Automatic Vehicle Number-plate Detection

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ABSTRACT

This paper presents a novel hybrid method for extracting license plates and recognizing characters from the digital camera image using morphological operations. The main problem in extracting text from the images is caused by several reasons including font size variation, alignment of text and variation of font colors. A novel hybrid method is proposed here for character segmentation and recognition. The objective of this work is to design and implement algorithms for Recognition of Indian License Plates. This paper presents a robust algorithm of license plate location, segmentation and reorganization of the characters present in the located plate. Since text regions in license plate images contain mostly repetition of vertical strokes (edges), once the group of edges is found, neighboring edges of a segment are connected to each other. The proposed method is effective for slanted or curved characters compared to existing methods.
Experimental results show that the proposed method improves the effectiveness and robustness for License plate recognition.
Keywords— *image processing, license plate localization, segmentation, text detection.*

1. INTRODUCTION

With the rapid development of public transportation system, automatic identification of vehicles plays a very important role in many applications such as managing park facilities, detecting stolen vehicles, controlling traffic volume, ticketing speeding vehicles, traffic law enforcement[2], road monitoring , security systems[1]-[2]. One of the most effective and useful identification methods is the license-plate recognition (LPR) of a vehicle through visual image processing. Vehicle number plate recognition is an image processing system whereby it is used to recognize the vehicles by identifying the license plate. Recognition of text from natural scenes is one of significant technologies used in several applications. Text information in any kind of digital images is helpful to extract information, and give better understanding of contents in them. Automated process of understanding the text from images has many computational challenges. The extraction of text from images are complicated due to various factors, such as variation in either one or a combination of light, alignment of text, color, font size, text orientation noise in background and camera angle[3]. Text information from natural images provides valuable information like, name of the place or description of the scene, as in sign boards or road signs. In this paper, an experimental system for the recognition of vehicle license plates, which is based on morphological operations, is presented.
The rest of this paper is organized as follows: section 2 discusses the system architecture and the steps involved in the recognition process; section 3 explains each step in details; section 4 shows the experimental results and has a conclusion regarding the system.

2. SYSTEM ARCHITECTURE

The typical license plate is composed of both letters and digits, as shown in Table 1. Generally there are two kinds of plate according to the number of rows. The one-row license plate is divided into four parts by three hyphens or dots. The first part is two letters, second part is two digits, third part is one or two letters and the remaining is 1 to 4 digits. In a two-row plate, the upper row is two letters and two digits separated into two parts by a hyphen and the lower is one or two letters and the remaining is 1 to 4 digits.

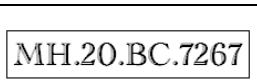
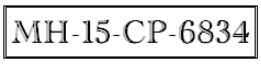
One row structure	Two row structure
	
	
	

Table 1: typical examples of number-plates

As shown in Table 1, the number of characters in a plate can vary from 6 to 10. Besides the number of rows or

the number of characters, a license plate can also be classified into three kinds, according to its background color and the color of characters. The typical license plate in India has a white background and black characters, but for some national-permit cars/vehicles, the color of the background is yellow with black characters, and there are some plates with red background and white characters, these are temporary plates for new cars/vehicles as not yet issued with permanent plates.

Types of plates	Backgnd. color	Chara.color
temporary plate	Red	black
national-permit cars/vehicles	Yellow	black
Common plate	White	black

Table 2: color scheme for different types of number plates

Three is a need to develop the algorithm for license plate recognition system which is compatible to all different types of plates in the country .The proposed must be compatible to all those different kinds of plates in the country.

The proposed system license plate recognition system is divided into four phases: a) preprocessing b) region of interest extraction, c) segmentation and d) recognition.

