ISSN 2278-3091
Volume 9, No.3, May - June 2020
International Journal of Advanced Trends in Computer Science and Engineering
Available Online at http://www.warse.org/IJATCSE/static/pdf/file/ijatcse195932020.pdf
https://doi.org/10.30534/ijatcse/2020/195932020

Automatic number plate recognition

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ABSTRACT

We live in a world where; a new technology is being invented every day. In earlier days, books were the major source of information. Optical Character Recognition (OCR) plays an important role to archive the information obtained. The need for reformation of vehicle between reality and the information system has led to the need of OCR system in vehicle's name plate recognition. OCR converts written information to a machine-readable format. In this format information becomes accessible at any time or place. The automatic number-plate recognition (ANPR) use OCR technology where the writings on the number-plate are extracted from the scanned image. This method helps to retrieve many other details about the vehicle using the extracted characters.

The implementation of the system uses coloured number plate image. It includes majorly two stages-The first stage is to convert the image of the number plate into text and the second stage is to process the text obtained from the number plate that is the recognition. Most of the OCR systems follow the same procedure which comprises of image acquisition, pre-processing, character segmentation and character recognition. The main advantage of using OCR systems is high speed, decreased error and less effort.

Key words: ANPR, OCR, Template Matching, MATLAB, ACPS

1. INTRODUCTION

OCR is Optical Character Recognition uses optical mechanism to automatically recognize the characters from the scanned copy, images, etc.[5]. OCR is the way of extracting characters by electronically identifying the typed or handwritten characters using scanner and software. The number plate recognition is an application of OCR, where the number plate is captured and then identified using the text obtained. It is one of the technique for automatic vehicle identification. This technique is also called as Automatic Number Plate Reading (ANPR). Earlier days, this ANPR was used for security systems to control access of vehicles. Recently, as its reliability is improved, the recognition rates go up to 65 to 75%.

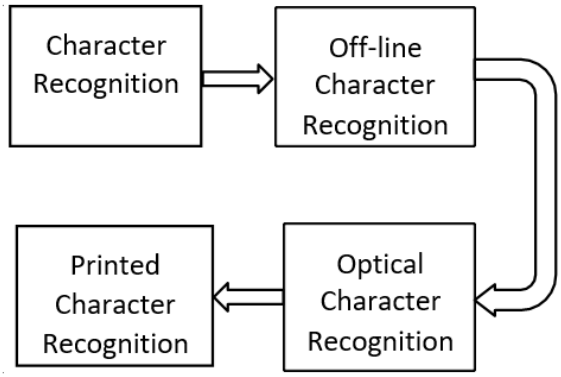

Figure 1: Block Diagram of Optical Character Recognition

There are many variations in the OCR system depending on the method of extracting every possible character in the image, which can be printed or handwritten. The figure 1 shows all the types in OCR.

2. RELATED WORKS

There are many related works on OCR and ANPR. In the paper by Ravina Mithe and others [1] an android app is built which converts the text into speech using an OCR engine "Tesseract". Rachit Virendra Adhvaryu [2], the author discuss the different substitute systems for OCR.

Er. Kavneet Kaur and others[3] has proposed a method to test on different ambient illumination images of vehicle. It is derived that distance of camera from image and template matching effects the accuracy. The paper[4], compare results of number plate recognition using 3 separate algorithms. Dr. Madhu Babu [5], the author has proposed a method where the system identifies the vehicle's path by comparing the pictures of the vehicles license plate at different locations. The idea here includes the usage of sensor. The paper [6] has used template matching to recognize the characters. Author [7] gives a MATLAB based algorithm which uses morphological operations and dilation on the images. The paper [8] discuss the ANPR system on Indian number plates. The paper [11] discusses about image resizing to maintain uniform dataset.

3. IMPLEMENTATION

There are two types of ANPR - mobile and stationary. Stationary ANPR uses a high-resolution camera to capture

a picture at one attempt. The mobile ANPR uses multiple cameras which captures images in different angles.

