Extraction of Vehicle Number Plate

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Abstract: Automatic license plate analysis from traffic surveillance cameras is a fast-emerging field based on computer vision techniques. It is a key technology to public safety, intelligent transport system (ITS) and for efficient management of traffic. In recent years, there has been an increased scope for automatic analysis of traffic activity. System define image analytics as computer-vision-based surveillance algorithms and systems to extract contextual information from image. In traffic scenarios several monitoring objectives can be supported by the application of computer vision and pattern recognition techniques, including the detection of traffic violations (e.g., illegal turns and one-way streets) and the identification of road users (e.g., vehicles, motorbikes, and pedestrians). Currently most reliable approach is through the recognition of number plates, i.e., automatic number plate recognition (ANPR), which is also known as automatic license plate recognition (ALPR). Here full-featured automatic system for vehicle license plate recognition is presented. This system has many applications in pattern recognition and machine vision and they ranges from complex security systems to common areas and from parking admission to urban traffic control. This system has complex characteristics due to diverse effects as fog, rain, shadows, uneven illumination conditions, occlusion, variable distances, velocity of car, scene's angle in frame, rotation of plate, number of vehicles in the scene and others. The main objective of this work is to show a system that solves the practical problem of car identification. All steps of the process, from image acquisition to optical character recognition are considered to achieve an automatic identification of plates.

Keywords- ANPR, ITS, Image Enhancement, Edge Detection, Morphological Operation, Number Plate Extraction, Template Matching.

I. INTRODUCTION

Automatic number plate recognition (ANPR) system has been a practical technique in the past decades. One type of intelligent transportation system (ITS) technology is the automatic number plate recognition (ANPR) which can distinguish each vehicle as unique by recognizing the characters of the number plates. Automatic number plate recognition system finds wide varieties of applications to fit itself beyond just controlling access to a toll collection point or parking lot. In ANPR, a camera captures the vehicle images and a computer processes them and recognizes the information on the number plate by applying various image processing and optical character recognition techniques. Prior to the character recognition, the number plates must be separated from the background vehicle images. This task is considered as the most crucial step in the ANPR system, which influences the overall accuracy and processing speed of the whole system significantly. Since there are problems such as poor image quality, image perspective distortion, other disturbance characters or reflection on vehicle surface, and the color similarity between the number plate and the background vehicle body, the number plate is often difficult to be located accurately and efficiently.

Generally vehicle number plate recognition is divided into several steps including number plate extraction, image region which contains a number plate, character segmentation, and character recognition. Generally, in order to recognize a vehicle number plate, the region of the number plate should be extracted from a vehicle image. Accurate detection of the plate region is essential process to go over to the step of character recognition. There are two major methods to extract number plate region,

1. Edge Detection
2. Finding Rectangles in a Vehicle Image

II. RELATED WORK

There are several common algorithms to locate the license plate. Widely used procedures that are solely based on image processing are as Hough transform, Top-Hat and Bottom-Hat filtering (highlights the black-white

transitions), Binary morphology algorithm, Edge finding methods, Procedures based on the color of the background and characters.

Ankur kr Aggarwal, Aman Kr Aggarwal [2] presented paper on "Vehicle Registration Plate Recognition System Based on Edge Transition by Row and Column Profile on Still Images". The system is developed based on digital images and can be easily applied to commercial areas based on a smart and simple algorithm for vehicles registration plate recognition system. The percentage of accuracy of the recognition is 97%.

M. M. Rashid, A Musa, M. Ataur Rahman, N. Farahana and A. Farahana [3] discussed paper on "Automatic Parking Management System and Parking Fee Collection Based on Number Plate Recognition". It also discussed on parking guidance system that can show and guide user towards parking area space. Humayun Karim Sulehria, Ye Zhang, [5] "Extraction of Vehicle's Number Plates Using Mathematical Morphological Techniques", this paper discus the method for extraction of the vehicle number plates from the image using hybrid mathematical morphology. They had obtained the high accuracy and rate of recognition is above 96%.

