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Bengali and English Vehicles Number Plate Recognition System using MATLAB

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Abstract*— *Automatic Number Plate Localization and Recognition (ANPR) is a method that uses template matching on images to read the number plate of vehicles. This paper presents a robust method of license plate localization, segmentation and recognition of the character present in the located plate using an algorithm, which is based on pixel. The whole process has been designed in such a way that it can detect the conventional English number plate and can also detect Bengali alphanumeric number plate with adjoined Bengali letter by an easy and efficient algorithm which is robust to work and less time consuming. The ANPR systems are largely recommended for security system like traffic monitoring, electronic toll collection, and surveillance device and safety supervision. This whole system has been developed using MATLAB R2009a.

Index Terms*— *ANPR, Character Recognition, Number Plate Localization, Template matching.

I. INTRODUCTION

ANPR is an image processing technology used to identify vehicles by their license plate. Characters has been extracted by pixel based algorithm where both English and Bengali characters are included. This paper has been summarized in four steps, (i) Localization, (ii) Plate Extraction, (iii) Character Segmentation,(iv)Character Recognition.

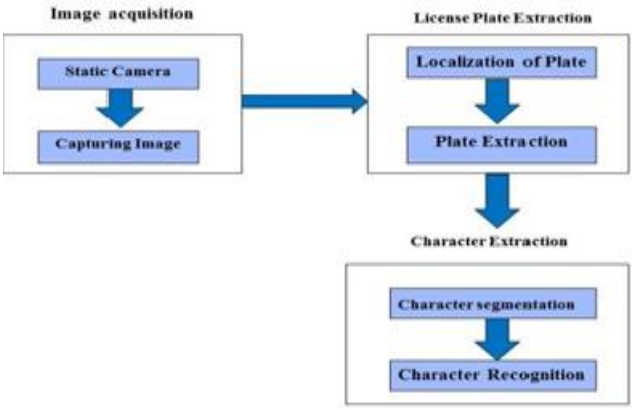

Fig. 1: Structure of ANPR system

II. LOCALIZATION

After capturing the image by using a digital camera (usb) with definite distance of 4-5 meters, it has been inserted in Matlab
to convert it in RGB to grayscale to binary process. First the image has been converted into grayscale by a Matlab tool (rgb2gray (Image)), but the range of this gray scale image is also(0-255) for one unit, so using another Matlab tool im2bw (image, threshold) the gray scale image has been converted into binary image, where the range of binary image is only zero and one(0&1), where the zero (0) implies black color and block the vacant space without the region of interest and the one (1) will stand for to localize the region of interest with having white color. The threshold value has been identified using Matlab tool. Then the Area, perimeter, Pixel List, Major Axis Length, and Minor Axis Length has been found out in order to calculate the boundary of that image and after doing all these processes the area of interest has been identified and plate was localized.

Fig. 2: Localized Image

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III. Plate Extraction

Plate extraction is the next step after localizing the number plate. This has been done by clipping. Clip function crops the white letter with black background and the dilation operation has been applied to the image for separating the characters. Horizontal and vertical smearing applied after this operation with a view to finding the character region and the next step Number plate extraction has been done by finding starting and end points of characters in horizontal direction. The extracted license plate is shown in figure 3.

Fig. 3: Extracted License plate

IV. Character Segmentation

The character segmentation acts as a bridge between the license plate extraction and optical character recognition modules.. If the segmentation fails, a character can be improperly divided into two pieces, or two characters can be incorrectly merged together. The analysis of image requires large amount of low level of data, which is in pixel to be extracted into meaningful information. A horizontal projection of a number plate could be used for the segmentation, or one of the more sophisticated methods, such as segmentation using the neural networks can be deployed. There are many factors that cause the character segmentation task difficult, such as image noise, plate frame, rivet, space mark, and plate rotation and illumination variance. The proposed algorithm in this paper is quite robust and gives significantly good results on images having the above mentioned problems. For segmentation of vehicles license plate, grayscaling, binarization, shape analysis and connected component analysis have been used. Grascaling is used here to produce a gray scale image from a RGB image. Grayscaling process improves the quality of the image for later computational processing. Other pre-processing techniques have been used to improve the quality of the image including image de-blurring, image enhancement, image fusion and image reconstruction. Image fusion is a process to enhance the image with multiple combinations of images. This technique integrates multi resolution image and produces a composite image using inverse multi-resolution transform. After that, a template of image from a grayscale has been shifted to vertical and horizontal direction. The contrast frequency is calculated for each position in the template and a new image using thresholding procedure has been created. Any color below the threshold has been set to back (zero) and any above the threshold has been set to white (one). The value determines the gray level resulting black and white image. A trained feed forward neural network (FFN) with Block Recursive LS algorithm has used to process car license plate. The location of the car license plate has been extracted using Discrete Fourier Transform (DFT). DFT has identified maximum value of horizontal and vertical edges. Then binarization process has been used to convert the grayscale image into black and white image or “0” and “1”. Previously, the gray scale image consisted of different levels of gray values ranging from 0 to 255. To improve the quality and extract some information from the image, the image is needed to be processed a few times and thus make the binary image more useful. Gray threshold value of an image was required in the binarization process as it is important to determine whether the pixels (that having gray values) has been converted to black or white. There may have some noise during segmentation. By using filter this noise should be removed. Different noise filter has used to remove this noise. In pixel based algorithm the noise has removed according to the pixel value of the noise [5]. Shape analysis is a technique that discovers the allocated structure. Firstly the connected component of the image has been calculated and then tried to find how many objects are there in that image [10]. Then Matlab built in function has been used to measure those objects’ Major axis length, Minor axis length, Area, Pixel Index List, Pixel List etc. To calculate connected components “bwconncomp” tool has been used.

