Review on License Plate Extraction Technique Used In Automatic License Plate Recognition System

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Abstract—Automatic license plate recognition (ALPR) system is also known as an intelligent transportation system (ITS). There are various research issues, presents, in the field of ALPR. ALPR consists of four modules named as license plate extraction, extraction of license plate, segmentation and recognition of characters. The main contribution of this paper is to provide a brief study on different methods of license plate extraction. Different techniques of extraction are described in detail along with their pros and cons. The paper also consists of some future direction in the field of extraction of license plate. Future directions in the field of plate localization are also foresees at the end of the paper.

Key words: Automatic License Plate Recognition (ALPR), Intelligent Transport System (ITS)

I. INTRODUCTION
Intelligent Transportation system plays a vital role in today’s life. It also have a powerful impact in the real life application like automatic toll collection, border crossing control systems, petrol station forecourt, surveillance systems, vehicle tracking systems, ticketing vehicles without the human control, customer identification systems, policing, red light violation systems, electronic payment systems (toll payment and parking fee payment) and traffic monitoring systems (1). The format and font size, used for the license plate construction is different for each country.

Therefore a license plate recognition system consists of four basic steps which is shown in fig. 1

- First of all, an image of a vehicle is captured from a camera.
  - Then from this image, background or undesired region of image, is eliminated. This stage is known as license plate extraction stage.
  - Character segmentation is the next step.

- Final step is the recognition of characters of license plate using different classifiers such as Artificial Neural Network (ANN), Support Vector Machine (SVM) etc..

In this paper, contribution of the paper is given as follows:

- A state-of-the-art review of extraction techniques are presented that can be used to localize license plate in ALPR system.
- Different extraction techniques are compared on the basis of their pros and cons.
- The paper is organized as follows: of VI sections.
  - In section I, brief introduction of the ALPR system is given. In section II, extraction of license plate process, used in ALPR is discussed. In section III, a state-of-the-art extraction techniques along with their pros and cons in ALPR are specified and performance evaluation of extraction technique in ALPR is given. In section IV, conclusion and future directions are summarized.

II. EXTRACTION OF LICENSE PLATE
Extraction of the license plate is a very difficult task. Accurate extraction of license plate from an image of a vehicle is a challenging work for researchers. Environmental conditions like illumination, bad weather conditions, pollution level, presence of noise, stationary background etc. are greatly effects the extraction process. Extraction of license plate of a vehicle is the key step in ALPR. If a license plate is not accurately extracted then further steps of ALPR cannot be perform well. Generally, license plate is made in the rectangular shape, but every country has its own rules for the designing process of license plate. Many researchers are doing work on the extraction of plate region (3). This stage is greatly responsible for the accuracy of the system. First of all, an image is captured by a infrared or color or black and white camera. Then this image is serves as input to the extraction stage of the ALPR system. Features of a license plate are used for the extraction of license plate from an image. Images can carries more than one license plate so it is needed to extract each and every license plate accurately (2, 38).

III. A STATE-OF-THE-ART REVIEW OF EXTRACTION OF LICENSE PLATE
In this section, various algorithm for extraction of license plate, have been demonstrated by the researchers. A state-of-the-art review of extraction techniques along with their pros and cons are presented here the accuracy of the used technique determines the efficiency of the ALPR system. The extraction algorithms are generally classified on the basic five approaches.
License Plate Extraction based on edge/ boundary based techniques.

- License Plate Extraction Using Global Image Information
- License Plate Extraction Using Texture Features
- License Plate Extraction based on color features.
- License Plate Extraction using character features and Combining Two or More Features

A. License Plate Extraction Based On Edge/Boundary Based Techniques

Mita Nasipuri, Satadal Saha, Subhadiip Basu and Dipak Kumar Basu present an extraction algorithm based on edge detection techniques (4). In extraction stage, image is converted into the grayscale image. The shape of the license plate is rectangular. Thus all possible rectangles of image are need to be detected. To find these rectangles (5-8), edge detection techniques play a very efficient role. M. Sarfraz, M. J. Ahmed, and S. A. Ghazi, presents a method for edge detection by using sobel filter (9-12). C. Nelson Kennedy Babu and K. Nallaperumal present that Edge detection techniques can be used to find the horizontal as well as vertical edges of an image. Geometric attributes can also be used to detect the edges (13). Magnitude of vertical and horizontal edges is calculated and then magnitude is used as a robust feature for extraction of plate (14). A. M. Al-Ghaili, S. Mashohor, A. Ismail, and A. R. Rahni present the most efficient algorithm that is used for the extraction of license plate is known as Vertical Edge Detection Algorithm (VEDA). The speed response of this method is faster as compare to the response of sobel filter (15). H.-J. Lee, S.-Y. Chen, and S.-Z. Wang present (16) a block based method, in this method magnitude of blocks are calculated and the block which has high magnitude, taken as region of license plate. D.-S. Kim and S.-I. Chien, presents another method for extraction of license plate. License plate can also be extracted by using generalized symmetry transform (GST) (17). Pros of this edge detection technique are that it is a very simple and fast technique for extraction but con of this technique is that this method cannot detect broken edges.

B. License Plate Extraction Using Global Image Information

K. Miyamoto, K. Nagano, M. Tamagawa, I. Fujita, and M. Yamamoto, present a method for license plate extraction, known as 2-D cross correlation (18). This method is independent of the position of license plate in an image. The disadvantage of this method is that it takes more time in the process of license plate extraction. M. M. I. Chacon and S. A. Zimmerman, presents another method named as contour detection algorithm (19). This method is used to detect the connected objects of a binary image. This method cannot detect plate region if the quality of image is worst. Another method, known as connected component analysis (CCA), can also be used for extraction of license plate (20-21). B.-F. Wu, S.-P. Lin, and C.-C. Chiu, present a method, in which spatial measurements are used for license plate extraction (22). Binary image is used in this method. CCA has an advantage that it can be used for low resolution videos or images.