Christos Nikolaos E. Anagnostopoulos, Ioannis E. Anagnostopoulos, Vassili Loumos, and EleftheriosKayafas, [6] describes "A Number Plate-Recognition Algorithm for Intelligent Transportation System Applications". This paper gives an algorithm for vehicle number plate identification on the basis of a novel adaptive image segmentation technique (sliding concentric windows) and connected component analysis with a character recognition using neural network.

Shyang-Lih Chang, Li-Shien Chen, Yun-Chung Chung, and Sei-Wan Chen, [8] "Automatic Number Plate Recognition". They have proposed two main modules for this system which are a number plate locating module and a number identification module.

Choudhury A. Rahman, Ahmad Radmanesh [10], describes "A Real Time Vehicle's License Plate Recognition System" in 2003. In this paper they have used the C++ for developing the project. The system is based on finding the number plate as well as the characters on the number plate by using horizontal and vertical projection and color concentration.

Hakob Sarukhanyan, Souren Alaverdyan, Grigor Petrosyan, [11] presented a paper on "Automatic Number Plate recognition system". For extracting number plate they have used the Hough transform. Hough transform work on only gray scale images so image is first converted to the gray scale image for further processing.

III. METHODOLOGY

The ANPR work is generally framed into three steps: Number plate extraction, character segmentation and character recognition. Figure 3.1 shows the design flow of the project.

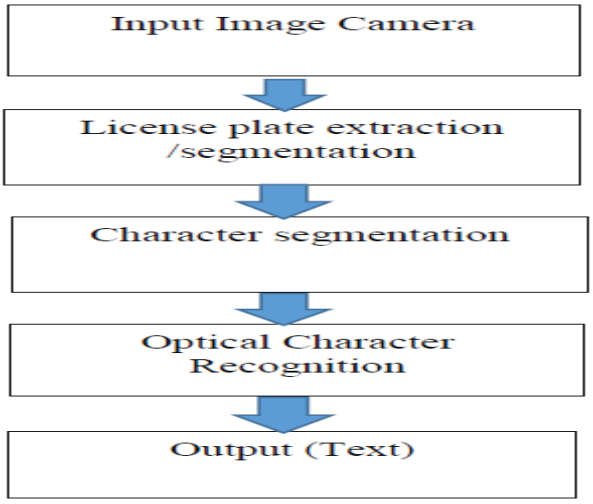

Fig. 3.1 Design Flow of ANPR

A) Image Acquisition

The first step is the capturing of an image using the camera. The images are captured in RGB format so it can be further process for the number plate extraction. Pre-processing of the captured image is performed such as RGB to gray scale conversion, noise filtering, Binarization process.

B) Location of License Plate

This plate localization algorithm is based on combining textural characteristics of license plate and morphological operation sensitive to specific shapes in the input image with a good threshold value by which the license plate is located. A fine percentage of localization of License plates is achieved by this algorithm. This is a better performing algorithm for License Plate Images with complicated background. License Plate consists of many vertical edges because it consists of Borders, Characters, and Digits. Sobel mask is used to detect vertical edges in the input image. Wavelet decomposition is performed to have better analysis. The resultant image is converted into a binary image. Morphological operations such as erosion and dilation are performed to find the location of the license plate.

C) Character segmentation

The process of identifying the characters, it is preferable to divide the extracted plate into different images, each containing one isolated character. There are some widely used methods for character isolation which are used in almost all available LPR systems. Those methods are: static bounds, vertical projection and Connected-Components. The first two methods cannot be used to segment number plates since they do not have a fixed number of characters for each plate. Following steps are used to segment the characters of the number plate:

1. Stretch the contrast of the image over the entire range of gray levels available (0-255).
2. Threshold the plate image.
3. Search for connected components in the image, each connected component will be assigned a special label in order to distinguish between different connected components in the image.
4. Resize each character from the previous step to the standard height and width in order to be used in the recognition process.

