

Automatic Number Plate Recognition

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Abstract- Number Plate Recognition system is a security system. Image processing concept is used in Number Plate Recognition system. OCR (Optical Character Recognition) scheme is also applied in this for reading the image of vehicle number plate. Number Plate Recognition system is used for many purposes like tollway authorities uses this system for allowing the vehicle to enter the toll road by detecting their number plate automatically and provide them with pay-slip and then open the road for that particular car. Parking authorities also use this system for allowing the vehicle to park in their area. In this system, firstly we capture the image of number plate then process it and read each and every character present in the number plate for their perfect recognition. The most significant phase is OCR, where the letterings on the image of number plate are changed into the texts which can be decoded later. In this given research paper, a full algorithm and network flow for ANPR and its efficient applications are shown. The concept of ANPR system is based on the matching of templates and exactness (result) of this system was established as 75-85% for Indian number plates.

Keyword: Automatic number plate recognition (ANPR);

Optical character recognition (OCR); thresholding; template matching

I. INTRODUCTION

A large enhancement in today's information technologies regarding all the fields/areas of work in present time initiated the demand for handling vehicles as theoretical means in information systems. Study of important information provided by vehicles for actuality and information purposes can be done by a person or by distinctive brainy kit which is capable to identify vehicles by their number plates in a actual world and redirect it into a theoretical means. As the number of vehicles is increasing day by day, it is a difficult task to find a car park for a huge number of scholars and professors at Scholastic Institutes or in the multi-storey buildings. A large number of car parkings are managed by hand via security guard who is not interested in keeping a record of the count of vehicles arriving and departing that parkings. This

creates an inconvenience for the vehicle driver to find a vacant space for their car to park that leads to a consumption of more time in addition not to forget the unease and hindrance that driver feels. Sometimes absenteeism of the safe keeper may cause robbery of the vehicles.

It is not a good idea/way to rise the number of car parks areas to include the rising figure in vehicles, thus creating an operational ANPR is the best way for this issue. In the recent years, the ANPR has grown into a beneficial technique for vehicle's inspection. Mainly, an ANPR system contains three core steps: 1) Number plate area detection, 2) Breakdown of characters, and 3) Optical Character Recognition (OCR).

In the last step, each and every character is separated from the Number Plate so that only beneficial figures/facts are obtained for recognition [1]. Numerous count of research papers were checked for getting appropriate data about ANPR centered applications. Systems of the ANPR are born on joint methodologies such as Artificial Neural Network, Probabilistic neural network, Optical Character Recognition, MATLAB, Configurable method, Sliding Concentrating window, Back-Propagation Neural Network, Support Vector Machine, Inductive Learning. In this paper, a template matching technique is used in implementing the ANPR system for number plate recognition of vehicles. The objective of this system is to recognize the vehicle's number plate by matching the template scheme.

The rest of the paper is organized as follows. A review of various existing methodologies has been presented in section 2. In Section 3, we present different methods and algorithms used for recognising the number plate region In section 4, we provide experiments and simulation results. In section 5 we present conclusions and scope of the future work.

II. EXISTING METHODOLOGIES

PC knowledge and character recognition, processes for certified plate recognition plays a main part in analyzing of licensed number plate. Hence, the basic components of any ANPR system is being developed. Number Plate Recognition scheme comprises of a camera, an edge capturing device, a PC, and custom intended software for image handling technique, examine and recognition.

Over the last few years researches are going on regarding vehicle identifications. Some of the studies have been done just to analyze the category of vehicle for example a car, van, bus, scooter or motorbike. In [12], Sobel filter technique is useful in recognizing the type of vehicle accurately. Edges of a vehicle can be found by this technique. There are some techniques that are used to find out the model of the vehicles such as -The Contour let Transform and Support Vector Machine. To get fully assured about these techniques, these were practically done & analyzed. In [11], Maximum Average Correlation Height filter and Log r-theta Mapping methods were applied to analyze the category of automobiles. For revealing of region of interest in messy/jumbled situation, MACH filter was used.

In [14], Optical Character Recognition method, which is a widely used tool for mechanical or electronic conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo or from subtitle text superimposed on an image. OCR software pre-processes the images to enhance the chances of successful recognition. The two non-intersecting images data sets were used to copy the actual-world cases where the neural network will be subjected to. Artificial Neural Networks are vastly used intelligent calculating design for recognition of patterns. The best common used ANN is the multilayer feed-forward neural network which has a meek structure that can categorize inputs into a set of target groupings. Basically, the workings completed in [15] and [16] use information mining to manage the contributions of neural network separately, the prior one is the supreme basic method used for neural network, which can attain decent enactment even under rough situations. In [17], recognition rate can be improved by a two stages hybrid OCR scheme. This scheme includes the independent recognition of input character by four statistical sub-classifiers and then uses the Bayes' method [17] to combine the results. Moreover, if the documented character from the first step fit to the collections of similar characters (e.g. A/4, B/8 and S/5), then an operational stage is used for a further differentiation. In [14], MATLAB software has been used for the execution of the procedure on a computer having a Dual Core 2GHz and 8GB of RAM. It has also been used to generate the masses of neural network. Approximately 6450 binary images with different tenacities were used. To begin with, resizing of the binarized images of the characters to the identical size is done. To pick the accurate size, different sizes of input images have been used. Large character images can be used to achieve high recognition

rates however this will end up in extra multifaceted arrangement of the neural network as the count of masses will rise. The size that delivers a finest proper outcome is used for the concluding neural network. All the systems discussed for identification of vehicles and recognition of number plates in the works study has its specific pros and cons.

