A NEW APPROACH TO REALTIME RECOGNITION OF LICENSE PLATES OF MOVING VEHICLES

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Introduction

Automatic License Plate Recognition (ALPR) has been a recurring research problem in computer vision because it can be used for many traffic and security applications such as detecting traffic light violations, access controlling, monitoring border crossings, calculating parking fee, tracking of stolen cars, etc. Although various techniques have been proposed in other countries (Anagnostopoulos *et al.*, 2005, Ozbay and Ercelebi, 2005, Nguyen *et al.*, 2008), very few research has been conducted in Sri Lanka (Wanniarachchi *et al.*, 2007). Therefore, it is very essential to have such a system in Sri Lanka.

The format of the License Plate (LP) and the number of characters in the LP vary from country to country. Even in Sri Lanka various kinds of LPs can be seen. Some LPs have six digits, some have seven digits and also there are some LPs which contain digits along with English letters. Moreover, single row LPs and double row LPs are available. The older versions of LPs contain the Sinhala letter "SRI" as a symbol. In addition, there are LPs with black colour characters on a lighter background as well as white colour characters on a darker background.

Although it is difficult to develop a system to detect and recognize all the above mentioned types of LPs, in this research we have considered all those types of LPs in order to improve the applicability of the proposed system. One main drawback of the existing ALPR methods is that their performance highly depends on the strong assumptions they made on the appearance of the LPs (Wanniarachchi et al., 2007).

Methodology

The proposed system consists of five phases. The first phase processes a given image and convolves it with a vertical edge detection sobel kernel. Then potential LP regions are roughly located by separating the regions with highest vertical edge density. Usually LP characters exhibit high contrast with respect to the plate background. Therefore, the vertical edge concentration is high in the LP region. Since this is an important characteristic that any kind of LP has the proposed algorithm is designed based on it. The second phase detects the skew of the LP using Hough transformation and corrects the skew using affine transformation. In the third phase, the LP is accurately located and verified. Then the fourth phase extracts the LP characters and numbers. In order to extract these characters, first the image is converted to a binary image using an

adaptive thresholding method and then the characters are extracted by analyzing the connected components in the binary image. A set of operations are also carried out in order to eliminate connected characters and characters connected with other unwanted spots in the background. This is an important feature where the other related studies have not paid much attention and is used to extract LP characters very accurately in complex backgrounds. At the final phase, the features are extracted from the input characters using their skeletons. Once the skeleton is created, its projection is taken on 16 different axes in such a way that each pixel of the skeleton image affects to the projection on 3 axes only. This is a faster LP character recognition method which has not been used in other related studies. Finally, the obtained features are applied to a properly trained neural network and the recognition is carried out.

The LP detection and recognition is a challenging task and it is still an unsolved problem in computer vision. This is due to the factors such as existing large variety of LPs, image lighting conditions, complex backgrounds, skewed or rotated plates, damaged plates and so forth. We investigate and propose an approach based on Image Processing and Neural Network techniques. The developed algorithm is embedded into a MATLAB GUI for ease of users and it has been tested with 90 color images taken at random places with different lighting conditions. The image database contains images of 300×400, 480×640 and 600×800 sizes. The database also consists of images which have been taken from an angle, which are not very clear, which are taken from a long distance or a short distance, which contain damaged LPs and have complex backgrounds. Table 1 shows the LP detection, segmentation and recognition results and Table 2 shows the test results of execution time.

Results and Discussion

Table 1. The overall performance of the system

LP detection	**Number of images**	**LP detected**	**Acceptance Percentage**
	90	88	98%
LP character segmentation	**Number of detected plates**	**Correctly segmented**	**Acceptance percentage**
	88	82	93%
Character recognition	**Number of characters**	**Recognized characters**	**Acceptance percentage**
	91	76	84%

Table 2. Test results of execution time

Image size (pixels)	Average execution time (seconds)
400 × 300	0.84
640 × 480	1.62
800 × 600	2.62

The experimental results show that the combination of vertical edge density and the Hough transform and the affine transform techniques can be successfully used to extract LPs from digital images. Images taken from a large distance, with complex backgrounds, and that have been taken from an angle were given to the system and LPs were successfully detected. The implemented detection, segmentation and recognition algorithms show significant accuracy rates on the image database which contains all forms of LPs available in Sri Lanka.

Conclusion

Image Processing and Neural Network can successfully be used to recognize license plates of moving vehicles. The proposed system developed based on these techniques, successfully detects Sri Lankan license plates. The system can recognize the LPs even when the colour of the LP itself is same as the colour of the vehicle and when the boundary lines of the LPs are not clearly visible. This is a place where most of the existing colour and contour based LP recognition methods have failed (Wanniarachchi et al., 2007). This system has a higher applicability as no colour information is used throughout the implementation. The overall performance of the system can further be improved by combining it with a more accurate character recognition algorithm which can avoid the problem of character similarity. Moreover, the proposed system can also be used in real time applications because of its lower execution time.

References

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