

Automatic Detection of Vehicle Number Plate using Intelligent Template Matching

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Abstract: This work proposes the development of robust and reliable systems for Automatic Number Plate Recognition. Due to the rapid growth of highways and the extensive use of vehicles, researchers launch more interest on proficient and accurate intelligent transportation systems. In such circumstances, it is difficult for identification of the vehicle number plate. The above mentioned challenge is highlighted in Automatic Number Plate Recognition of vehicle. For this, the concept of Optical Character Recognition is used under five stages such as capturing image, image enhancement, feature extraction, character segmentation and individual character identification. The methodology used is Intelligent Matching is primarily used for recognition of character and number of a vehicle number plate. In added to this work, focus for angle related, environmental conditions such as rainy, foggy and vehicle trade mark symbol are included and implemented for detecting the number plate in a faster manner. The matched text can retrieve the vehicle owner details from the database. The database consists of all information like name, address, telephone number, place of registration. The overall performance of the system is efficient and can be applied in cyber security based real-time applications.

Keywords: Enhancement, illumination, localization, neighborhood, morphology.

1. INTRODUCTION

The identification of vehicle number plate is a component in digital image processing. It is widely used to identify the vehicle in transportation system [3]. Number Plate Recognition (NPR) [3] systems control the traffic management system and have ample of applications such as traffic maintenances, tracing of stolen cars, automatic electronic excise collection system. Automatic Number Plate Recognition (ANPR) [1] is a key concept for solving research oriented problems. It has numerous applications in traffic monitoring system, ticketing vehicles devoid of human control, tracking the vehicle, security, and so on. It can amass the images captured and text information from the license plate. For input images, it uses infrared lighting to allow the camera to capture the picture.

In the proposed system, the problem of ANPR for Indian vehicle number plate is taken under the research for recognition of vehicle number plates. The corresponding number plate image can be damaged under environmental conditions [3] such as rainy, foggy, angle rotated, single row others images on number plate have to be included and implemented for detecting the number plate in a faster manner.

ANPR is a technology uses optical character recognition (OCR) [1] [12]. OCR can be used to read images of vehicle registration plates. The software component of the system works on customary domicile computer hardware and can be allied to other applications or databases. ANPR initially use strings handling techniques to identify and progress the image of the number plate. OCR is mainly used to extort the alphanumeric of the license plate. The algorithms for the ANPR with OCR have six algorithms to process and to identify the plate number. The first algorithm is plate localization. Here, the image is initially captured on the screen and then plate orientation and sizing method is applied that balances the skew and corrects the dimensions to attain the favored image size. Moreover, found in ANPR with OCR, is the normalization, character segmentation and geometrical analysis algorithms. The last algorithm and system is optical character recognition. Business entities can formulate enormous use of the automatic number plate identification with OCR in tracking and tracing the target of the company owned vehicles.

In India, the vehicle number plate format is white background with black foreground color for private cars. The commercial vehicle use yellow as background and black as foreground color. The number plate instigate with two digit letter “state code” followed by two digit numeral followed by single letter, subsequent to four consecutive digits. It designates the country code, state code, district code, type of vehicle and the actual registration number. Initially, identify the location of the number plate from the particular vehicle and then segment [1] of all the numbers and letters of the number plate. The recognition task is most demanding because of the temperament of the light. The location error will be mounting if the color of the number plate is comparable to the background. The existence of noise may cause error and less accuracy.

The paper is organized as follows. The related works is explained in section 2. The importance of proposed system, in which the matched text retrieves the vehicle owner details from the RTO database described in Section 3. Results and discussion are highlighted in Section 4. Conclusion highlighted in Section 5 followed by References in Section 6.