When the image is captured it is then it compared with the real time data to identify the vehicle. Practically, the database is updated after certain period of time. We have implemented stationary ANPR using the image from a database. The database consists of previously collected images. The figure 2 shows different steps of ANPR.

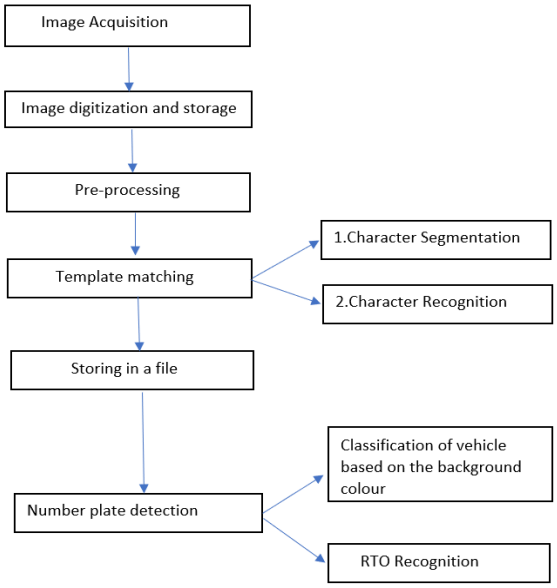

Figure 2: Steps of Automatic Number Plate Recognition

3.1. Image Acquition

An image is usually defined as a 2- dimensional function f(x,y), where (x,y) is a co-ordinate in a 2-D space and intensity is given by I. The position of co-ordinate is nothing but pixel. Pixel is the smallest unit of an image it can also be called as pel or picture element.

The image acquisition consists mainly of 2 process- sampling and quantization. The two methods are used to convert the data which is in continuous form to digital form. Sampling is the process of measuring the values at the sampled point. Quantization is the process of representing the sampled values with only limited set of values. For human perception of fine details, the quantization levels need to be high.

3.2. Finding ROI

To achieve more accurate image we need to select specific region and discard other regions. The specific region is called ROI(Region of interest). We define ROI by Binary mask, where the binary image is the one which needs to be processed. The figure 3 and 4 shows image captured and ROI.

Figure 3: Image Captured

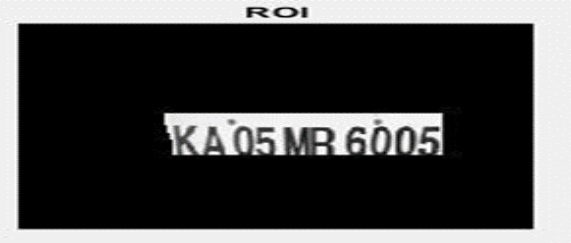

Figure 4: Region of interest (ROI)

3.3. Pre-processing

Pre-processing involves many steps, including conversion of RGB image into a grayscale image [9], calculating the threshold for the image, converting the grayscaled image to a binarized image, noise removal or removal of the lower pixels, determining the brightness of the image and adjusting the brightness to required range [10] and many more. These pre- processing steps act as a major role in optical character recognition. It highly effects the character segmentation, character recognition and thus overall efficiency of the system. The image in the RGB model is represent as the M×N×3 matrix of color pixels [3]. Similarly, the grayscale image is represented as only M×N matrix.

Conversion from RGB to grayscale is done by first eliminating the color and saturation component without altering luminance values. We have used Global image thresholding using Ostu's method. We compute threshold and use that value to binarise the high intensity image. Threshold is a normalized value ranges between zero and one. Ostu's method chooses the threshold to minimize the intraclass variance of the thresholded black and white pixels. Image binarization is the method of converting all the pixel values of the image to align between the only two values, that is [0,1]. Figure 5, 6 and 7 shows the RGB, Grayscaled and Binarized images respectively.

Figure 5: RGB image of number plate

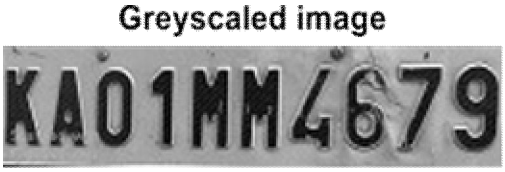

Figure 6: Greyscale image of number plate

Figure 7: Noised Binary Image

3.4. Noise Removal

The noise removal process is removing the noise in the image by eliminating the pixels with low values. The

function modifies the binary image by removing of all connected components that have pixel value lesser than the input pixel and produces another binary image. Figure 8 is the denoised binary image.

