An Efficient Algorithm to Recognize the License Plate of Vehicles

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***Abstract*: License plate recognition has 3 main steps, the license plate detection, character segmentation and recognition of character. After all the characters are read, it is important to accurately segment the characters. The segmentation step may be affected by many factors. Some of it might be frame or edges. For 100 percent accuracy the characters has to be segmented properly. Various image processing techniques are used for the segmentation process and using python code the characters are extracted. It should be useful to the law agencies but are not limited to that itself. LPR technology has a varied use.**

I. INTRODUCTION

License Plate Recognition (LPR) system is an important technique, used in Intelligent Transportation System. It is an advanced machine vision technology used to identify vehicles by their number plates without any direct human intervention. It is an important area of research because of its many applications.
LPR provides the data of vehicle numbers which can be used in follow up, analyses and monitoring. LPR is important in the area of highway toll collection, traffic problems, borders and custom security, premises where high security is needed, like Parliament, Legislative Assembly, and so on. LPR is a form of automated vehicle identification.
LPR is an image processing application used to identify vehicles by their license plates. Real time LPR plays a major role in automatic maintaining law enforcement and monitoring of traffic rules on public roads.
Nowadays vehicles play very important role in transportation. Additionally the utilization of vehicles has been increasing owing to population growth and human desires in recent years. Therefore, management of vehicles is changing into an enormous drawback and much harder to unravel. LPR can be used for the aim of effective control.
LPR system typically consists of 3 major components: license plate detection, character segmentation and license plate (or character) recognition.
License plate detection is a very important step in a every LPR system. The standard of a vehicle plate detector influences the accuracy of vehicle plate recognition. On the opposite hand, many factors will have an effect on the accuracy and potency of license place detection. Most existing vehicle plate detection algorithms area unit restricted by numerous controlled conditions like mounted backgrounds, notable color, or selected ranges of the distance between cameras and vehicles.

In this paper, we have used a learning algorithm based on both global statistical features and local Haar-features to construct a cascaded classifier for license plate detection. There have been number of commercial systems for license plate recognition around the world. Among these systems, two types of classifiers are applied. They are (optical character recognition) OCR-based method and learning-based method. OCR has shown its advantage in recognizing written document or text wherever the background has no or little noise. How- ever, registration code pictures captured in period usually con- tain significant noise and with advanced backgrounds. OCR primarily based recognition needs image prepossessing to get rid of the boundaries before it is properly used for registration code recognition beneath advanced and unrestricted condi- tions. Learning-based approach extracts optimal features of characters to improve the recognition accuracy. This approach heavily relies on the accurate character segmentation.
However, license plate images taken in real-time can be very difficult for proper character segmentation due to image noise, rivet, plate frame space mark, plate rotation and illumination variance.
In this paper LPR work best for Indian cars. Images square measure taken out with totally different different background, illumination conditions and orientation. Median filter, histogram equalization are used which beware of distinction and lighting drawback. Sobel vertical edge detection and mor- phology is utilized to locate range plate. Projection analysis is employed to section the characters gift on the plate. For recognition work model is employed.

II. LICENSE PLATE DETECTION

Licence plate extraction is the key step in LPR system, which influences the accuracy of the system significantly. Extraction of licence plate is difficult task, essentially due to: licence plates generally occupy a small portion of whole image; difference in licence plate formats, and influence of environmental factors. This step affects the accuracy of recognition work and character segmentation.
The main motive here is to first identify the number plate in the image given and then using algorithms divide it into fore- ground and background images. The image of the license plate is brought in the foreground and the remaining image is put as background using various image processing techniques. At different places or position, the area of the image covered was

divided into classes and the classification was done using a already trained classifier as a license plate areaimage(positive) or a non license plate area image(negative).This was done using python code implementation.
The classifier used was SVC. It is implemented on the basis of libsvm. The fit time complexity is found greater than quadratic with the number of samples which makes it very difficult to measure to dataset with more than a couple of 1000 data.The different pre-processing techniques used for the number plate extraction are Morphological operations,Thresholding operation,Vertical edge detection,Candidate plate area detec- tion.When the acquired image are slant by certain degrees the skew correction and angle correction measure is used to first correct the angle of the license plate image and the the above image processing techniques are applied on that.Morphological image is used to give or define the structure of the image.


Fig. 1: Original Image Fig. 2: Morphological Operation


Fig.3: Thresholding Operation Fig. 4:Number Plate Extraction

III. CHARACTER SEGMENTATION

Character isolation from the licence plate region is the significant step in LPR system, which influences the accuracy of character recognition. The goal of this phase, given the licence plate image, is to segment all the characters, without losing detail of the characters.
When we apply the basic algorithms and thresholding image processing technique we sure can get the license plate image area only nut along with that we might get several other features which are of no interest to us,such as frames,logoes,etc. All three of these aspects can cause problems for our character segmentation algorithm, so well need to give special attention as we write our code.The main part of the project is done by the python codes which we have written.These divide the image in segments which are later matched with the trained data for each letters from A-Z and 0-9.The letters are recognized using the trained data set.There is a init file which is just the constructor.For the python file responsible for character segmentation we use many different image processing functions from scikit- image and imutils.The main features for license are

a) 1 or 0 showing if the license plate detection was a pass or a failure
b) Image of the license plate area
c) The threshold part showing the license plate characters
d) Numbers of digits/character candidates that should be successful on to our machine learning classifier for the last detection.

