Detection And Recognition of Multiple License Plate From Still Images

Aiswarya Menon
Dept. of Computer Science
SCMS School of Engineering and Technology
Angamaly, India
aiswaryamenonm@gmail.com

Bini Omman
Dept. of Computer Science
SCMS School of Engineering and Technology
Angamaly, India
binireni@gmail.com

***Abstract*— License Plate recognition is the most efficient and cost-effective technique used for vehicle identification purposes. Automatic license plate recognition (ALPR) is used for finding location of the number plate. These approaches and techniques vary based on conditions like, image quality, car at fixed positions, conditions of lights, single image etc. It should also be able to cope with the variations in license plates from different nations and states. The approach should also be able to work seamlessly with number of characters varying in plates or size of the plates in the captured images. We mainly focus on detection and recognition of multiple cars license plate from a single frame. Proposed system consists of two steps: plate number detection and recognition. In plate detection part we apply both Spanish and Indian license plate. In our test case we will be working with number plates from Spain. Three different license plates which differ from one another in their size and shape. In plate number detection phase the license plate is detected from the captured image and then in second phase segmented plate is passed to plate recognition that makes to determine the characters and numbers.**

Keywords—Number plate identification; license plate recognition (LPR); license plate segmentation; edge detection.

I. INTRODUCTION

Automatic number plate recognition (ANPR) can be used to store and process license plate images captured by cameras with a high rate of accuracy and efficiency. In ALPR we can enact different techniques based on varying conditions like, image quality, fixed car positions and multiple plates extraction. The ever increasing vehicle count in our roads have hindered the smooth flow of traffic. It finds great use in managing real-life applications such as border control, parking, motorway road tolling, journey time measurement, access control, road traffic monitoring etc.

A vehicle in a country is distinguishably identified by a unique alphanumeric number, which will be depicted on its license plate. Systems commonly use IR cameras to take the picture. Due to a change or a distinct form in color, texture size, shape, and position of plate regions in such images the localization of plate regions is a challenging task. ALPR system completes the entire process passing through different stages. The stage is based on some features of the captured image to extract the license plate from the image. In the next stage by projecting their color information we can segment the license plate. After that characters are extracted. Finally, recognition using template matching is done.

A. Motivation

License plate detection application, most methods work under restricted conditions like specified illumination, cameras, specified car positions, limited vehicle speed, and light conditions designated routes etc.

We are mainly focusing on detection and recognition of multiple cars license plate from a single frame. Lp detection based upon combinations of mathematical morphology features and edge statistics produce high standard results [1] [2] [3]. Edge based methods are not much used for complex images, for the reason that it is too sensitive to the unwanted edges [2]. Mathematical morphology [3] [4] that is based on nonlinear neighborhood operations are used.

B. Contributions

Following are the contributions of this study,

- Efficient car license plate detection and recognition system.
- Detect and recognize multiple car number plates in single camera frame.
- License with complex background are tracked correctly.

II. RELATED TECHNIQUES

In [5], Panahi, Rahim, and Iman proposed an accurate online system for ANPR. Three main parts for this process : plate detection followed by character segmentation finally character recognition. They used a revised version of algorithm RANSAC for license plate localization process. Different data sets were created Crossroad dataset and Highway dataset and was used for training and testing. The crossroad data set were collected from different crossroads. We obtained highway data set from highways and streets. Plate segmentation was done, input a gray scale image, applied a global/adaptive threshold then divided M*N blocks. After locating the plate region the characters are processed then, output line is given to character recognition part of the RANSAC. After that to predict whether a component is a character or not they use a two-class SVM. The framework accomplishes 98.7%, 99.2%, and 97.6% for three stages. The system is not language dependent, achieved 97% overall accuracy.

In [6], image processing technique established on number plate recognition (NPR) system, to identify vehicles by applying neural networks and image co-relation. Extracting license plate from lacking brightness and less brightness image obtained recognition rate of 96.64%. In [7], detection is used to identify vehicles, using image co-relation and neural networks. Different novel approaches have been presented to improve the results. Pattern rrecognition are divided into two broad categories: recognizing abstract items and recognizing concrete items. They were used a multi-

978-1-5386-0576-9/18/$31.00 ©2018 IEEE

thresholding and neural pattern recognition (NPR) techniques combined with artificial neural networks. They obtained the recognition rate of 98.40%.

