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Detection and Extraction of License Plate of Vehicles

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ABSTRACT

License plate detection is one in every of the foremost widely-used real-world applications in fields like toll control, traffic site analysis, and suspected vehicle tracking. Issues such as Stealing of vehicles, violation of traffic rules and regulations, entering a place which is legally restricted has been increasing rapidly. Car number plate recognition system could be of great help in order to solve these problems. With the information of the vehicle and data of the vehicle owner, we can stop or lower the risk of any such hurdles.

The main steps in this process includes detection of the number plate which involves Connected Component Analysis (CCA) algorithm, segmentation of characters, Recognition and prediction of the characters one by one. Segmentation of characters plays an important role in the process; the more perfect the segmentation is, the more accurate will be the prediction and recognition. Here I have proposed a one-stage anchor free objector detector so that it can simultaneously detect the regions of the license plates. This paper thus provides an efficient way to segment and recognize the characters that located within the plate. It captures images from videos and pictures and frames them according the pixels. Those framed images are then converted into grayscale images and the further proceedings are followed.

Keywords- Toll controls, traffic-site analysis, connected component analysis, detection, segmentation, prediction, recognition, anchor-free, localization, grayscale.

1. INTRODUCTION

The method that we shall use here is background subtraction. This method isolates or separates the moving parts of a clip by segmenting it into background and foreground is known as background subtraction. It is one of the basic steps in the field of image processing. Based on the changes that takes place in the ground the background is separated. With emergence of new developments in the field of information technologies the requirements up for Intelligent Surveillance Systems (ISS) technologies keeps changing or adding. One of its major roles is to efficiently capture traffic information, track information about accidents and maintain traffic safety. Hence to improve the operational efficiency in this field, it is believed that vision-based information could be of great help.

Identification of a vehicle can be done in an easy manner through License Plate Detection system. License Plate Recognition system plays an important role in many applications like toll payment system to find cars that have stolen before, traffic surveillance etc. For example, in a parking lot, number plates are used to calculate the duration of the parking and are charged according to that duration while also helping them to restrict unacceptable activities. When a vehicle enters the gate of the parking place, the system detects the plate and predicts the character and then searches the database to match which an existing entry. When the car leaves, the number plate is again detected and compared with the data which is already stored in the database. The difference in time is then used for calculate the parking fee. This makes the LPR system convenient and cost-effective automated system.

This procedure usually consists of three major operations: license plate detection, character segmentation and character recognition. License plate detection is an important step in this system. The quality of a license plate detector depends upon the accuracy of license plate recognition. On the other hand, there are many factors that can affect the accuracy and efficiency of license place detection such as low light, less trained models, designated ranges of distances between camera and vehicle, similarities in characters etc. In this paper, we tried to present a system which can rightly and precisely perform segmentation of the characters on license plates.

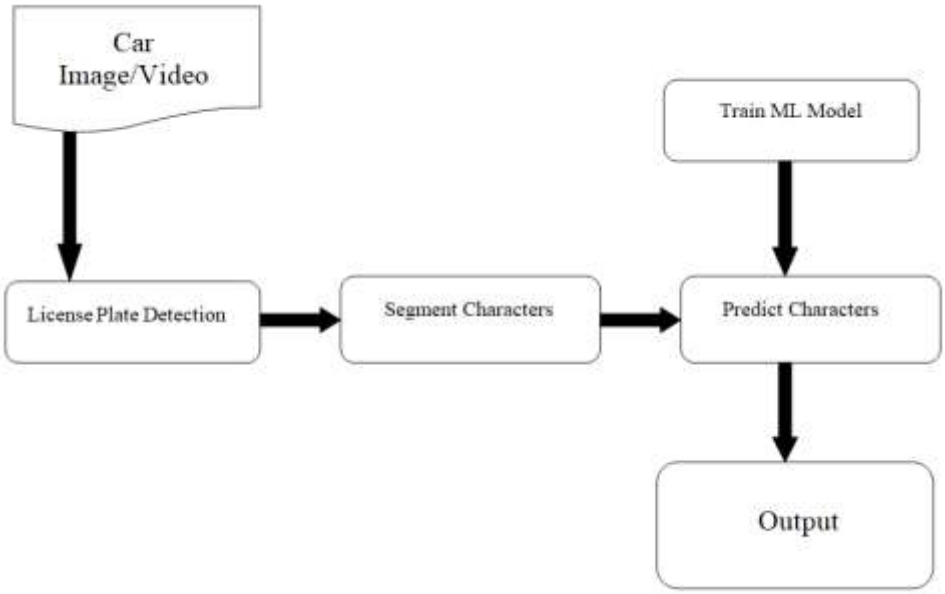


Figure 1. Architectural flow

2. LITERATURE REVIEW

[1] In this paper, authors have discussed the different approaches of Automatic Number Plate Recognition (ANPR) by considering the size of the image, success rate and has taken the parameter as processing time. Throughout this whole process, many constraints for the number plates have been considered into order to receive precise results. Here, the License plate detection algorithm is divided in four steps: (1) Capture of vehicle image (2) Detection of number plate from the image captured (3) Segmentation of characters and the final step (4) Recognition of Characters which takes input from the previous step.

