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RECOGNITION OF VEHICLE NUMBER PLATES AND RETRIEVAL OF VEHICLE OWNER'S REGISTRATION DETAILS

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Abstract

Automatic vehicle number plate recognition system is a system plays an important role in traffic controlling, security checks, toll gates and road accidents. In this paper vehicle numbers are recognized and later used for retrieval of vehicle owner details for the above said purposes. Morphological operations and edge features are used for the segmentation of vehicle number using two level decisions. An efficient algorithm is proposed and tested on large set of images and demonstrated the efficacy of the proposed approach.

1. Introduction

Though the applications of automatic license plate detection have emerged in the last decade or so, the technology has been present for nearly 30 years. In the late 1970s, researchers for the United Kingdom police department manufactured the first working license plate recognition system and began deploying it by the beginning of the 1980s. The first US patent for an automatic license plate reader was issued in 1989. In a rare break for computer science, some issuing states/countries around the world adapted their license plates to assist automatic license plate recognition systems. In 2003, the Netherlands modified their license plate by introducing a new typeset font. During the same year, Texas passed a bill banning novelty frames (later overturned in 2007) because they impeded the view of the license plate to recognition systems [4].

Automatic Vehicle number plate recognition system used for identifying number and obtaining owner information from a large database of registration details. Recognition process includes, submitting a query, and extracting characters of the image that best matches with template if matched, obtain the owner details. In which visual contents, normally called as features are used to recognize alphabets and numeral characters to obtain registration details from large databases. Vehicle number plate recognition systems are used as core modules for intelligent infrastructure systems like electronic payment systems (toll payment and parking fee payment) and freeway and arterial management systems for traffic surveillance [5].

Automatic license/number plate recognition is a specific application of optical character recognition. Typically employed by law enforcement agencies, the uses for automatic license plate recognition have grown tremendously since its inception. Automatic license plate recognition may be used to cite individuals who violate traffic signals or drive in excess of the speed limit, as a method of electronic toll collection, to place a suspect at a scene, or identify uninsured motorist (when combined with a database search).

License plate recognition may be complicated by frames that obscure parts of the plate, debris, complex backgrounds, and a wide variety of fonts. Furthermore, license plates are not configured in a standard format; license plates typically vary across issuing states and countries. Recognition systems must also account for rotation in the plane if a license plate is improperly mounted (this is more likely to occur after an accident). Difficulties also occur in the acquisition phase. Many systems acquire license plate images in the near-infrared spectrum and providing proper illumination is challenging. Also, cameras must be equipped with extremely shutter speeds to capture objects moving at very fast speeds. Motion blur and noise make character recognition (and most other areas of computer vision) difficult. Acquisition devices may only have one chance to capture the target, so it is imperative that images are of good quality.

The problem of automatic number plate recognition is been done from so many years and many methods have been proposed to address this problem. Developed a mobile LPR system for Android Operating System (OS). LPR involves three main components: license plate detection, character segmentation and Optical Character Recognition (OCR). For

License Plate Detection and character segmentation, we used JavaCV and OpenCV libraries. And for OCR, we used tesseract-ocr [1].Automatic Number Plate Recognition System (ANPR) using Morphological operations, Histogram manipulation and Edge detection Techniques for plate localization and characters segmentation. Artificial Neural Networks are used for character classification and recognition [2]. Neural Network techniques are used for character recognition, one is Back Propagation Neural Network and other one is Learning Vector Quantization Neural Network [3]. Here they have used the technique of binarizing image and edge detection of a license plate image. Line detection is done by using Hough transformation. In next step detected the position of arbitrary shape. Points and regions of different intensity are found using blob analysis, regions are labeled and morphological operations like dilation, erosion are applied on the images. Characters are segmented and based on template matching characters are recognized [4]. Issues such as processing time, computational power, and recognition rate are also addressed in [5]. For character identification pre-classification with Euler number, Parallel classification with skeleton features classifier, template matching classifier and neural network classifiers are used [6]. Adaptive thresholding is used because it produced solid characters instead of the contours with edge detection [7]. OCR is used to recognize an optically processed printed character number plate which is based on template matching [8]. Objective is to design an efficient automatic authorized vehicle identification system by using the vehicle number plate. The system is implemented on the entrance for security control of a highly restricted area like military zones or area around top government offices e.g. Parliament, Supreme Court etc [9].Mathematical principles and algorithms, which ensure a process of number plate detection, processes of proper characters segmentation, normalization and recognition. Work comparatively deals with methods achieving invariance of systems towards image skew, translations and various light conditions during the capture [10]. A work on recognizing license plate using segmentation presents a new approach for identifying using localization technique. Algorithm is based on combination of morphological operations based on area. Region properties are used for segmentation of characters. Characters are identified by the technique of template matching [11].