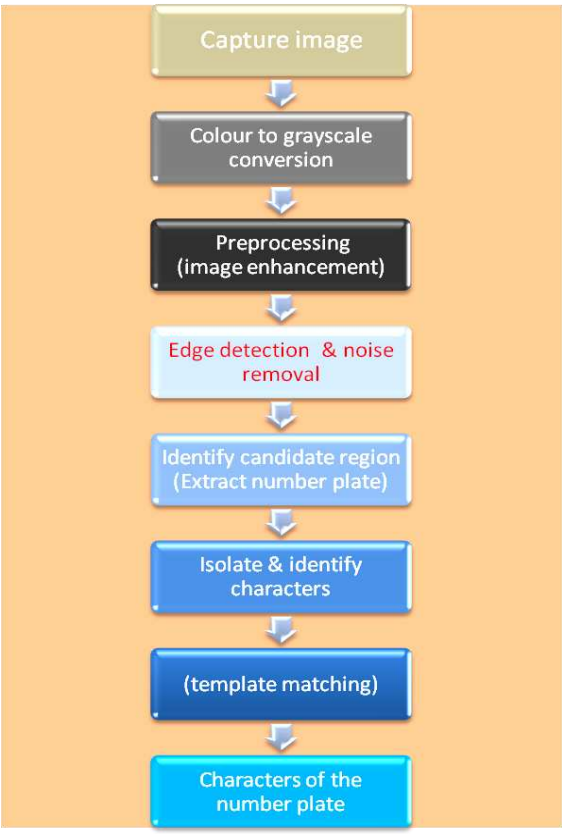


Figure 1:flowchart of the proposed system

a) Preprocessing: Image enhancement and conversion from RGB space to Gray scale.
b) Region of interest extraction: the proposed system uses a efficient morphological algorithm to find the region of interest that may contain characters in the input image.
c) Segmentation: According to the value of the projections and choosing a threshold, we can divide the plate into separated characters in this stage.
d) Recognition: The final stage is an O.C.R (Optical Character Recognition), a template matching method can be used to recognize the characters in a plate.
e) The following figure1. depicts the approximate flow of the proposed system.

3. SYSTEM IMPLEMENTATION

The sample image from the digital camera is the colored image (fig.2.a). In the RGB color space, a grey scale image has equal intensities for the red, green and blue components. It is therefore only necessary to specify a single intensity value for each pixel. This single intensity value is specified by formula:[10]

Intensity value=30% x red+59% x green+11% x blue--- (1)

The input image is initially converted to a gray scale image (fig.3.a). Then the preprocessing is carried out at this part of stage so as to remove noise and enhance the contrast (fig.3.b). The feature extraction process then follows.

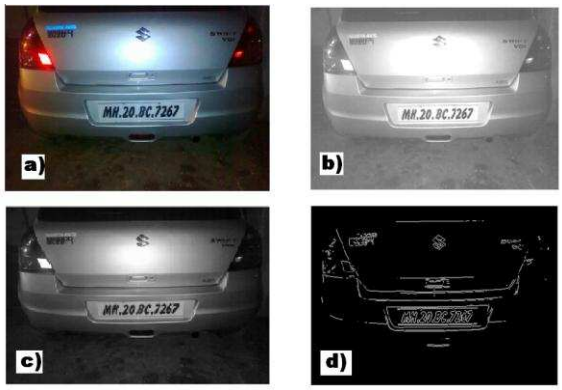


Figure 2:a)original sample image(from 5MP digital camera 1280x696, jpeg). b)contrast enhanced image of image(c). c) gray scale image of image(a). d) edge detected image of image(b)

Extraction methods can be divided into two categories, region based and texture based. Mostly the texture based method is robust, but the high complexity of texture computation is a drawback, when processing complex images.

Figure 3: few examples of original gray scale and respective contrast enhanced images

Color based method is to find the background color which is helpful in investigating text candidate regions in images with uniform background [8]. In [2], edge features are used to identify the text region based on filters and block information. The drawback in color based approach is that it cannot detect text from graphics with non-uniform colors in the image. Clustering based approaches have been presented [4], but they are more sensitive to noises and color variations.[1] The histogram based analysis is suitable only if text is present in straight line, but if the text is tilted or arranged in curves it is quite hard to locate text in full view [11]. Another drawback of histogram analysis is that it detects the false peak in text region, resulting in incorrect text location. Frequency information of the DCT coefficients is illustrated in [9], but it is not suitable for images with text scattered over several parts of the image [6]. Fast and effective method based on stroke filter have been presented, which detects stroke like structure present in images. But, there is a high chance of considering logo and other graphics image as stroke like structures and classifying wrong area as text.

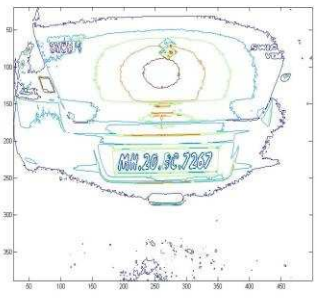


Figure 4:Characters are clearly visible in the contour of image obtained from image 2.b

Edge based method usually extracts text based on connected components and morphological operations [4]-[11]. Compared to previous works, in this paper, we present a preprocessing step to refine the text area more clearly and reduce the high complexity of finding background noises and find the text easily. As the text has unique characteristic of continuous vertical strokes, we applied edge based text detection method [4] to extract all the possible vertical edges from the input image. After extracting vertical edges we used morphological operations to connect those edges and form a group of connected edges. For this two algorithms called dilation and erosion are used. Once all the edges are connected we applied geometrical feature based techniques to extract text region. We tested our algorithm with several input images that has text in curved shape or titled text.

The rest of the paper is organized as follows. Section 4 introduces edge detection for text localization, and illustrate the connecting edges. Elimination of noises and searching for the text candidate area is explained in section 5 and 6. Experimental results are shown in section 7. Finally the conclusion and future works are given in section 8.

