

A Review of Recognition Technique used Automatic License Plate Recognition System

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ABSTRACT

Automatic License Plate Recognition (ALPR) is the extraction of vehicle license plate information from an image or a sequence of images or video as input. A learning based approach plays a very important role in recognition process. ALPR system consists of four modules named as Acquisition of an image, localization of license plate, segmentation of an image and character recognition of license plate. Recognition module helps in recognition of character that is present on license plate. Template Matching, Neural network (NN), Support Vector Machine (SVM) etc. can be used as recognition process. This paper presents different methods of character recognition in an Automatic License Plate Recognition system (ALPR). Recognition techniques are presented along with their advantages and disadvantages. The methods are categorized according to their response, accuracy and faster response. The future foresees for researchers are also given at the end of the paper.

Keywords

Automatic License Plate Recognition (ALPR), Artificial Neural network (ANN), Neural Network (NN), Support Vector Machine (SVM) Optical Character Recognition (OCR).

1. INTRODUCTION

Character recognition, an important step in Automatic License Plate Recognition System, is a process which is used for identification of the alphanumeric characters. This can be done by using predefined class of characters. As we know, interest of people is increasing in computer applications. So, it should be able to recognize the text easily. Modern society needs that all machines like computer should be able to read the text data at very fast response. The text can be available in various kinds of fonts. The character recognition system provides a better platform in between machine and human being. There are several methods, which are used to identify the characters. But visual characters cannot be recognized by using some classical methods [5]. There are various fields exist, in which character recognition techniques plays a vital role like money counting device, smart card processing system, address and zip code recognition, bank cheque or demand draft processing, license plate number recognition, writer identification etc. A character, which is greatly affected by noise content, can't be correctly recognized.

Fig 1 shows the basic block diagram of character recognition system.

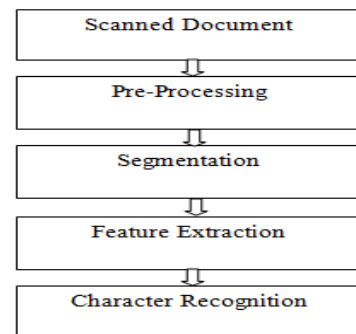


Fig 1: Block Diagram of Character Recognition System [3]

Different techniques have been used for character recognition in an ALPR system. More recently, there are literature evidences of applicability of Soft Computing Techniques for character recognition such as Genetic Algorithms (GA), Biogeography- Based Optimization (BBO), Memetic Algorithms (MA), Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO) and Bacterial Foraging Optimization (BFO) [1, 2, 7].

The contribution of the paper is detailed as under:

- A state-of-the-art review of recognition techniques are presented that can be used to recognize characters in ALPR system.
- Different recognition techniques are compared by clearly citing their advantages and disadvantages.
- There exists some ambiguity problem in similar kind of characters like 0-O, B-8 etc. Further work can be done by researchers on this problem.

The rest of the paper is organized as follows:

In section 1, Introduction of character recognition system is presented. In section II, a brief introduction of an ALPR system is given. In section III, character recognition process, used in an ALPR is discussed. In section IV, a state-of-the-art recognition techniques and their advantages and disadvantages in an ALPR are specified. In section V performance evaluation of recognition technique in an ALPR is given. In section VI, conclusion and future directions are presented.

2. AUTOMATIC LICENSE PLATE RECOGNITION SYSTEM

ALPR is used to automatic recognition of license plate number of a vehicle. It is used in various applications like automatic toll collection, road monitoring, parking lot system, traffic law enforcement etc. an ALPR process consists of four basic stages named as: 1) image acquisition, 2) license plate extraction, 3) image segmentation and 4) character recognition. Fig. 2 shows the basic block diagram of the ALPR system [2].

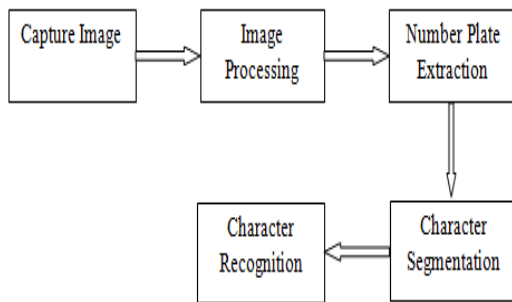


Fig 2: Basic Block Diagram of ALPR System [2]

There are different techniques that can be used to recognize license plate number. In the image acquisition step, an image of a vehicle is captured by using camera. The camera can be color or black and white. The camera quality should be high for proper recognition of characters. In second step, license plate is extracted from image and background is removed. So that, image carries only license plate [4, 5]. In third step, segmentation is done. In last step that is character recognition, characters are identified using different classifiers like Support Vector Machine (SVM), Template Matching, Artificial Neural Network (ANN), Fuzzy Classifiers etc. [1, 7].

3. CHARACTER RECOGNITION IN ALPR SYSTEM

The Character Recognition stage is the most essential stage of an ALPR [1,2, 19, 21, 22, 24, 27]. In this paper, many methods of character recognition are given. In this stage, segmented license plate is considered as input. The extracted characters obtained from the segmentation stage are then recognized. Many hurdles can be take place in this stage due to the zoom factor of the camera [3]. The difficulties may also be occurring due to the different size and style of the characters used. This problem can be overcome by resizing an image. All the time, font sizes of characters are not same. This can also make some difficulty in recognition of characters. Broken characters and dust on plate are issues for recognition process [29]. Different structure of a language can be build by the basic building blocks known as character. Recognition of optically processed characters can be done by a technique known as Optical Character Recognition (OCR). It is a better known technique in the field of character recognition. Already existing set of characters are used to interpret the input for the system. a ranked list of Candidate character may be produced by the two basic types of OCR algorithm.