2. RELATED WORKS

In [1], it highlights the ANPR problem for Argentinean license plates for robust pattern recognition and shows enhanced results both in classification precision and training time. For successful License plate extraction, License plate localization [4] method can be used. Horizontal Rank Filtering [4] recognizes clusters of enormous density of apparent edges in the region of the number plate. Poor lighting, low contrast, reflection or shadows may generate problems due to over exposure for proficient license plate recognition system. Region based algorithm [5] is used in grayscale images such that it smoothen the non plate regions and eliminates the unwanted edges thereby the algorithm run time decreases considerably and increases the algorithm accuracy. Sobel operator [5] and morphological filtering is applied to extort the vertical edges and the candidate regions. In Iranian vehicle license plate identification [6], MET a new localization method and Gaussian filter is used to split object from the background. SVM [2] recognize the numbers in every cluster after collecting by decision tree. It recognizes merely eight characters in the Iranian license plate. In [8], license plate localization worked on texture and edge component is proposed. Image scissoring algorithm is used to segment into individual characters. This approach is based on some constraint with vehicle being stationary and the image of vehicle can be captured at fixed distance and fixed angle. The input image is the rear outlook image of the car. Macao license plate recognition system [9] such as compound types of plates and disunity of character fonts were conferred

in which before row separation procedure, the plate region optimization was carried out. The algorithm is able to identify license plates in usual circumstances as well as cases with rotation and related background color only. A video processing methodology for a field-programmable gate array (FPGA) [10] based LPR system is commenced in which the raster scan video is used as an input with less memory utilization. Gabor filter [14], threshold selection [11], and CCL algorithms [13] are used to attain license plate region.

3. PROPOSED APPROACH

The various stages of proposed systems as shown in Fig. 1 are (i) Image Capturing (ii) Image Enhancement (iii) Plate Extraction and Identification (iv) Character Segmentation (v) Feature Extraction (vi) Classification using SVM (vii) Detecting owners details.

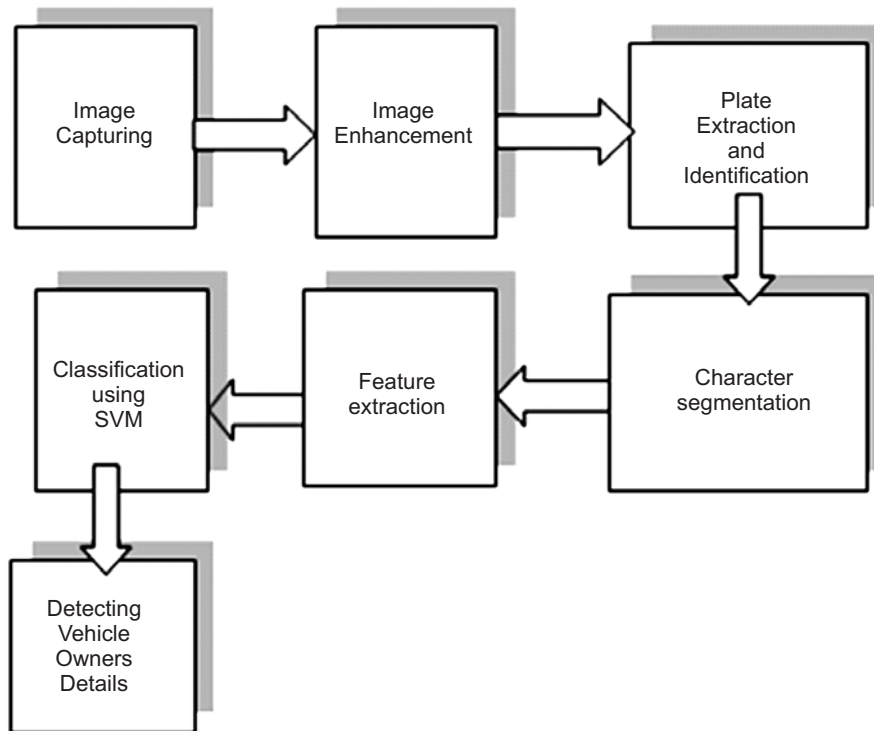


Figure 1: Block Diagram of Proposed System

3.1. Image Acquisition

The primary pace is capturing an image using electronic devices such as optical (digital/video) camera, webcam etc. Here, vehicle images will be taken with a Panasonic FX/Nikon digital camera.

