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Extraction and Recognition of Alphanumeric Characters from Vehicle Number Plate

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ABSTRACT: Text extraction from an image is an important area of research. In this work, vehicle number plate information is extracted from vehicle's image or from sequence of images without direct human intervention. A simple approach based on efficient morphological operations is proposed. Here, all the letters and numbers used in the number plate are segmented by using a bounding box method and then template matching approach is used to recognise numbers and characters.

KEYWORDS: Number Plate Recognition, Morphology, Bounding Box, Template Matching.

I. INTRODUCTION

The advancements in image acquisition techniques have resulted in cost effective and efficient cameras and computers[1].Vehicle identification is an essential area in the development of intelligent traffic systems and surveillance. It is a research area where image processing methods are used to identify vehicles by detecting and identifying the license number plates. Vehicle identification systems consist of three main stages, the identification and tracking of vehicles in motion, locating the license plate and accurately identifying the alphanumeric characters in the license plate. However, the critical issue in data extraction from number plate image is that no standard is maintained for font style and size. This problem restricts the use of automated Vehicle Number Plates Identification System in various complex situations and places [2].

In this work, the Number Plate Recognition is generally divided into-

1) Capturing the image,
2) Pre-processing the image to remove unwanted information,
3) Applying bounding box,
4) Comparison of each bounding box with the database, and
5) Displaying the alphanumeric characters in the form of text. It is assumed that all the number plates have characters of the same font[2],[3]. A database of all the alphabets and numbers in fixed font and size is created.

PinakiPratimAcharjya et al.[4] used a combination of median filtering and watershed algorithm using distance transform technique for segmentation and edge detection.

SarbjitKaur et al.[5] suggest the use of Adaptive Histogram Equalisation for contrast enhancement. This method provides better contrast when compared to Histogram equalisation. In this work, convolution is used to brighten the edges. SarbjitKaur et al. also use Sobel edge detection to detect the edges. Bounding Box technique is used in this work.

Ankush Roy et al.[6] used a Multiple Layer Perceptor(MLP) neural network while G. T. Sutar et al.[7] used Optical Character Recognition(OCR) to recognize the alphanumeric characters. OCR uses correlation method to match the individual characters with the alphanumeric database. Template matching in OCR is regarded as a common methodology for identification of characters from an image. When the characters are of predefined font this produces very satisfactory results.

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II. PROPOSED ALGORITHM

Number plate is a pattern with very high variations of contrast. When an incoming vehicle is detected, the image is captured by the camera. The following operations are carried out to extract the alphanumeric data from the image.

- Pre-processing
- Binarisation
- Apply Bounding box
- Comparison with Alphanumeric database.

A. Pre-processing

In pre-processing the noise is minimized and the region of interest is retained. For this image is first converted from colour to gray scale.
Then Median Filtering is used to reduce noise to a minimum level.

Median filter is one of the simplest and most preferred approaches for removing impulse noise before binarising. A 3x3 masking sub window is used for this purpose. This filter replaces the center pixel of the window considered, by median of the window.

Sample window Output

$$\begin{pmatrix} 10 & 3241 & \\ 255 & (43) & 52 \\ 1032 & 41 & \end{pmatrix} \quad 10 \begin{pmatrix} 32 & 41 & \\ 255 & (41) & 52 \\ 1032 & 41 & \end{pmatrix}$$

Dilation and erosion[8] are the main morphological operations. A structural element[8] is a characteristic of certain structure and features to measure the shape of an image. Here, a disk-shaped structural element[5] is used. In dilation operation the objects are expanded, hence small holes are filled and disjoint objects are connected. The objects are shrank in erosion operation in which the boundaries are etched (or eroded) away.

The morphological operations are carried out separately on the same image and image subtraction[5] is performed on them.

B. Binarisation

The grayscale image mapped from 0 to 255 is converted to double and mapped between 0 and 1. This image is convoluted with the matrix

$$\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$$

to brighten the edges[9],[10]. The double values are adjusted such that, any value below 0.5 is mapped as 0 and any value above 0.7 is mapped as 1. The intermediate values are weighted towards higher output values[11]. This is done to scale the intensity between 0 and 1. The image is now converted to binary.