Figure 8: Denoised binary image

3.5. Template Matching

Template matching includes both character segmentation and character recognition [3]. Template matching technique is different from other methods because in this method we will not extract any features. In this method we compare the matrix containing the image of each character directly with the stored images. The correlation between the current character image and all the images in the training set is found and best match is returned. This flow is showed by figure 9.

This method is easy and efficient and used in many OCR systems. However, this method is quite sensitive to noise and style of the characters. There is no technique used which can recognize the rotated character. Because the images of number plates have less noise, less style variations and are not rotated we use Template Matching in our project.

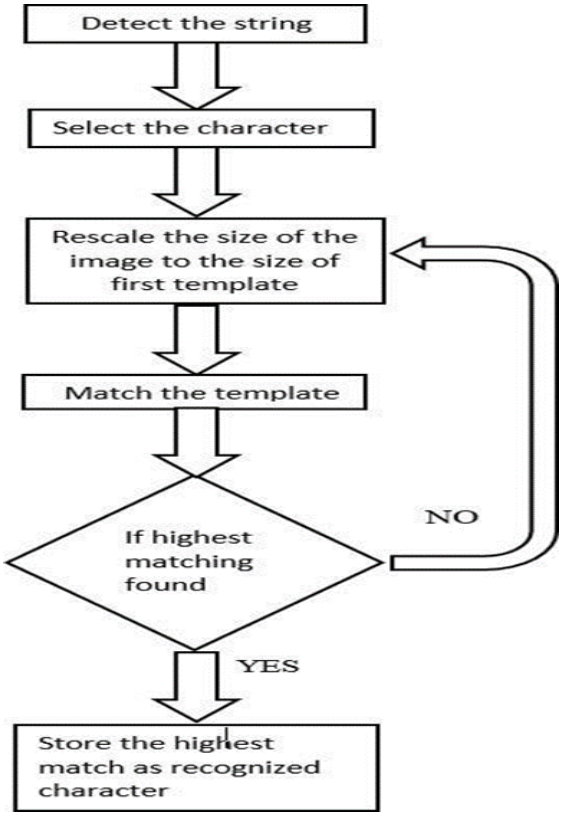

Figure 9: Workflow of template matching

3.5.1. Character Segmentation: The character segmentation is considered to be the decision step in the Optical Character Recognition[3]. It is a process of decomposing images into individual sub images. In an image the segmentation involves, finding the next character of the image in the document, extracting the features of the image and finally matching the obtained character with the existing data set. The same is repeated until the last character of the image. The segmentation decision is independent of previous results. There are two parts, line crop and letter crop. The line crop and letter crop work in a nested loop, where letter crop comes inside the line crop. The code first identifies each line after which each letter in the line is identified. This is done until every line, letter is covered. Since we have used the number plate detection, we have used only the first iteration of the loop as number plate contains only one line. The letter crop is done to each line. Each character of the line is recognized.

3.5.2. Character Recognition: After the segmentation of character, the bitmap image of each character is obtained. In character recognition each bitmap image is mapped into corresponding character. This step is done by creating the global template of bitmap images of all the character and comparing each obtained bitmap image of character with the template and finding the best match. Recognition includes two steps creating the template and reading the character. Template specify the default formatting and fixed content for the report, templates in our project is the set of bitmap images of each character of resolution 24×42. Reading the letter is a function used to map the bitmap image to the corresponding character. The function computes correlation between the bitmap image and the templates. The input image must be of resolution 24×42.

3.6. Storing and Recognition of Number Plate

The character returned from the character recognition must be stored for future development. It is stored as a text file as a string of characters in .txt format. A number plate of any vehicle in India typically contains four parts [8] as shown in figure 10. The state or union, RTO, vehicle classification and information on owner of vehicle. We are also detecting whether it is commercial or private transport based on the background color of the image.