3.2. Preprocessing

In this processing, remove as much background noise as possible is vital. Then optimize the localization algorithm, thereby it saves the processing time. Several algorithms were introduced for localizing number plate such as multiple interlacing algorithms, Fourier domain filtering, and color image processing [2]. These algorithms though do not adequately work for Indian number plates because they presume features like: border for the plate, plate color and character colors. Feature-based localization technique can be appropriate for Indian provisions. To eradicate the outcome of shadows and to remove the stumpy contrast area of an image, binarization has to be performed adaptively.

3.3. Image Enhancement

Here conversion of color image into a gray image can be performed. This method is based on different color transformation.

3.4. Image Filtering

Median filtering is used to preserves edges by removing noise. The Mean Filter [7] is replaced by weighted local means and can be written as

$$\frac{\partial u}{\partial t} = \Delta u \quad (1)$$

The non linear partial differential equation can be written as

$$\frac{\partial u}{\partial t} = |\Delta u| \operatorname{div} \Delta u |\Delta u| \quad (2)$$

Similarly, the total variation minimization can be represented as

$$\frac{\partial u}{\partial t} = \operatorname{div} \Delta u |\Delta u| \quad (3)$$

Median filter substitutes the intensity of a pixel by the median of the gray levels of images in the neighborhood of that pixel and can be denoted in (4) as

$$\hat{f}(x, y) = \operatorname{Median} \{g(s, t)\} \quad (4)$$
$$(s, j) \in S_n$$

3.5. Morphological Image

Morphological processing is a congregation of non-linear operations associated to the contour or morphology of features in an image. Morphological process relies merely on the relative ordering of pixel values, not on their numerical values, and consequently suited for the processing of binary images. Morphological operations applied to grayscale images such that their light transfer functions are unknown and consequently have absolute pixel values.

3.6. Region

To implement efficiently imfill (BW,'holes') function is used which fills the holes in binary images.

3.7. Character Segmentation

A binary image can be attained subsequent to license plate localization. In order to identify the vehicle number plate characters, every character ought to be alienated correspondingly. This is the chore of character segmentation. Here, the characters and digits of the plate are segmented and each is accumulated as dissimilar image. Number Plate segmentation plays an imperative task in ANPR system.

3.8. Character Recognition

This is the most vital and critical phase of the ANPR system. Character recognition process is utilized for categorizing the distinctiveness of the character. In this arena, the segmented characters are rescaled to equalize the characters into a window. For this reason, each character is standardized to appropriate size and then tracks by restructuring to a typical dimension prior to supplementary processing.

3.9. Classification with SVM

SVM is a pattern recognizer that classifies data using hyperplanes from diverse classes. Several hyperplanes are fitted to split the classes, but there is only one optimal extrication hyperplane. The optimal one is anticipated to generalize well in similarity to the others and can be determined by support vectors distributed near class boundaries. The matched text can retrieve the vehicle owner details from the Regional Transport Office database. The database consists of information like name, address, telephone number, place of registration.

Algorithm :

- Step 1:** Preprocess number plate input image
- Step 2:** Convert to gray image
- Step 3:** Filtering the noises in the image
- Step 4:** Perform morphological operation
- Step 5:** Fill and bound the image region
- Step 6:** Extracting the features
- Step 7:** Add these features into the data base
- Step 8:** Recognize the number plate
- Step 9:** Detecting the user details