In [8], idea based on SVM recognition. Support vector machines (SVMs) consist of a set of related supervised learning system. Two stages have been used for SVMs multiclass classification "one against all" and "one against one". First method "one against all" (OVA) [9][10], binary classifiers sets were used. One against one ' are applied to each pair of classes. They input 315-dimensional feature vectors into SVMs for training. They performed procedures on 180 images of license plates under different conditions.

In [11], for plate detection, proposed several algorithms. Proposed canny edge-detection used based on optimization. The algorithm is based on clear and simple steps, six to be precise. Firstly read and resize the image, convert a gray scale image followed by complement of the image were received and the edges finded. Using filters image converted to small objects after that separate the image into objects. Finaly recognition the plate.

In [12], VLP recognition system uses the combination of contour algorithm and Hough transform. It produces the higher accuracy and faster speed. To detect objects a closed boundary contour algorithm used. The lines are considered as a plate-candidate. The main limitation of approach is the time required because it used to a numerous pixels.

In [13], localization of plate consists of six steps. First image capture and grayscale conversion. Then binarization followed by a global threshold. Local thresholding is then applied. After getting the binary image, discard the irrelevant pixels using proposed a preprocessing method.

In[14], locate license plates by principal visual word (PVW). The input image of the license plates are done by matching local features with PVW. The three main stages they included PVW generation, visual word matching, and license plate location. The disadvantage of this method is that it may be unsuccessful when the license plate resolution is too low. They are applied to a dataset of two types of license plate images.

In[15], approach detects only the edge vertical element. Inserting the positive and negative example learning dataset, two steps were used. Applied learning Japanese vehicle license plates by changing the 1.84 aspect ratio of 4.72 aspect ratio. The number of created learning datasets was license plate images of 50 and non-license plate images of 50. More number of datasets used in machine learning is an approach which can produce a large detection rate for the Japanese vehicles license plates.

In [16],methadology used gray level morphology and in [17], identify license plates in images taken from a camera that is distant from the vehicle. They included four main stages for the algorithm. Edge Detection followed by pick the candidate characters.Character extraction and vehicle license plate localization.Detecting and localizing efficiently rates of 95% and 81% respectively.

In [18], plate location stand on edge detection and mathematical morphology. Original color image changed to gray-scale. They were applied morphology operations imerode, imdilate, opening operation and closing operation. They collected 120 images as dataset. 109 images predict correctely, 11 images fails, and the rate was 90.833%.

III. METHODOLOGY

A. Overview

Architeture of ALPR is shown in the fig.1. The two main steps for algorithm is divided into: Plate detection & Plate recoginition. In plate detection step licence plates are choosen from different countries depending upon the width and height. Segmentation and classification are the two main steps in plate detection. In segmentation stage, we use various filters, morphological operations, contour algorithms, and extract the region of image that contains the plate. In classification stage, we use a Support Vector Machine (SVM).

ALPR system image is captured with an infrared (IR) camera. The various approaches and techniques used for ALPR system depends on different situations. From the camera frame we have to extract all the number plates. Each country has various plate sizes, languages and measurements. The proposed methods are for license plates from Spain, shown in the fig. 2.