The proposed work is to develop a system to recognize the vehicle number plate and retrieve the owner information from the database. It is based on inputting a vehicle number plate image to the system, which recognizes the characters of vehicle number plate and using that characters the details of particular license plate image are fetched from the database as described in the next section.

2. Proposed Methodology

In this section, the proposed methodology is described as per the block diagram shown in Fig 1.

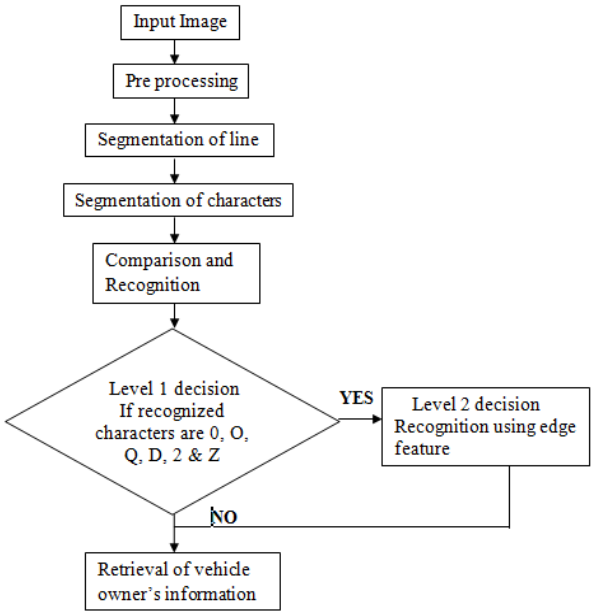


Fig.1. Block diagram of proposed method

2.1 Preprocessing

In preprocessing, vehicle number plate images are captured using high resolution camera in RGB. Images and are then converted into gray scale images. Filtering is applied to remove noise and also to improve the contrast and sharpness of the image. Images are cropped only the character part of the number plate automatically as shown in fig.2 and fig.3.

Fig.2. Input color image with noise

Fig.3. Prepocessed image

If the image contains numbers in two lines, then segmentation is applied to separate the lines as shown in fig.4. Each line is used for the recognition of numbers.

Fig.4. Image after line segmentation

Further, Segmented lines are subjected to recognition phase. Here different regions of the line are identified using blob analysis and are labeled as shown in fig.5.

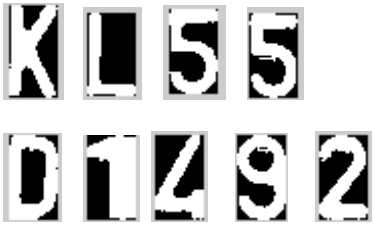


Fig.5. Image after characters segmentation

2.3 Comparison and Recognition

Level 1 decission

In which the segmented characters are recognized and converted into text for further processing. This involves process like feature extraction, comparing with correlation coefficient, edge direction feature and classification. Here the characters are normalized to standard dimension. Templates are prepared and normalized into blocks with no borders or white spaces that surround the characters as shown in fig.6.

Fig.6. Standard templates of English alphabets and numerals

Similar process is used to segment the characters from the test image. Each character is matched with the standard template using correlation technique to measure the similarity between them using equation.1. Correlation coefficient value ranges from 0 to 1. The value 0 indicates minimum match and value 1 indicates maximum match.

$$r = \frac{\sum_{\substack{i=1,n \\ j=1,m}} (X_{i,j} - \overline{X})(Y_{i,j} - \overline{Y})}{\sqrt{\sum_{\substack{i=1,n \\ j=1,m}} (X_{i,j} - \overline{X^2})} \sqrt{\sum_{\substack{i=1,n \\ j=1,m}} (Y_{i,j} - \overline{Y^2})}} \quad \textbf{(1)}$$

Where X and Y are test and template image respectively, i and j are rows & columns of the image.

Level 2 decission

In case of characters like 0, 2, D, O, Q and Z, there may be of chance of mismatch due to highest similarity. In such cases second level decision is taken using edge directional histogram. Here the edge direction for test and template character is obtained and distance between them is calculated using Euclidean distance measure given in equation.2. Based on distance obtained best matched character can be obtained. Distance value ranges from 0 to 1. The value 0 indicates no match and value 1 indicates correct match.

$$d = \sqrt{\sum_{\substack{i=1,n \\ j=1,m}} (X_{ij} - Y_{ij})^2} \quad \textbf{(2)}$$

Matched characters are then converted into notepad text for further retrieval of vehicle Owner details from the database as described in the next section.