4. RESULTS AND DISCUSSION

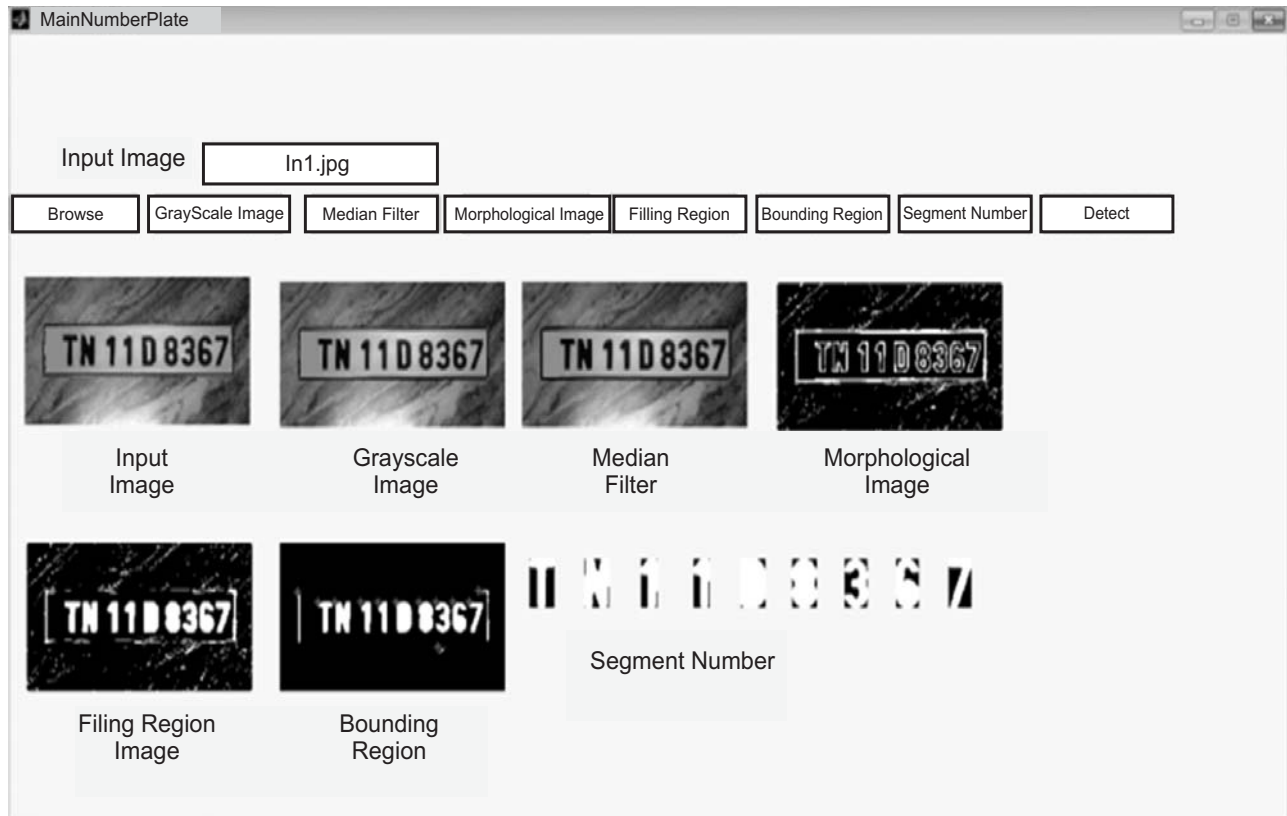


Figure 2: Images of 9 character detection of number plate

A database consists of different sized JPEG colored images. Images are resized to 1024 x 768. 50 images can be considered for testing the algorithm. The images are taken with diverse background as well as illumination surroundings. Experiments illustrate that the algorithm has superior results on extracting number plate and segmenting characters for identifying the images correctly, with noise, illumination variance, and rotation. Fig. 2 and Fig. 3 are

Table 1
Number plate extraction and character segmentation success rate tested on the different types of car image to identify the location accurately

<i>Algorithm</i>	<i>Total No. of images</i>	<i>Success Rate %</i>
Number Plate Extraction	50	85
Character Segmentation	40	80

The number plate extraction and character segmentation success rate for the tested images is shown in Table 1. The timings are calculated by **tic**; **toc** function. The elapsed time can be calculated with **toc** function which is highlighted in Table 2.