C. License Plate Extraction Using Texture Features

H.-K. Xu, F.-H. Yu, J.-H. Jiao, and H.-S. Song, present scans line technique. In this method, change in gray level of image is notices as the number of characters presents in the image (23). In this method, peaks in the scan line of gray image are considered. R. Zunino and S. Rovetta, present another method for extraction of plate (24). The method is named as Vector Quantization (VQ). This method provides hints about the plate regions. C.-N. E. Anagnostopoulos, I. E. Anagnostopoulos, V. Loumos, and E. Kayafas, present a method known as Sliding Concentric Rings (SCW) (25). In this method, irregularities in the texture of the image of license plate of vehicle are considered. After this, any change in the local characteristics of image region is considered as the license plate region. R. Parisi, E. D. D. Claudio, G. Lucarelli, and G. Orlandi, present a method known as discrete Fourier transform (DFT) (26). This method is used for identification of the spatial frequency. It produces harmonics in the spectrum analysis. DFT can be used in row-wise and column-wise manner to detect the horizontal and vertical position of the license plate. C.-T. Hsieh, Y.-S. Juan, and K.-M. Hung, present wavelet transform (WT)-based method for extraction of license plate (27). In this method, four sub-bands are used such as HL and LH, which are used to describe vertical and horizontal edge information respectively.

D. License Plate Extraction Using Color Features

The color of the characters and the plate is not same. License plate extraction using color features is used as the plate extraction of vehicle (28). E. R. Lee, P. K. Kim, and H. J. Kim, presents another method known as Neural Network (NN). In this method, an image is converted into HLS, after this, color of each pixel is classified (29). Then highest color density area is considered as the license plate region. S. Yohimori, Y. Mitsukura, M. Fukumi, N. Akamatsu, and N. Pedrycz, present Genetic algorithm (30-31). This method is used to extract the color information of the license plate. Lower and upper threshold of the plate is determined by brightness of the plate. After this, pixels, whose value lies in between these two threshold values, is labeled. These labeled pixels form a shape of a rectangle then this region is considered as license plate region. W. Jia, H. Zhang, X. He and M. Piccardi, present Mean Shift Algorithm (32-33). By using this algorithm, candidate regions are obtained after segmentation process of color images. The accuracy of this method is high.

E. License Plate Extraction Using Character Features and Combining Two or More Features

Character features are also used in the extraction stage of the license plate. In this presence of characters are taken into consideration. J. Matas and K. Zimmermann, present a extraction method based on region based approach (34). In this method, NN is used to classify the regions. H. Hontani and T. Koga, present a method, known as scale-space analysis (35), for analysis of characters. In this method, character candidates are extracted by using scale space analysis. The technique, which uses two or more features for license plate extraction are known as hybrid technique. These techniques are more reliable as compared to another method for plate extraction. K. K. Kim, K. I. Kim, J. B.
Kim, and H. J. Kim, presents a hybrid method, in which texture features and color features of license plate are combined (36). M. H. T. Brugge, J. H. Stevens, J. A. G. Nijhuis, and L. Spaanenburg, present a hybrid technique in

<table>
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<tr>
<th>Methods</th>
<th>Rationale</th>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>Using boundary features</td>
<td>The boundary of license plate is rectangular.</td>
<td>Simplest, fast and straightforward.</td>
<td>Hardly be applied to complex images since they are too sensitive to unwanted edges.</td>
</tr>
<tr>
<td>Using global image features</td>
<td>Find a connected object whose dimension is like a license plate.</td>
<td>Straightforward, independent of the license plate position.</td>
<td>May generate broken objects.</td>
</tr>
<tr>
<td>Using texture features</td>
<td>Frequent color transition on license plate.</td>
<td>Be able to detect even if the boundary is deformed.</td>
<td>Computationally complex when there are many edges.</td>
</tr>
<tr>
<td>Using color features</td>
<td>Specific color on license plate.</td>
<td>Be able to detect inclined and deformed license plates.</td>
<td>RGB is limited to illumination condition, HLS is sensitive to noise.</td>
</tr>
<tr>
<td>Using character features</td>
<td>There must be characters on the license plate.</td>
<td>Robust to rotation.</td>
<td>Time consuming (processing all binary objects), produce detection errors when other text in the image.</td>
</tr>
<tr>
<td>Using two or more features</td>
<td>Combining features is more effective.</td>
<td>More reliable.</td>
<td>Computationally complex.</td>
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Table 1: Pros And Cons Of Different Methods Used For License Plate Extraction (2)

which, two trained neural networks are used for texture feature and color features respectively (37). In this section, we described performance evaluation of license plate localization methods based on the features used by them. In Table 1, different techniques for plate localization are summarized along with their pros and cons.

IV. CONCLUSION AND FUTURE DIRECTIONS

The paper presented a state-of-the-art review of the different existing techniques, used for license plate extraction in the ALPR system. In this paper, comparison of different techniques is also summarized in a table, in terms of their pros and cons. There is an illumination problem, which affects the efficiency of the system. Sensing system should be used to elevate the performance and efficiency of license plate. Good preprocessing methods can also be used before extraction of license plate region.

REFERENCE