[2] The objective of this paper is to effectively locate standard number plate, segment the characters in it and recognize them when a car image is inputted. The system has considered many constraints such as different angles, distances, scales, resolutions and illumination conditions. This paper mainly introduces a system that uses histogram based morphological edge detection techniques for segmentation of characters. The characters are classified on by one using Artificial Neural Networks and the recognized with the same.

[3] In this paper, the author proposed license plate recognition system by using skew detection for detecting connected components and morphological operations. The objective of this paper is to obtain a useful viewpoint for the License plate detection systems. Some License Plate Recognition (LPR) systems are designed to work under restricted conditions while some are designed to work even in an uncontrolled environment. It is realized that in case of motorcycles the combination of search window method and artificial neural network has given accurate results. But in case of cars, the combination of Fuzzy and SO neural network algorithms has given precise results.

[4] In this paper, authors have proposed a fresh license plate detection and character recognition algorithm using a combination of feature extraction model and BPNN (Back Propagation Neural Network) which works fine in weak illumination and complicated backgrounds. At first preprocessing is done which is used to eliminate noise, boost the contrast ratio of the original car image that has been inputted. Secondly, the whole image is checked and the region of the license plate is extracted in a frame using integral projection method. Finally, using three sets of feature combination, a new feature extraction model is processed.

[5] In the proposed system, the authors have designed a system for detection of license number plates. Firstly, the image is selected and preprocessing is done to remove noise and find the candidate region for the plate. Using edge detection technique, it detects the exact location of the plate and then segments the characters one by one. Lastly, using template matching method, the characters of the plate are recognized.

[6] In this paper, a system is used to automatically detect license plate numbers. The system used data from the database to recognize the vehicle by using various image processing techniques. The data in the database is store by an user. The system works well for wide variation of constraints and particular sort of number plates. The system is executed in Matlab and execution is tried on genuine images. In proposed work a fresh system has been proposed to recognize characters using standard classifiers of neutral network algorithms.

[7] In this paper, the authors proposed an efficient license plate recognition system. It first detects vehicles and then extracts license plates from vehicles in rectangular frame. It then applies convolution neural networks to improve the character recognition of blurred and noised images. Using this method, they gained

excellent results in terms of accuracy and performance compared to traditional license plate recognition systems. [8] This paper proposes a license plate recognition system where neural network concept has been applied. In this recognition system, photographic lens shall return still images from running videos. Several processes of this system include localization of number plates, detection and extraction of plate frame, segmentation and prediction of characters in it.

3. PROBLEM STATEMENT

Traffic control and analysis and vehicle owner identification has been always a big problem in our country. Most of the times it becomes difficult to identify the owner of vehicles who breaks traffic rules and regulations and drives too fast. Therefore, it is not always an easy task to catch those culprits and punish them because of the fact that they might be moving in such a speed which makes it impossible for the traffic police to retrieve the vehicle number. In such cases, Number plate detection system in real-time could be of great use. Some other great field where this system can be used efficiently are toll gates and parking lots. Many tollbooths use fiber optic sensors to classify a vehicle and the manually enter the results into their database. This system is very expensive and complicated.

Keeping in mind that India is an economically weak country, the industry can go with vehicle identifications systems not to eliminate man force labor but to ensure that human intervention doesn't cause any malpractices especially in the finance department.

4. SOLUTION

The process of automatic number plate recognition consists of three main stages:

a) License Plate Detection **b) Segmentation of Characters** **c) Prediction of character**

The scope of the project includes the following main points:

- The license plate is detected using images and videos. It only works for a single car. It won't handle cases where there are multiple cars in a single image.
- For the purpose of accuracy, it would be best with images/videos that contains less disturbances.
- Python files are used for the detection, segmentation and prediction algorithms.

The method that has been followed in the process:

- Detection of License Plate using CCA (Connected Component Analysis)
- Segment characters individually (again applying CCA on the plate)
- Train a Machine Learning model using images of characters as many as we want (numbers and alphabets)
- Prediction of characters.