To segment the license plate in to the characters we have to use adaptive thresholding.Simple thresholding and also the Otsu's method are used and using that the segmentation can be done easily.Once we see that all the letters and digits are cleanly separated from each other we apply connected component technique.(shown in the picture below).The main image processing techniques used are

a) Image binarization

As well known, image binarization is to change grey values of an image into binary values and re-represent the image as a binary image accordingly. Image binarization highlights the pixels of interest and suppresses the background pixels. The simplest way for image binarization is to choose a threshold
400 value, and classify all pixels with values above this threshold as white (255 grey value), and all other pixels as black (0 grey value). Otsu [12] gave an idea to select a good threshold globally. Otsus method is based on an analysis of the gray scale level histogram of the whole image and selects an optimal threshold for a given image by maximizing a discrimimant criterion, i.e., the separability of the resultant classes in gray levels. Fig. 3 shows the results of binarization on the images in Fig. 1 after cutting the upper and lower boundaries of the license plates

b) Vertical Projection

Character segmentation is enforced to isolate each character on the licence plate. Vertical projection analysis is used to find the

void between the characters. The characters are segmented based on the figure of valleys in projection. Row and column indices of each character are recorded, and it is extracted from the original gray scale licence plate. This proposed work isolates every letter and digit on the licence plate oriented horizontally in one row, along the width of number plate.

c) Separation of character

In some cases, one character region may have been separated into 2 segments. One other hand, two characters may have been grouped into 1 single character segment because they are connected to each other or due to other reasons. Therefore, as a refining segmentation process, any two segments of which the width is 2/3 smaller than the average width of character segments on the same licence plate are linked into one segment.

Fig. 5: Character Region Enhancement

The region here is enhanced here first for proper segmentation.

Fig. 6: Connected Component Analysis

Fig. 7: Vertical Projection Analysis

The training data for A is shown here. Similar training data is used for letters from A to Z.
Also the data for 0-9 has been trained.

Fig. 8: Training Dataset of alphabet A

Fig. 9: Training Dataset of number 1

IV. GRAPHICAL USER INTERFACE

We developed a user interface for the user to insert the images. The interface is developed using a web application and Django framework. As our code is in Python we use Django framework which is free and open source web application written in Python. Also it helps to develop website faster and easier.

The interface takes the image provided by the user as an input and processes it. It also has option to show the intermediate images. This input is sent to the Python code with the help of Django. After processing, it returns the license plate character in text format which is displayed in a text box. Also, if it is an Indian license plate, it shows the details such as the state in which the vehicle is registered. It is an efficient way to display the result as the user does not have to interact with the code.

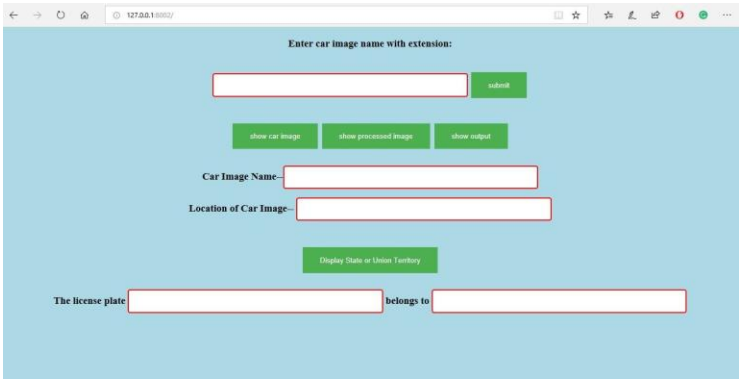

Fig. 10: Screenshot of the graphical user interface

V. EXPERIMENTAL RESULTS

We apply the above algorithm to car license plate images. In total, we have used 20 license plate images for training with 180 characters. All characters are segmented correctly. Our license plate detection has an accuracy of 98%.
Figures 11 to 15 show us how the interface works and the images of segmented and recognized characters.

Fig. 11: The image being given as an input

Fig. 12: Show car image

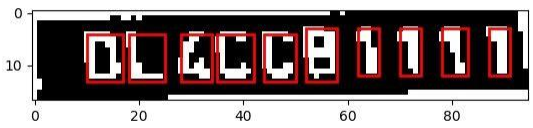

Fig. 13: Show processed image

Fig. 14: Show output

Fig. 15: Display State or Union Territory

Our system has a few constraints in detecting and recognizing the number plates. The minimum height of the character should be 25% of that of the license plate, and maximum height can be 75% of the height of the license plate. The minimum width of the characters should be 3% of the width of the license plate, and the maximum width can be 30% of the width of the license plate. There is a lot of room for optimization to be carried out in the future.

CONCLUSION

In this paper, we have proposed an algorithm for character segmentation of license plates of vehicles. It is crucial after detection of license plates and before recognition. Various well-known techniques such as edge detection, image binarization, and vertical projections are used to get the algorithm in this paper.

The experimental results show that the method is efficient and accurate for character segmentation, and performs very well. Some of the concepts such as detection and localization have been explained in the referenced papers and hence, their detailed description has been omitted here.

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