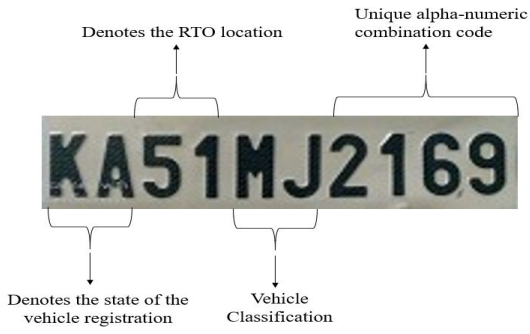

Figure 10: Indian Number plate parts

4. RESULT

The accuracy of the OCR system generally measured as character and word accuracy. As our input which is number plate includes single word, the accuracy of our system is

measured in the character level. Speed of the OCR system is measured in ACPS, which is nothing but accurate characters per second. The 11 and 12 shows the number plate image and text extracted respectively.

Figure 11: Image displayed by MATLAB app

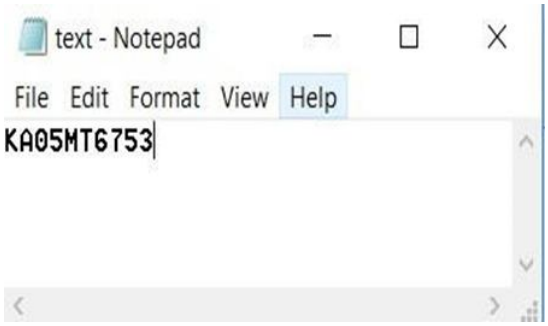

Figure 12: Text extracted in .txt file

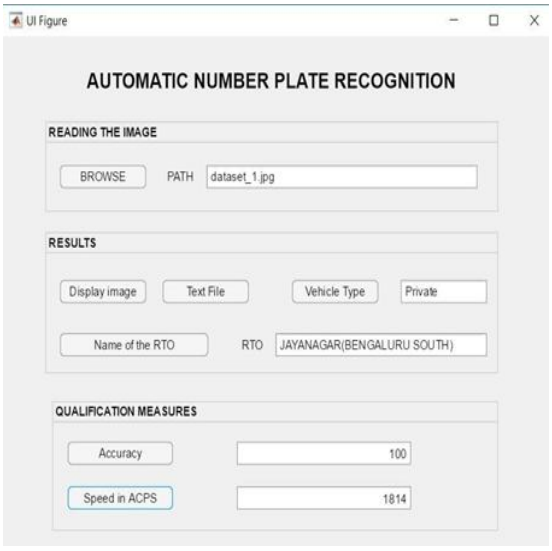

Figure 13: MATLAB application of ANPR

As shown in the figure 13. The results include identifying the type of the vehicle (Public or Private), retrieving the text from the number plate and RTO location of the vehicle. The overall accuracy achieved is in the range 90-100 percentage and Speed of the OCR system is around 1800 ACPS.

5. CONCLUSION

The main object of the project is to implement the idea of Automatic Number Plate Recognition using OCR. Our project focuses on the number plate recognition which helps for traffic surveillance and for the record purpose. We have adopted a method in the project which is comparatively efficient and easy to use. The processing includes noise removal, changing the image format, segregation and finally recognition. We have trained in a such a way that it is very accurate when it comes to recognition. The project mainly helps the traffic police to prevent the traffic violation by the people. The ANPR has also evolved with the growing technology. It has proven to be useful in many areas related to vehicles.

6. FUTURE SCOPE

In any project there is scope for future expansion, and we can improve our system by adding these features.

- Using the number plate, we can detect the vehicle details and its owner information. But these details are confidential, and we cannot have the access.
- This method can be extended to the international number plates by modifying the formats.
- This technique helps in maintaining a record of the vehicles which are supposed to be parked in a specific place like apartments, technology parks etc.
- This technology can be implemented in smart city concept.

ACKNOWLEDGMENT

The authors would like to thank the management of BMSCE, Bengaluru for financially supporting this work.

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