. The output of this stage is a set of monochrome images for each candidate character in plate. The first step in this stage is to convert the plate image to a binary image. This is done using adaptive threshold with a window of size 11. Then a process of noise removal is applied. This is done by getting the connected components from the binary image based on the 8-neighbourhood using flood fill. For every component, we decide if it's a noise or not based on the aspect ratio of the component and based on the number of pixels in that component. After removing the noise components a maximum filter is applied to make the effect of thinning the characters to make sure that no two components are merged. This is followed by a horizontal projection, to detect the boundaries between the characters to be able to cut them individually. The peaks in this projection correspond to the gaps between the characters. So, we get all of these peaks and a rejection process is applied also, since a true plate has a fixed range of gaps between characters. So, any plate that has number of peaks that do not fit in that range, will be rejected. Also, there is a powerful rejection measure; it is the variance of the characters width (the variance of the spaces between peaks). After

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this the characters are cut according to the peaks of the previous projection. Then another set of measures are computed to reject the false characters that may still exist after the noise removal operation. These measures are aspect ratio, deviation from average height test, deviation from average contrast, deviation from average brightness, deviation from hue, deviation from average saturation. After rejecting false characters, if the number of characters is not located in a predefined range, then the plate is rejected.

5.1 Character recognition

The goal of this stage is to recognize and classify the binary images that contain characters received from the previous one. After this stage every character is recognized using template matching method [14-16]. This method is considered to be efficient compared to artificial neural network, also the speed of execution is faster. Here each character in the number plate is compared with the known template and its corresponding representation is revealed.

6. Vehicle tracking system

Once the characters in the number plates are recognized and stored in a centralized cloud based system so that the data can be fetched anywhere. Here in the cloud details related to number plate of the vehicle and the time it crosses the various CCTV camera installed in prime areas along with the date are stored in the database. The personnels involved in the tracking are equipped with a handy device (Mobile phone) to access database stored in the cloud.

7. Experimental results

Initially all sample images capture in CCTV are color image. So it has to transformed in to gray scale followed for median filtering. This is done to remove the additive white Gaussian noise that may be present in the image. If not done edge detection cannot be done efficiently. The step by step processing of the sample image is shown in the figure 2. Standard morphological operation like erosion and dilation are performed to detect the edged.

a. Original image b. Gray scale Image c. Image after Median filtering

d. Image after dilation e. Eroded image f. dilation-erosion

Figure 2 : Morphological processing original image to segment the number

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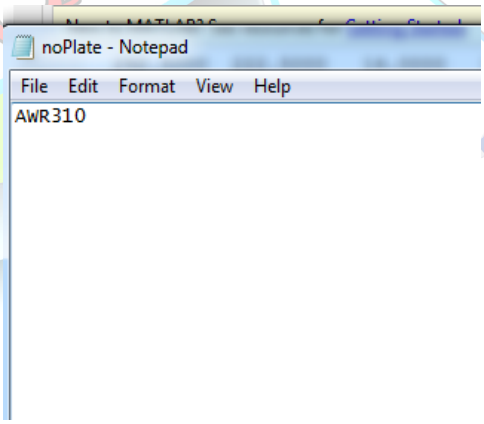
This will help us to localize the number plates in the image and helps to segment the character in the plates. As all the characters in the plates are of same dimension using vertical histogram of the characters segmentation is done followed by template matching method to recognize the characters in the number plate. Finally the recognized numbers are displayed on the note pad see figure 3 and 4. This may be considered equivalent to log the information about the vehicle in the cloud storage. Once it is done tracking is made easier by database management system.

8. Conclusion

Figure 4: Recognized number plate displayed on the note pad



A new method for tracking the vehicle has been proposed that will track the vehicle using the numbers plates logged in to the cloud. With the increase in the use of CCTV camera for surveillance purpose this system can be incorporated with lesser cost. As the data related to vehicle are logged in a distributed manner, so effective monitoring of traffic can be done. The proposed algorithm detects the Indian number plate with greater accuracy. The system consists of extraction of image, character segmentation and recognition. We've got applied the algorithm on many images and located that it successfully recognition. The automated range plate system is enforced in Matlab and it performance is tested on a true pictures. The result shows that robustly detects and recognizes the vehicle using vehicle plate against different lighting condition and might be implemented on the prime areas where close monitoring is required.

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