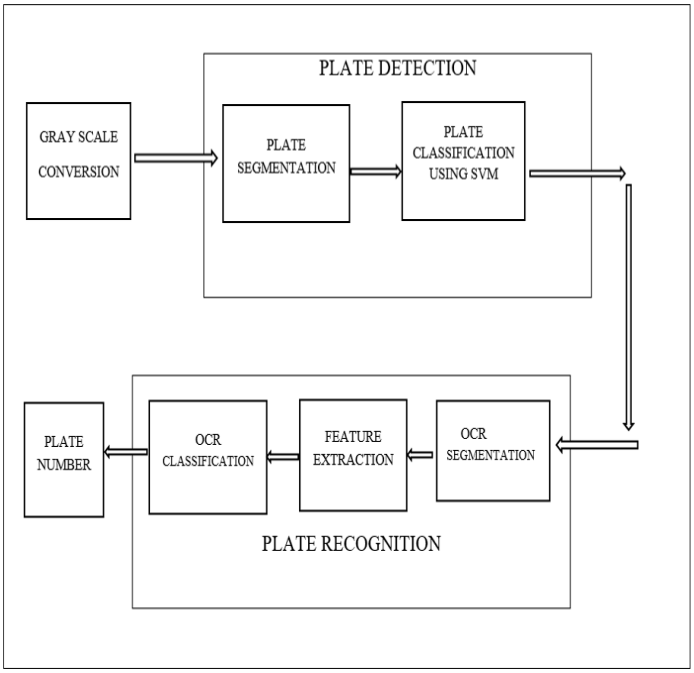

Fig.1. Block diagram of proposed method

Fig.2. Example of a license plates from Spain [20]

In Spain, the plates consists of three different sizes and shapes, where the characters in the plates are separated by a

41 mm space and then each individual character in the plate separated by a 14 mm width[19],[20].

B. Plate Detection

First step in the segmentation process, in which we divide the image into multiple segments.

1) Gray Scale Conversion:

First we want to change color image to gray scale image. License plate region contains large number of vertical edges which is the major feature of plate segmentation. In this step we remove the portions that don't contain any of the vertical edges. Before finding vertical edges we will remove all the noise. The gray scale conversion is shown in fig.3.(a) example of a gray scale conversion on Spain license plate and fig.3.(b) is the example of a gray scale conversion on Indian license plate.

Fig.3(a).Example of a Gray scale conversion on Spain license plate

Fig.3(b). Example of a Gray scale conversion on Indian license plate

2) Sobel Filter:

We use a Sobel filter to find the vertical edges. Here we calculate the first horizontal derivative. Gaussian smoothing and differentiation combines the sobel operator works shown in fig: 4.

3) *Threshold:*

We apply a threshold filter which is the simplest segmentation method using Otsu's method. Otsu's method got a binary image with a threshold value. Otsu's method automatically determines the optimal threshold value. We can assign them a value of 0 for black, 55 for white or any value. The image obtained after thresholding operation is shown in fig.5.

4) Morphological Operation:

Close morphological operation that can process images based on shapes. Morphological operations are mainly divided into two: Erosion and Dilation. In this process we will have the possible areas that can contain plates. The object in erosion white is smaller. Process is obtained by the dilation of an image and then by an erosion, it is called Closing and it is useful to remove small holes in dark regions as shown in fig.6.

Fig.4: Example of a Sobel edge detection on Spain license plate

Fig.5. Example of threshold operation on Spain license plate

Fig.6. Example of a closing operation on spain license plate

5) Contours:

We have areas in the image that could consist a plate. Most of the portions will not include license plates. These portions can be divided by using the find Contours function extract the bounding rectangle. License plate contain parts detected based on its area and aspect ratio. Aspect ratio calculated by plate width divided by plate height. By using Flood fill algorithm the plate has white background and we can retrieve more effective contour box shown in fig.7(a)& fig(b).

6) *SVM*:

All possible parts of an images were pre-processed and segmented, by applying classification methods. To predict if

each region is or is not a plate by applying support vector machine (SVM) algorithm. Supervised learning use labelled data for learning procedure. We train our classifier in the classification process. To create a DetectRegions class and SavingRegions variable. Fig.8 (a)&(b) shown the number plate detection using svm.