III. PROPOSED METHOD FOR LICENSE PLATE DETECTION

The objective of this segment is to provide a detailed information about how to find a number plate in the captured image? Generally a monochrome camera with colour camera is used in ANPR system.

Finding out the number plate area is a needed pioneer to certified plate identification. We can combine the approaches used to trace the number plate's position or section in images into three processing categories. To recognize separated characters, some processes use pattern image, grayscale, and colour. Character separation is a crucial method for recognition of characters, which we can similarly separate out /matching of template or learning-based classification. The flow chart explained in Figure. 2, shows the various method involved in recognising the plate numbers.

A. Binary Image Processing

This method is used to mine license plate regions from background images as shown in Figure. 1, it is a combination of edge statistics and morphology techniques. This process has achieved a 98 percent recognition rate from 9,745 images—supposing that the number plate frame's edges are perfect and plane. Moreover, this method of extracting characters from the binary image to define the no plate region is time-consuming because it processes all the binary objects. Furthermore, it gives an incorrect result if there is other text in the image.



Fig. 1. Binarized image

1) Gray-Level Processing

Greyscale Images are those images which contain only a single value that is each pixel has only a single value, they carry only the information of intensity under them. They are also known as black and white image or a monochrome image as they mostly in grey colour the intensity is divided in such a way that black has the lowest intensity while white has the strongest. We firstly start by converting an color image into an greyscale image. The expression is:

$$R = \text{rgb2grey}(p)$$

Where R is the greyscaled image and p is the color image.

2) Color Processing

Color processing is a fundamental step in image processing as well as for plate recognition as in most of the countries certain norms are fixed for the plate color and nos like in india the vechiles have to keep the letters in black with a white background. But due to poor lightining conditions and plate location the output is not efficient that is why we need color processing so as to have an accurate retrieval of characters with greater efficiency.

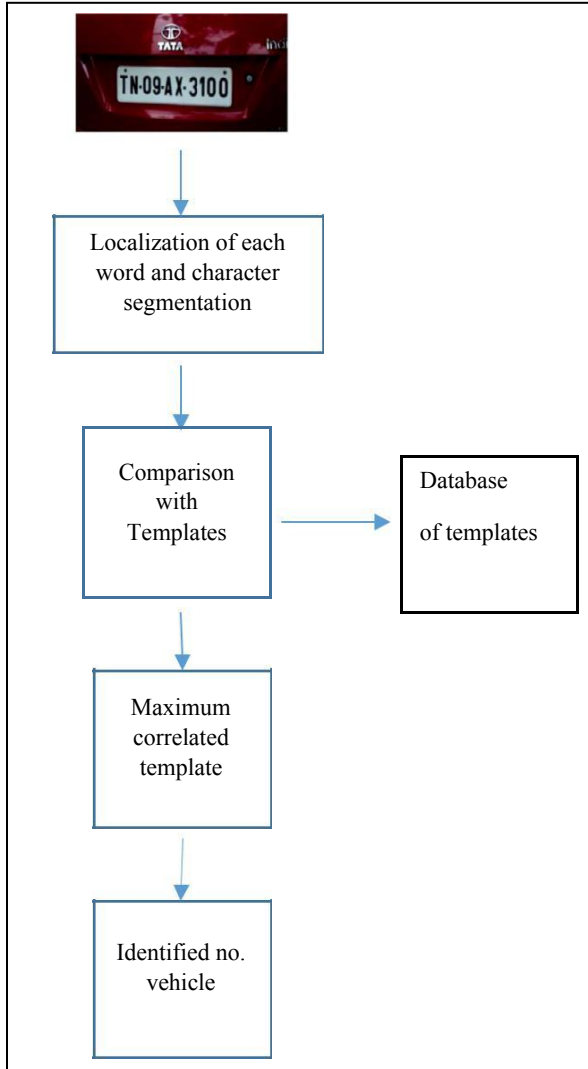


Fig. 2. Block diagram of system for car number plate popularity the use of Template Matching

B. Adaptive Thresholding

Before proceeding with thresholding the images must be converted in greyscale. Thresholding is done so as to create a binary images. Adaptive thresholding is a process in which a threshold value is calculated and then each pixel is compared with that constant(threshold) value and replaced with a pixel of black colour if the value is less than the constant value or a white pixel if the value is greater than the constant value. The threshold value is calculated taking an average of the local values of pixel

On the basis of local mean of pixels intensity, the adaptive threshold is formulated:

$$O(X,Y) = 255 \quad I(X,Y) < \alpha + \beta$$

$$O(X,Y) = 0 \quad I(X,Y) > \alpha - \beta$$

Where I and O are the input and output images respectively. The window size parameters, m and n , are chosen based on the characters size in the region.