4. TEXT REGION LOCALIZATION

Initially, we convert the original RGB image to a grayscale image. A well known global binarization technique of Otsu's is applied and connected component from the binary image is obtained as shown in figure (2.c), then all the geometrical features including height (h) and width (w) of all connected components are computed. If both h and w are within a certain range, these connected regions are recognized as candidate text regions and the others are eliminated. Still there could be more connected components similar to the text region as shown in figure (2.d). We can remove those noises by using text alignment and arrangements. Edge detection plays a vital role in finding the text area. They are more accurate in extracting the edge features of all the objects present in the images. Since the text in images has continuous vertical edges arranged closely, we first focus on extracting vertical edges. There are many methods to find the edges, but still Sobel edge detection is more solid and accurate to find edges in any kind of images. This helps to find all the possible stoke like structure in images. Sobel filters are applied to find two kinds of edges like vertical and horizontal. Our idea is to find continuous vertical strokes present in image and to extract these vertical edges we applied only the Sobel vertical edge detection method to a gray scale image. As a result numbers of shorter and longer vertical edges are created, some edges are closely packed together and others are sparse or scattered. In certain images the presence of logo and graphics in text area gives additional number of edges. So these edge

features are analyzed in further steps to extract text region effectively.

5. EDGE GROUPING

Although the vertical edge detection gives prominent features for text region detection, but still it is hard to locate text area. In many cases, different kinds of morphological operations are applied to extract text area [4]. We apply edge grouping method in our algorithm based on fact that text images contain repeated vertical strokes. These edges are joined by drawing lines between them to form possible connected region, which is essential to proceed to the next level of text region location. In the edge grouping process, we first scan the edge image horizontally from top to bottom, the start and end pixel are found, based on condition that the pixels must be greater than a threshold value (T). Once the start pixel is found, we move the index to predefined Maximum interval and start to scan backward towards the start pixel. Pixel found in between start and maximum interval is marked as the end pixel. If more than one pixel is found, the pixel near to the maximum interval is selected as the end pixel. Now the pixel between these pixels is filled with an intensity value of the neighboring pixel. This form of connection between edges is repeated for the entire pixels. To reduce the possibility of connecting unwanted regions, we set maximum interval as 10 pixels. The interval is set on the basis of empirical data. As the result of eliminating the rest of the edges with more gaps, the computation time for searching text region in the next step is reduced. When compared [4] in our work we make a difference in horizontal scanning process, they compute the edge height for each pixel above the threshold and group the edge, but in our work we connect each pixel, this help use to connect whole text edge with out and missing shape of text character.

6. FINDING THE TEXT REGION.

Images give clean vertical edges with some shorter edges that are not connected in the previous process and still remain unconnected. To eliminate those edges, erosion is used. This process helps to reduce the number of candidate regions for the next step and make the search process faster. Still there are number of connected text and non text regions after elimination process, and the process is repeated to search for text region from this image. So we make our search little narrow based on the geometrical features of the text such as height and width. Indeed, text in a label are arranged in a strip of character in straight line, tilted or curved shape with length greater than, usually, multiple times of its height. Based on the above mentioned features, properties of the entire region in image were detected. If region height and width are greater than specified measurement, we exclude them from text candidates. Figure 5 shows the result of candidates regions.

7. EXPERIMENT RESULTS

We used simple images taken by digital camera with complex background, noise, images under low lighting; focused closer and wider angle. In most of the case our methods works well. Figure 5, 6 & 7 shows the final results of our algorithm.

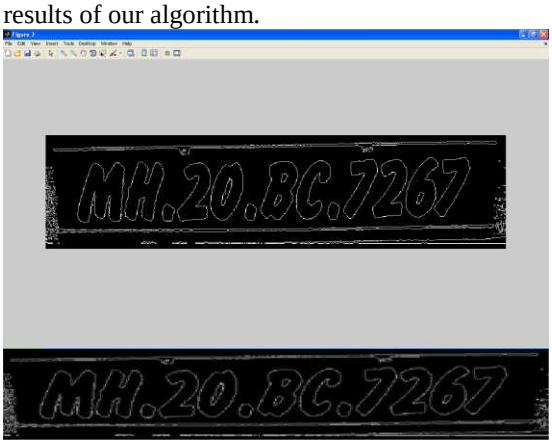


Figure 5: text localizaton from soble edge detected image(fig.2.d)

Figure 6: image binarization and background removed image.

MH 20 BC 7267

Figure 7: characters identified by template matching.

8. CONCLUSION

This method can be used to implement a real time application for identifying the number plates. The number plate can be compared with database or used to maintain information at parking lot or at entrance. Our method fails to find the text in some images, which has text more widely spaced and written in script font with larger gaps between each letter and if the font color is much similar to background colors. So in future, we would modify our approach to solve spaced font and color effects in text detection.

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