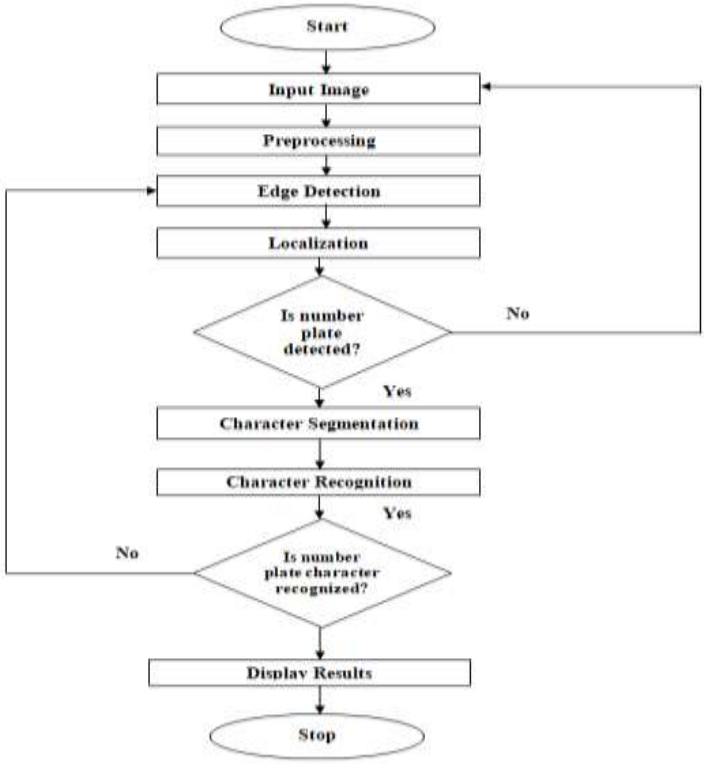


Figure 2. Flow Chart

5. IMPLEMENTATION

Step-wise process to implement the license plate recognition system:

5.1 Detection of License Plate using CCA (Connected Component Analysis)

Here, Connected Component Analysis has been used to perform segmentation of images. If a set of pixels are not separated by any boundary then are considered as connected. It scans the whole image and then separate them into components consisting of set of pixels. It works with binary or graylevel images. Here is what we did in our detectplate.py file:

Car Image/still video frame -> Graylevel Image -> Binary Image -> Application of Connected Component Analysis (CCA) to retrieve connected regions -> Detect the license plate out of all connected regions.

The car image which has been inputed in the file is converted into a gray level image. The grayscale images is the converted to a binary image. We apply Connected component analysis to the binary image with the use of regionprops and measure modules of python. measure.label is the method that classifies the connected regions of binary car image and returns a labelled image. Regionprops method returns a list of regions along with their properties like area, bounding box etc. The coordinates of the bounding box such as column and row are compared with maximum and minimum dimensions of the license plate. According to assumptions the width should be 15%-40% of the full image and the height should be between 8%-20% of the full image. Once the dimension parameters are satisfied by the labeled regions, it pushes the parameters into plate_like_objects list.

5.2 Segment Characters by applying CCA

The above step returns an output which is a car image with a bounded box of red color around the license plate. Connected Component Analysis is again applied on the license plate to perform segmentation of the characters. Once the segmentation part is done, the characters are resized into 20px X 20px and are pushed into list.

5.3 Train a Machine Learning model using images of numbers and alphabets

A ML Model is trained using Support Vector Machine (4 cross-fold validation) on a set of data consisting of images of characters with size 20px X 20px. Once the characters of the license plate are obtained properly and the model is trained, the model is then loaded to predict the characters. If we input videos as input, we here capture images as frames from the video consisting of the car. It keeps capturing frames till we press a key to quit. The last frame is used for further detection. A video with multiple cars in it wouldn't work better.

5.4 Prediction of characters in License Plate

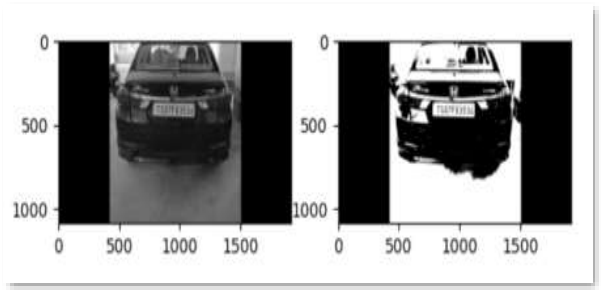
It predicts the characters in the number plate and then sorts it accordingly. After sorting, it displays the classification result.