Matrix matching technique is used in character recognition. In this technique, a pixel by pixel comparison is performs on the image and stored glyph. This process is called as image correlation or pattern recognition or pattern matching. This

technique can works only on the stored fonts of similar characters. If character arises with new fonts then it cannot perform well. If feature extraction technique is taken into consideration then some features of the characters like closed loops, open loop, line intersection and line directions, are extracted using this technique.

4. A STATE-OF-THE-ART REVIEW OF RECOGNITION TECHNIQUE FOR ALPR SYSTEM

Some techniques of character recognition focus on the individual character and other focuses on the entire word. Various methods are employed by the researchers, in the recognition of license plate number. Existing recognition techniques based on feature used, are explained as follows:

4.1 Character recognition using raw data

K. Kanayama et. al. [29] presents that Template Matching is a technique, which is used for recognition of characters. This method is very simple and follows a straight forward method. This method has some drawback like it can recognize only non broken characters. Text written only in single font can only be recognized by Template Matching. Binary images are used for recognition of character by using Template Matching technique. If a plate is tilted, then it becomes very difficult to recognize characters correctly. T. Naito et. al. presents that tilt problem can be solved by using different set of font of same alphanumeric character [18]. X. Lu et. al. presents Normalized Cross correlation technique, which is another method to recognize a license plate number. P. Comelli et. al. presents that normalized cross correlation is used to match the character with its stored templates [24, 13]. Each and every character is divided in column. Then normalized cross correlation of each column is calculated, which helps in recognition of character. There are many other techniques are defined by S. Tang et. al. [11] for measuring the similarity between characters like Hausdorff distance [9]. E. R. Lee et. al. presents Jaccard value method [27], Bayes decision technique [29], Mahalanobis distance and the Hamming distance [14].

4.2 Character Recognition Using Extracted Features

Feature Extraction technique is used in recognition of characters. K. Kanayama et. al. [20] present that this method is well suitable as compare to Template Matching. This method takes lesser time than Template Matching, without feature extraction. The extracted features are known as feature vector, a comparison is done on the basis of pre-stored features of that particular character. Projection profile can also be used to extract the features as shown in Fig.3 and 4. H. A. Hegt et. al. [23, 30] present that a character is projected vertically as well as horizontally to extract the features. Hotelling transform can also be used for feature extraction. S. N. H. S. Abdullah et. al. [10, 16] present Gabor filter and Kirsch edge detection techniques, which is applied on the segmented image to obtaining the features of characters. Y. Amit et. al. [12] present many methods like Prewitt and Wallis, which can also be used for edge extraction but Kirsch edge detection provides best result. After extraction of features of different fonts of all characters, dilation and erosion is performed on it. J. Jiao et. al. [9] presents that, these features are used as input to Neural Network. ANN is known as classifier like another classifiers such as Support Vector Machine (SVM) [17]. An integrated form of these

classifiers can also be used to recognition of characters [8, 15, 25, 27, 30].



Fig 3: Horizontal lines at different heights [6]



Fig 4: Vertical lines along width [6]

5. PERFORMANCE EVALUATION OF RECOGNITION TECHNIQUES FOR ALPR

This section presents the performance evaluation of recognition techniques for an ALPR. Different techniques that are used for character recognition has some pros and cons. For example, template matching is a simple technique of character recognition but, it has some disadvantages also. The advantage of the Template Matching technique is that, it is a straight forward technique, which works in a simple manner [29]. The disadvantage of this technique is that, it can not perform well for recognition of the broken characters and tilted characters. It consumes more time for processing. It can not provide better result if there exist changed fonts and noise on plates. Different templates of same characters can be used to remove this tilt problem [18]. Normalized cross correlation is used for character recognition. The advantage of this technique is that, it is a simple technique. It can recognize the characters if and only if characters have fixed size [13, 24]. Character recognition using extracted features is used in recognition of characters. The advantage of this method is that, it consumes less time as compare to template matching technique [20]. Hotelling transform is less sensitive for tilted characters and more sensitive for segmentation results [20]. The advantages of other recognition techniques such as Kirsch edge detection, Gabor filter [16, 10], ANN, SVM can also provide better recognition results. These techniques provide better result for a noisy plate at very fast speed [9, 17]. These techniques take much time to extract feature vectors, which is the disadvantage of these techniques. Some characters like 0-8, A-4, B-8 are looking similar. When these characters are broken or distorted then it is very difficult to recognize them by a machine [4]. This problem is known as ambiguity problem. It can be removed by the future researchers.

6. CONCLUSION AND FUTURE DIRECTIONS

In this paper, the recognition methods, which are used to recognize the characters, are presented in detail. Performance and efficiency of the recognition system depends on the techniques. Feature extraction techniques provide better result as compare to other techniques. This paper contributes a state-of-the-art review of recognition that can be used to recognize characters in ALPR system. Different recognition techniques are compared by clearly citing their advantages and disadvantages. In case of ANN, if increase the number of neuron, flexibility of the system is improved at the cost of increased complexity of system. Template Matching is simple

and straight forward method. There exists some ambiguity problem in similar kind of characters like 0-O, B-8 etc. Further work can be done by researchers on this problem. Soft computing techniques such as Genetic Algorithms (GA), Biogeography- Based Optimization (BBO), Memetic Algorithms (MA), Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO) and Bacterial Foraging Optimization (BFO) which have already shown a promise for solving various combinatorial optimization problems may provide an efficient solution to the recognition in ANPR system.

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