After finding the connected components, the unwanted components have been removed by making a margin of their pixel values. Finally connected component analysis has been used to segment the license plate and same procedure has been executed in the clipped image for extracting every character separately. Connected components labeling is used to scan an image and group its pixels into components based on pixel connectivity, i.e. all pixels in a connected component share similar pixel intensity values and are in some way connected with each other[9]. Once all groups have been determined, each pixel is labeled with a gray level or a color (color labeling) according to the component it was assigned to. The vehicular number plates maybe of Non-standard forms and may vary in their fonts. The elements of output image are integer values greater than or equal to 0. The background pixel level is 0 and the pixels labeled 1 make up one object. Therefore individual characters can be obtained, which can be stored in an array format for further work called template matching [10]. The extracted and segmented characters are shown in the Figure 4.

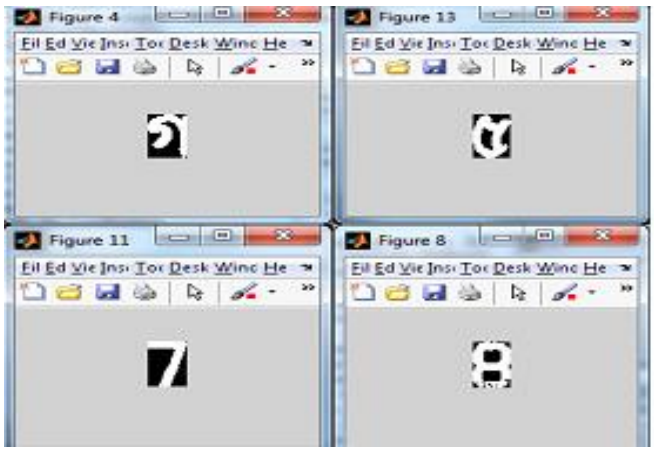

Fig. 4: Extracted and segmented Characters

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V. CHARACTER RECOGNITION

The characters have been recognized for extracting the number for the number plate of any car. The character recognition issued to make a character image normalize for identifying the character then to convert the normalized image to text format or to display the normalized image in the database directly The key part of the identification is the feature extraction and the classification of the organization. The feature extraction is a process of transformation of data from a bitmap representation into a form of descriptors which are more suitable for computers to operate [2]. The recognition of character for extraction should be invariant towards the user font type or a skew is accounted for deformations. Again all instances of the same character should be same in description. A description of the character is a vector of numeral values known as descriptors or patterns [3]. In our paper, template matching has been used for character recognition. For character recognition, template matching is mostly used all over the world. It is the easiest and the simplest method of character recognition. After extraction of characters following processes have been used to recognize characters.