C. Contrast Extension

To expand the contrast of the image we have to perform the process of histogram equalization. Contrast extension process increases the sharpness of the image. Gray level histogram of an image indicates the brightness of a pixel. Histogram equalization is done to improve the quality of an image which has a very poor contrast. The total process is divided in four steps: (i) summing up all the histogram values (ii) dividing these values with the total no of pixels so as to normalize the values. (iii) enlarge these values with the highest grey level value. (iv) chart the new grey level value.

D. Median Filtering

Median filter is used for removing the undesirable noises in the image. In this method a matrix of 3x3 is passed in the image. According the noise levels these dimensions can be adjusted.

This process involves sorting of all the pixel values orderly, and then replacing the pixel being considered with the median pixel value.

E. Character Segmentation

By using the Regionprops function of MATLAB the characters of the resulted number plate region are separated which gives us the defined boxes for each of the characters. The smallest defined box that contains a character is returned by Regionprops function. This method is used to obtain the defined boxes of all characters in the number plate.

F. Feature Extraction

In Feature extraction process we find, we mark, and save all the features from the number plate segmented. To recognize the character in number plate images we use zonal density feature. In Zonal density function image is divided into different areas and object's pixel in each of the area is been counted. The density of each area is the total object's pixel. Total area in the image equal to total features acquired in the image. For 16 zonal density we divide a 32x32 image, so that in an image there are 16 features. In order to be divided into 16, 64, 128, 256 zones the pixel should be 32 x 32.

G. OCR by use of Template Matching

One of the Character Recognition techniques is template matching. It's miles the procedure of locating the region of a sub-photograph called a template, inside an picture. Matching of templates entails figuring out resemblances between a given template and home windows of the same size in an image and figuring out the window that produces the very best similarity degree. it works by comparing each and every pixel of the photograph and template for every feasible template displacement. This method involves the use and help of a database of characters or templates. For all feasible input characters there exists a template. for every alphanumeric characters templates are created (from A-Z and zero-nine) the use of 'regular' font style. figure 3 demonstrates the templates for few of the alphanumeric characters.

For acknowledgment to take place, the present information character is contrasted with every format to discover either a feasible match, or the layout with the nearest portrayal of the information character. It can catch the ideal position where the character is by moving standard layout, in this manner do the correct match. Moving the layout coordinating technique depends on the format of the target character, utilizing the format of standard character to coordinate the objective character from eight bearings of up, down, left, right, upper left, bring down left, upper right, bring down right. The consequences of layout coordinating for character acknowledgment on a portion of the Indian number plates taken from static pictures are appeared in Table 1. The pictures of number plates utilized for format coordinating are appeared in Figure 4.



Fig. 3. Template creation

TABLE I: Results of Template Matching

Actual Plate	Predicted Plate	Mismatched Character	Accuracy
TN 09 AX 3100	TN09 AX 3100	0	100%
TN 11 K 3613	TN 11 K 33	2	77%
KA 19 P	KA 19 P	3	67%



Fig. 4. Licensed Number Plates used for Matching of templates.

IV. RESULTS

To measure our method and precision we tend to perform our experiment on several prototypes of vehicles with entirely different forms, and dimensions below changing conditions. The method of segmentation did not produce desired results for plates at an associated degree and plates at the edge of picture taken, this confined the accuracy of the algorithm.

TABLE II: Comparison between clustering and character segmentation technique

Actual Plate	Plate	Accuracy by clustering	Accuracy by character segmentation
TN 09 AX 3100	TN09 AX 3100	92%	100%
TN 11 K 3613	TN 11 K 33	69%	77%
KA 19 P	KA 19 P	55%	67%

Our technique achieved commendable outputs: with 82 percent of the letters were able to be recognise in cases where character segmentation was achieved. Comparison between the two methods of character recognition of ANPR has been shown in Table 2. Failed identification came from principally motion blurred or overlapped by unlike vehicles bodies.

V. CONCLUSION AND FUTURE WORK

The existing methodologies on this sketch and algorithms proposed in for quantity and car the no Plate recognition have been seen through. Because of the unavailability of such an ANPR gadget off the shelf in tune with our requirements, it's far our endeavour to personalize an ANPR system for instructional institutions. Template matching become used on quantity plates acquired from static photos and an average Accuracy of 82.6% has been obtained. The accuracy of each character (number 1-9, alphabet A to Z and a to z) has been shown in Figure. 5. This accuracy can be advanced significantly by way of putting the digicam definitely to capture the perfect body and the use of neural networks in two layers. The execution of the given method can be moved further for the popularity of quantity number plates of multiple vehicles in a solo photo body by way of the use of multi-level genetic algorithms. Additionally, a extra easier model of this gadget can be carried out by way of capturing pictures from stationery clip and choosing the great car border for category of vehicles and spotting the quantity plates the use of neural networks.



Fig.5. Accuracy of each character

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