6. EXPERIMENT AND RESULT

6.1 Car video

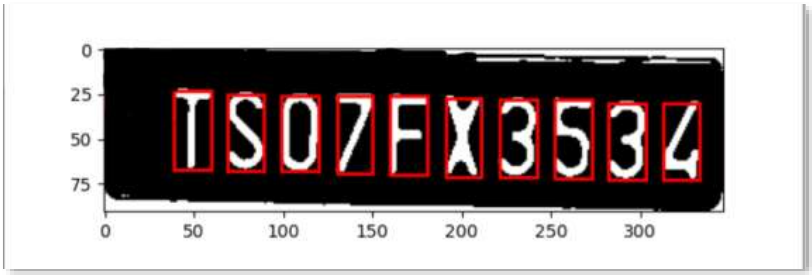
Let us first experiment with a video input. Firstly, a car video is inputted. This is the original frame of video:

The image is then turned into a grayscale image using CCA. And then converted into a binary image.



Number Plate is then detected. (Shape: Rectangle ; Mark : Rectangle Red Box)

Segmented Characters are then shown in rd bounding boxes.



Predicted Values are then displayed with a final license plate number

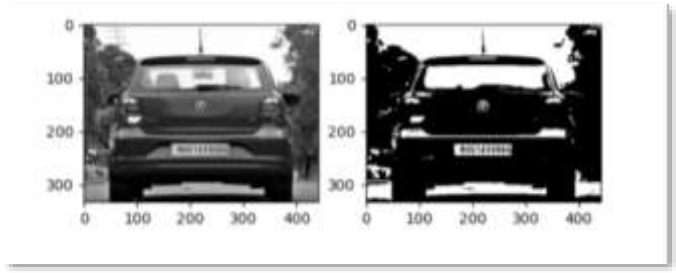
```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.19041.572]
(c) 2020 Microsoft Corporation. All rights reserved.

C:\Users\user\Downloads\LicensePlateDetector-master\LicensePlateDetector-master>python PredictCharacters.py
(1080, 1920)
Loading model
Model loaded. Predicting characters of number plate
Classification result
[array(['F'], dtype='<U1'), array(['T'], dtype='<U1'), array(['S'], dtype='<U1'), array(['0'], dtype='<U1'), array(['7'], dtype='<U1'), array(['F'], dtype=
U1'), array(['5'], dtype='<U1'), array(['3'], dtype='<U1'), array(['4'], dtype='<U1')]
Predicted license plate
 TS07FX3534
License plate
 TS07FX3534
```

6.2 Car Image

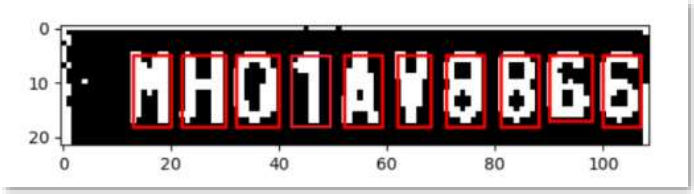
Now let us try with car images. This is the original image of the car

Conversion to Grayscale and binary image



Detection of number plate

Segmented characters



Predicted Values and the desired result is displayed.

```
C:\Users\user\Downloads\LicensePlateDetector-master\LicensePlateDetector-master>python PredictCharacters.py
(333, 442)
Loading model
Model loaded. Predicting characters of number plate
Classification result
[array(['M'], dtype='<U1'), array(['H'], dtype='<U1'), array(['0'], dtype='<U1'), array(['A'], dtype='<U1'), array(['V'], dtype='<U1'),
U1'), array(['6'], dtype='<U1')]
Predicted license plate
MH01AV8866
License plate
MH01AV8866

C:\Users\user\Downloads\LicensePlateDetector-master\LicensePlateDetector-master>
```

7. CONCLUSION

As far as the proceedings have been done, it has become quite clear that License plate detection is not an easy system because of different number of phases and currently it is not possible to achieve 100% accuracy as each step is dependent on previous step. Certain circumstances such as several illuminating conditions, shadow of vehicles and varying sizes of license plate characters, similarities in characters influence the performance of this process. The system works well for variation of conditions and distinctive sorts of number plates. First, we select the image, covert it into a grayscale image, find the interested area of image, then the license plate location is extracted using edge detection then segmentation of each characters is done individually. At-last the result is displayed for the predicted characters.

8. FUTURE ENHANCEMENT

- The predicted characters output could be shown in a window-frame or notepad.
- User-input for selection of image/video could be added.
- The more we train the model, the more accurate the results will be. So we can add more data to the repository.
- Implement image preprocessing (including noise removal, image whitening, sobbel filter, etc) techniques.
- Use suitable CNN for more accuracy.
- Use for real time prediction by changing frame specifications and detections. This could also be used in case of detecting multiple cars in a single frame.

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