D) Character Recognition

In order to overcome the shortcomings of the simple template matching algorithm, low-resolution template matching method is adopted, namely the using of a lower pixel resolution to represent the images and templates to be recognized. Each matrix element corresponds to a sub-matrix in a high-resolution matrix. The element's value is the average of the pixel gray value in the corresponding high-resolution sub-matrix. Compared with the high-resolution matching algorithm, correct identification rate of the letters and numbers is greatly enhanced. The reason is that if the resolution rate goes through a moderate reduction, the error generated by the image distortion and the noise will be decreased. The recognition errors of letters and numbers mainly occur in some of the characters with the very similar main structures but some detailed differences, such as B and 8, O and 0, S and 5. When we use the similarity method to calculate the matching degree, the evaluation of these values provided by these subtle differences is crucial. The use of high-resolution template matching method, these deviations in the relevant calculation have a serious interference of the evaluation of the value function, which makes the calculation unstable. When we use the low-resolution template matching method, the deviation of this alignment will have a small proportion in each element of a matrix. Therefore, in a considerable number of cases, it does not affect the structure description of the alpha-numeric and thereby increases the correct identification rate.

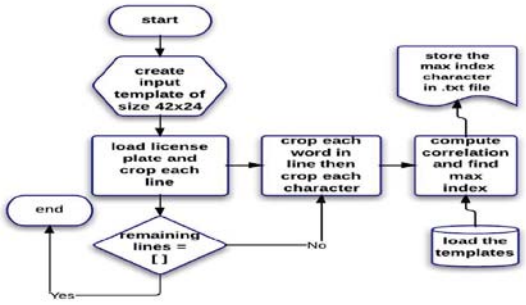

Fig 3.2: Flowchart of ANPR system

The following steps have been used to recognize the character from the extracted license plate using template matching algorithm.
Step 1: First step is to create templates (A-Z), (0-9) of size 42 x 24 (binary image). It is important that all the template characters created should be of same window size.
Step 2: The extracted license plate image is first loaded and pre-processing is performed.
Step 3: After converting the input image to binary, each character from the image is detected by the technique of segmentation. First, the image is cropped to fit the text. After that, line by line the image is cropped.
Step 4: Thereafter in each line word by word the image is cropped, followed by cropping of each character in a word to fit the text.
Step 5: Each character which is detected is resized to the size of template window (42x24).
Step 6: After resizing the character, correlation coefficient for each template with the character is found and the correlation coefficient values are stored in a matrix.
Step 7: The main operation used for the classification was the two-dimensional correlation. This operation gives a value of the similarity between two matrices (images).
Step 8: The index of the best match is stored as the recognized character. After recognizing the first character the next character is taken and thus after recognizing the first line, the next line is taken, and procedure from step 3 is repeated until the last line detected is empty.

IV. EXPERIMENTAL RESULTS

The table 4.1 shows identification efficiency, which is achieved while testing on different types of number plates. As per the results, our system achieve better responses to clean plates, tilted plates and plates with difficult surrounding condition causes substantial degradation of identification capabilities.

Table 4.1: Identification Efficiency

	Total number of Plates	Total number of plate Recognized	Identification %
Clean plates	99	88	88%
Blurred plates	15	09	60%
Tilted plates	18	13	72%

Fig. 4.1 Result of the Number Plate Recognition

V. CONCLUSION

The process of vehicle number plate recognition requires a very high degree of accuracy when we are working on a very busy parking area in which may not be possible manually to keep record of each vehicle. As a human being tends to get fatigued due to monotonous nature of the job and they cannot keep track of the vehicles

when there are multiple vehicles are passing in a very short time. An effort shall be made in this work to develop an accurate and automatic number plate recognition system for vehicle parking management system. It reduce the human work and also increase the efficiency of keeping record of vehicle's by reading the number plate.

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