2.4 Retreieving vehicle owner's registration information

By using the matched text, we can retrieve the vehicle owner details from the Regional Transport Office (RTO) database. Here the database consists of all the information like name, address, telephone number, place of registration, etc as shown in fig.7.

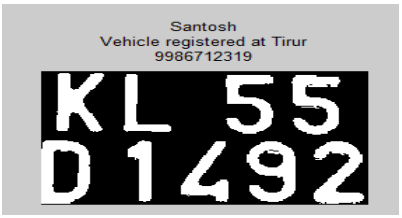


Fig.7. Output Image with Owner and registration details

2.5 Proposed Algorithm

Input: Vehicle number plate Image
Output: Vehicle Owner Details

Step1: Input vehicle number plate image in RGB
Step2: Convert RGB to Binary image
Step3: De noise the image and retain region of Interest
Step4: Segment lines using horizontal profiling
Step5: Segment characters $X_{i,j}$ using vertical profiling
Step6. For each $X_{i,j}$ find correlation *r* using eq.1 between $X_{i,j}$ and the standard templates $Y_{i,j}$
Step7. Consider $Y_{i,j}$ whose Correlation *r* is maximum.
Step8. If $Y_{i,j}$ ='0', '2', 'D', 'O', 'Q', 'Z' Go to Step 9 Else Go to Step 11
Step9. For each $Y_{i,j}$ find Euclidian distance *d* using eq.2
Step10: Consider $Y_{i,j}$ whose Euclidian distance *d* is maximum.
Step11 Y=Y+ $Y_{i,j}$
Step12 Repeat steps 6-11 for each $X_{i,j}$
Step13: Retrieve the vehicle owner details from the database matching with Y

3. Sample Experimental Results

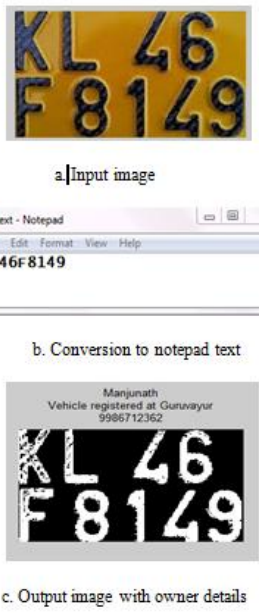


Fig 8.Sample Experimental Result 1

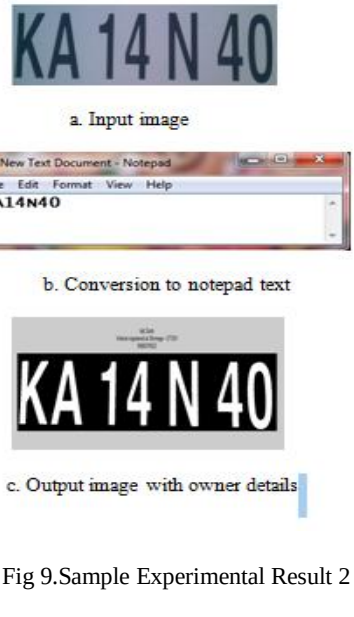
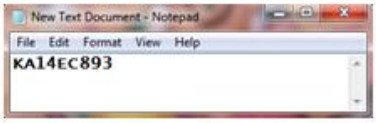


Fig 9.Sample Experimental Result 2

a. Input image



b. Conversion to notepad text

c. Output image with owner details

Fig 10. Sample Experimental Results 3

4. Conclusion and future work

This paper work addressed the problem of vehicle number plate recognition automatically. Recognition of image is done by using character matching and edge features like edge direction and edge gradient. Database consists of different images of vehicle number plates with different font and background. The performances of different methods are evaluated on the collected database in order to check the robustness and to study the behavior of recognition system.

The proposed method works well to images with standard font and uniform intensity. It works effectively in case of images with any color background and without any invariant moments. Mismatched words are recognized using edge direction and histogram matching using Euclidean distance measure which achieve high hit rate. The study revealed that the proposed approach performs well and effective to different types of vehicle number plates.

Our future work concentrates on complex number plate images such as, cluttered background, different fonts, and different intensity images, even images captured while on move.

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