Fig.7(a). Example of Contours on Spain license plate

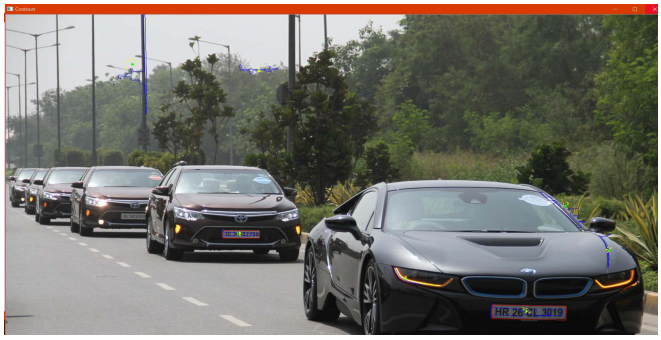

Fig.7(b). Example of Contours on Indian license plate

Fig.8(a). Number plate detection using svm

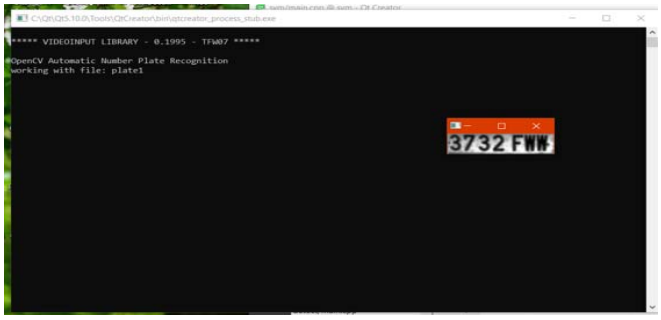

Fig.8(b). Number plate detection using Svm

C. *Plate Recognition*

Last stage of our method is Plate recognition using Spanish number plates only. After detecting the plate, the plate for each character is proceeded to segment, and machine-learning algorithm is used to predict the character. For plate recognition we use an Artificial Neural Network (ANN). First we apply OCR segmentation, using OCR function with an equalized histogram. We then want to apply a threshold filter and threshold image as the input of a Find contours algorithm.

For training and classifying the Artificial Neural Network algorithm we apply feature extraction for each segmented character. OCR classification use an Artificial Neural Network. We apply Multi-Layer Perceptron (MLP), which is the most commonly used ANN algorithm. An ANN-trained network passes the values to the hidden layer and computes the results with the weights and activation function. The training data is loaded from an XML file just as we did for the SVM training fig.9.shown successfully recognized plate.

IV. EXPERIMENTAL RESULT

The whole system is implemented on PC with Intel core i5, in c++ we developed the algorithm using Windows operating system with OPENCV 3.2.0 library.

A. *Dataset*:

Proposed license plate detection system was tested on a number of images. Each image is of different length and also the environment conditions. Dataset contains license plates from Spain and India. In plate detection part we apply both Spanish and Indian license plate. For plate recognition phase we use Spanish number plates only because we are trained for the Spanish license plate only.

B. *Output:*

This method successfully detected and recognized license plates from Spain. The method was able to successfully detect the Indian license plates too. Our system fast, efficient and cost-effective. The final output shown in fig 10.

Fig.9. Example of a Plate recognition

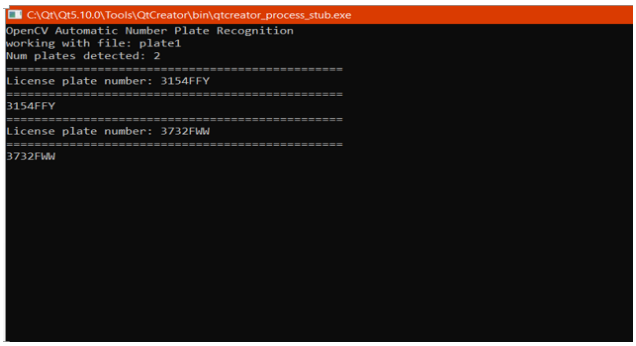

Fig.10. Example of a final output of multiple plates

V. CONCLUSION

This paper presents a successful and quick process for detecting multiple license plates both Indian and Spain. Automatic license plate recognition (ALPR) is used for location detection of the number plate. The advantage of our proposed method on multiple plates is its high accuracy in plate detection part. The proposed method detects multiple car number plates in single camera frame performed correctly. License with complex background are tracked correctly and obtained a good result.

ACKNOWLEDGMENT

We would like to give the first honors to God who gave the wisdom and knowledge to complete the work. We thank the chairman and the management of SSET for providing the infrastructure without which it would not have been possible to complete this paper work and also we thanking to our coordinator who gave valuable support to us.