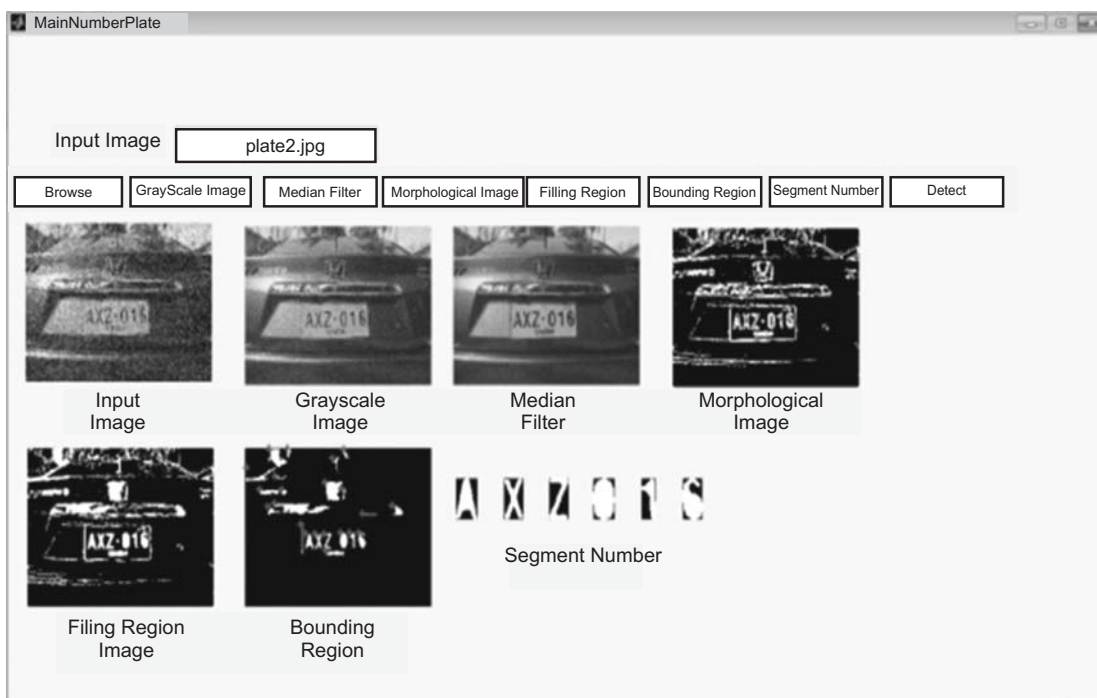


Figure 3: Images of 6 character detection of number plate

Table 2
Comparison of elapsed time for various images

<i>Images</i>	<i>Elapsed time (sec)</i>
Straight Image with 9 characters	.000005
Straight Image with 6 characters	.000004
Inclined Image with 6 characters	.000007
Inclined Image with 9 character	.000009
Foggy Images	.000008

5. CONCLUSION

A novel approach to work out the OCR dilemma via intelligent template matching in the perspective of resolving the ANPR problem for Indian Vehicle Number license plates is highlighted. It launched a innovative method for OCR, by way of rejection of prior training. The research is performed for the image under environmental conditions such as rainy, foggy, angle rotated, single row, other images on number plate, poor lighting conditions. The flexibility of the proposed approach yields numerous paths to be explored in future, such as the likelihood of improving the overall performance via smaller skeletons sizes, or testing added proficient policies for the assessment of character features.

In future, the number plate recognition system can be used for double line detection system. Viewing ability can be improved from 12 degrees to further inclined angles and this system can combined with the automation system such that the details can be transmitted to the emergency wing for the fast tracking of the car.

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