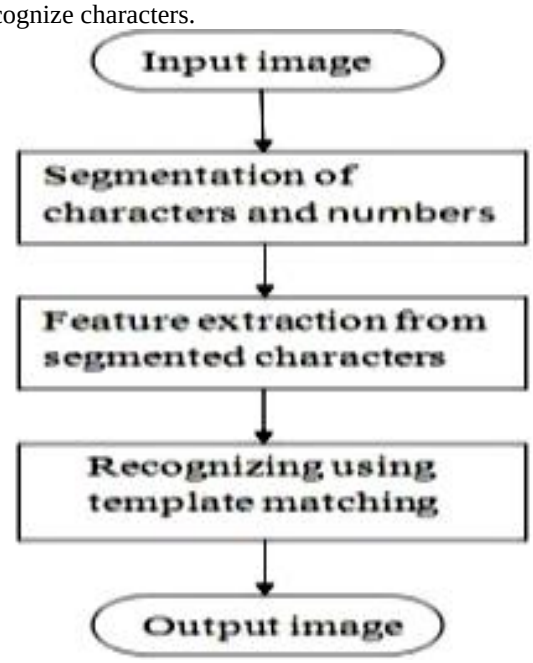

Fig. 5: Flow chart of Character Recognition Process

It has an ability of anti-interference. Compared with other algorithm, it has high recognition accuracy. It has been done by correlating the obtained number images with the saved number images. A function is defined to represent the output variables as an input. This function that precedes it, 'Objects' as number of characters and 'ImgChar' as an array of sub images. The output variable 'strPlate' who's content is a set of char type elements corresponding to the identity of each character. The procedure is called template matching, and it has compared to the image obtained from each sub-image of our program with a predefined template [11]. These comparisons are based on finding the maximum correlation, i.e. the maximum similarity between the real image and the template. Every character is tested at each position and the highest probability has been stored along with its position and thus the highest character match is selected. The position of that character is then used as reference to step to the next position and the process has repeated. After location and segmentation process, every characters has been saved in (24*42) length of bit map file (bmp) for matching with previously saved template characters. A structure has been created by us where images have entered for each of the 10 possible digits that are random outputs of the previous function. The template matching has been performed differently in the number of characters 0 to 8. For instance, when real character 6 will match with saved template character 8, then there will be an overlap in 8 and in this real time the real character (6) won't take after the saved template character (8) exactly so the possibility will go to greater or less than 1 in contrast, at the time of matching 8 with 6 the same incident will happen and this procedure will be continued until it matches the real character (6) with the saved template character (6) and this procedure has been conducted consistently till the real and saved characters correspond properly, which leads the possibility 1.Before algorithm recognition, the characters are normalized The recognized characters for are shown in figure 6.

Fig. 6: Recognized Image (English Font)

VI. BENGALI NUMBER PLATE EXTRACTION

The algorithm that has been used to detect the English number been has also been used in this case. First the number plate has been localized. Various operators have been used to localize the number plate. These are sobel edge detector, canny edge detector etc. These edge detectors have used to high light regions with a high edge magnitude and high edge variance has identified. In our paper, first the connected components have been calculated and then the area, major axis length, minor axis length etc. are calculated. Using major axis length and minor axis length the number plate has been found out. During the processing of localization some noise may attached to the image. Various filters are available to remove these noises. Among these Linear filtering, Median filtering, Gaussian filtering, Adaptive filtering etc. are common. As pixel based algorithm has been used no noise filter is needed to remove the noise. The pixel based algorithm itself has been used as a noise removal filter. Thus the license plate for Bengali alphanumeric system has been recognized. Then the number plate has to be extracted by clipping function. Clip function crops the black letter with white background and the dilation operation is applied to the image for separating the characters from each other when the characters are close to each other. Horizontal and vertical smearing applied after this operation with a view to finding the character region. To cut the plate is the next step and it is done by finding starting and end points of characters in horizontal direction. The extracted license plate is shown in figure 7.

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Fig. 7: Extracted License plate

Then grayscaling process is brought under operation to produce a gray scale image from a multicolour image. The threshold of an image is calculated to separate the object of interest from the background [14]. Same procedure which was used for the English front where followed to obtain connected components and various lengths (major axis and minor axis etc) and to remove unwanted components in order to clip the number plate with individual character). The vehicular number plates maybe of Non-standard forms and may vary in their fonts. The elements of output image are integer values greater than or equal to 0. The background pixel level is 0 and the pixels labelled 1 make up one object. So therefore individual characters are obtained, which are stored in an array format for further work called template matching [11].The procedure which was analysed in character recognition part was repeated for template matching of Bangla character. The recognized license plate is shown in figure 8.

Fig. 8: Recognized Image (Bengali Font)

VII. Future Work

Though the ANPR system has fulfilled most of the requirements in security system but it still has some interesting scope which can be addressed in the future. There are still some Bangla words that can't be recognized, because Bangla alphabets are adjacent to each other. The feature of the camera (robustness) and speed can be increased by using a high recommended digital camera/ webcam.

VIII. Conclusion

The ultimate goal is to obtain vehicle information from license plate recognition system and extraction of license plate is the key part of vehicle number plate recognition system. In this paper, the algorithms of image processing and segmentation which are based on the analysis of character recognition system have been accomplished by using template matching system.

IX. Acknowledgment

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Nafiz Ahmed Chisty, has completed his Bachelor of Science in Electrical and Electronic Engineering (EEE) from American International University-Bangladesh (AIUB). He stared his teaching career as a Lecturer at Electrical and Electronic Engineering Department of AIUB, Banani, Dhaka in January 2006. Since then he has been teaching as a Full-time faculty, conducting both theory and laboratory classes for the undergraduate Engineering students. He has also supervised several final year graduate and undergraduate thesis groups. After working for 2 and half years, he took study leave and went to Lund University (LTH), Sweden for his Master's in System on Chip (SOC) design. After the successful completion of his Master's program, Mr. Chisty has returned to Bangladesh and currently working as an Assistant Professor and Special Assistant in the Department of EEE at AIUB. His research interest is on ASIC implementation of wireless technologies (MIMO, OFDM).

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