REFERENCES

[1] Christos-Nikolaos E. Ioannis D. Psoroulas, Vassili Loumos Anagnostopoulos"License Plate Recognition From Still Images and Video Sequences: A Survey" IEEE Transactions On Intelligent Transportation Systems, Vol. 9, No. 3, September 2008.

[2] S. Wang and H. Lee, "Detection and recognition of license plate characters with different appearences," in Proc. Conf. Intell. Transp. Syst., 2003, vol. 2, pp. 979–984.

[3] F. Martin, M. Garcia, and J. L. Alba, "New methods for automatic reading of VLP's (Vehicle License Plates)," in Proc. IASTED Int. Conf. SPPRA, 2002.

[4] R. C. González, R. E. Woods, Digital Image Processing (Reading: Addison-Wesley, 1992).

[5] Panahi, Rahim, and Iman Gholampour. "Accurate Detection and Recognition of Dirty Vehicle Plate Numbers for High-Speed Applications." IEEE Transactions on Intelligent Transportation Systems (2016).

[6] K. Yilmaz ,"A Smart Hybrid License Plate Recognition System Based on Image Processing using Neural Network and Image Correlation",Innovations in Intelligent Systems and Applications (INISTA), 2011 International Symposium on18 June 2011.

[7] Bharat Bhushan "License Plate Recognition System using Neural Networks and Multithresholding Technique" International Journal of Computer Applications (0975 – 8887) Volume 84 – No 5, December 2013.

[8] Kumar Parasuraman, Subin P.S "SVM Based License Plate Recognition System "International Conference on Computational Intelligence and Computing Research2010 IEEE.

[9] Foody, G.M.; Mathur, A., "A relative evaluation of multiclass image classification by support vector machines", IEEE Transactions on Geoscience and Remote Sensing, Volume 42(6), pp.1335–1343, 2004.

[10] Jian-xiong Dong, Ching Y. Suen and Adam Krzyzak, "Algorithms of fast SVM evaluation based on subspace projection", 2005 IEEE International Joint Conference on Neural Networks, Vol. 2(31), pp.865870, 2005.

[11] Allam Mousa "Canny edge-detection based vehicle plate recognition," Int. J.Signal Process., Image Process. Pattern Recognit., vol. 5, no. 3, pp. 1–8, 2012.

[12] T.D.Duan,D.A.Duc,andT.L.H.Du,"Combining Hough transform and contour algorithm for detecting vehicles' license-plates," in Proc. IEEE Int. Symp. Intell. Multimedia, Video Speech Process., 2004, pp. 747–750.

[13] P. Kanani, A. Gupta, D. Yadav, R. Bodade, and R. B. Pachori, "Vehicle license plate localization using wavelets," in Proc. IEEE ICT, 2013, pp. 1160–1164.

[14] Wengang Zhou, Houqiang Li, Yijuan Lu, and Qi Tian "Principal Visual Word Discovery for Automatic License Plate Detection" IEEE Transactions On Image Processing, Vol. 21, No. 9, September 2012.

[15] Shigeharu, Kenji Oka" Automated License Plate Detection using a Support Vector Machine "2016 14th International Conference on Control, Automation, Robotics & Vision.

[16] J. Hsieh, S. Yu, and Y. Chen. "Morphology based license plate detection from complex scenes" 2002.

[17] Hinde Anoual, Sanaa ELFkihi,Abdellilah JILBAB, Driss Aboutajdine "Vehicle License Plate Detection in Images"2011 International Conference on Multimedia Computing and Systems.

[18] Aili Wang, Xusheng Liu, Yuhui Han, Changyan Qi "License Plate Location Algorithm Based on Edge Detection and Morphology" 2012 7th International Forum on Strategic Technology (IFOST).

[19] https://www.safaribooksonline.com/library/view/mastering-opencv-with/9781849517829/ch05.html ,"Number Plate Recognition Using SVM and Neural Networks".

[20] https://www.packtpub.com/mapt/book/application_development/9781849517829/5/ch05lvl1sec40/introduction-to-anpr

[21] https://github.com/MasteringOpenCV/code/tree/master/Chapter5_NumberPlateRecognition.

.