C. Bounding Box

Bounding box is a rectangular box that is applied around any unconnected object in the image. Prior to the application of bounding box, there are certain operations to be carried out. Any long horizontal lines present in the image are eliminated. Any closed region or holes (black region enclosing a white region) is filled. The characters are isolated from each other by thinning the image. Thin horizontal images are eliminated. The components in the image whose connecting pixels are less than 100 are eliminated.

A rectangular bounding box is applied around each of the remaining components in the image[12]-[14]. Each bounding box is numbered based on its occurrence from left to right in the image.

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D. Comparison with the Alphanumeric Database

A database of the alphabets from A to Z and letters from 0 to 9, of a particular font[2],[7] is created beforehand. Each of the bounding boxes is compared with each of the numbers and alphabets present in the database. If the image present in the Bounding Box does not match any of the alphabets and numbers in the database then, it is discarded.

When the bounding boxes are matched with the database, the corresponding characters are stored in a string. After the comparison of all the bounding boxes, the string is displayed. This is the extracted number plate.

III. RESULTS

The captured image as shown in Fig 1, is converted to gray scale image as shown in Fig 2.

Fig 1. Image captured by the camera

Fig 2. Gray Image

Noise is removed using median filtering as shown in Fig 3.

Fig 3. Image after Median Filtering

The image is dilated as shown in Fig 4. It is also eroded as shown in Fig 5.

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Fig 4.Image Dilation

Fig 5. Image Erosion

The eroded image is subtracted from the dilated image (Fig 6.) to brighten the edges.

Fig 6. Image after Subtraction

The image is converted to binary as shown in Fig 7 and the enclosed regions are filled as shown in Fig 8.

Fig 7. Binary Image

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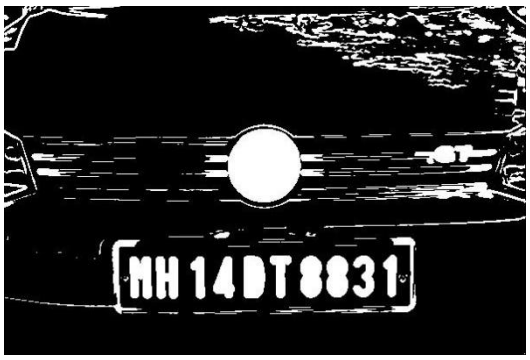

Fig 8. Image after filling the Holes

The Bounding Boxes applied on the characters are shown in Fig 9.

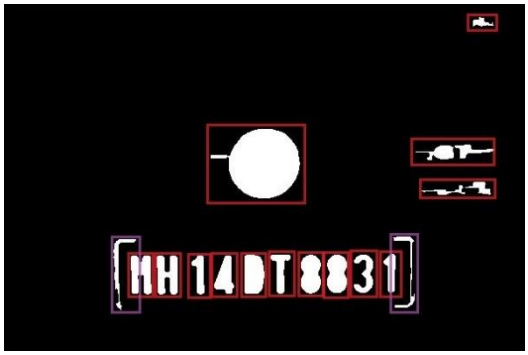

Fig 9. Image after applying Bounding Box

Once the algorithm execution is completed, the data extracted from the image is displayed in a separate window as shown in Fig 10.

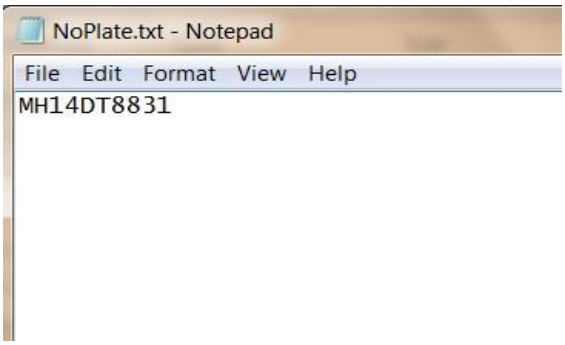

Fig 10. Message Box displaying the output

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IV. CONCLUSION AND FUTURE WORK

The above algorithm was tested on ten different vehicle number plate images. An accuracy of 95% was obtained when fixed font and size is used in the number plates. However, when it was applied on different font and sized number plates, an accuracy of 90% is obtained. The present work can be improved to detect vehicle number plates with various fonts and sizes.

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