International Journal of Advanced Scientific Inovation
ISSN: 2582-8436 doi:10.5281/zenodo.4641674

Vehicle Number Identification using Machine Learning & OPENCV

Chandan R, Veena M

#PG Student, Department of MCA, Bangalore University, Karnataka, India

mailtochandan4@gmail.com

Abstract - Surveillance is important in most of the applications. Vehicle number plate detection is the major part of traffic surveillance. The detection of number plates has become more challenging and interesting in the past few years. The most challenging part of number plate detection is the varying size, shape and font styles of the number plates. The interesting part of number plate detection is its use in security applications. This project proposes a method to detect the vehicle number plate using methods like edge detection and morphological operations. The approach is performed in five steps. The first step is image acquisition which captures the image scene using a camera. Next step is preprocessing which involves conversion of an image to a different model and noise reduction. The next step is license plate detection which involves use of various edge detection algorithms. The final two steps are character recognition and character matching which involves knn classifier and finally the characters are compared with test samples and matched.

Keywords Vehicle number plate detection, Surveillance, Edge detection, K nearest neighbour, OpenCV

I. INTRODUCTION

ANPR (automatic number plate recognition) is a system that is designed in such a way that the license number plates are detected of vehicles. Security is the main reason for designing this system. The system detects the number plate, processes it and then uses the processed data for other uses like storage. Invention of ANPR [1] was in the year 1976 in the UK. Based on the results obtained from ANPR the first arrest was made in the year 1981. The system may use a closed-circuit television camera or a camera specifically designed for this purpose. Some countries have been using ANPR like Belgium uses ANPR system since 2011 to keep note of all the cars which cross the city limits [2]. The cars which have no insurance or stolen cars generate an alarm and then the cars can be obstructed by the police personnel. Similarly other countries like Denmark Canada etc. also have been using ANPR [3].

Entrance gates of many buildings and organizations use number plates to detect vehicles. Whenever the vehicle enters the gate, its number plate is stored automatically by the system data base. If the license plate number of the vehicle is black listed then it will be denied permission inside the gate. When the vehicle exits the gate again the details will be recorded and will be compared with the previously obtained details stored in the data base [4]. Then that will be considered as a count. Automatic number plate recognitions systems are used for access control especially in companies where they allow only vehicles belonging to a particular person.

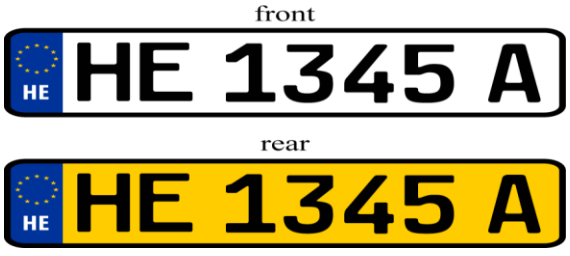
To recover stolen vehicles, each vehicle information can be stored in the central data base and the details can be compared with the details of the stolen vehicles. In case of traffic control detection of license number plates can direct the vehicles to different lanes to avoid traffic congestion on a particular lane.

ANPR has two important components for recognizing of the number plate:

1. Recognition software with recognizing algorithm.
2. Image acquiring technology along with illumination and camera.

After capturing the image we can store this image along with additional information so that it can be used in future. This information can be used by crime department to track vehicle in cases of theft or to track a vehicle in case of accidents. This information can also be used by survey department to keep track of the busy roads or number of vehicles crossing a particular road. This information can be stored on small scale or in the large scale usually it is stored in large scale that is in the database [5][6].

There are databases to store the record of the recognized



number plates. The record stored contains the information

Fig 1: Vehicle Registration plate

that can be used as an input to the other applications. The following are the information that is contained for every record:

- The vehicle number.
- The time of recognition as well as date.
- Camera ID.
- Image of the number plate with proper display of vehicle number.

This project uses various edge detection algorithms to detect the license number plate. There are various challenges while capturing an image. These challenges are overcome using pre processing methods [7]. The characters of the detected license plate are recognized and finally displayed on the screen. One of the examples of vehicle

A. Digital Image Processing

Image is a 2D representation of a signal. Image processing includes processing of images using mathematical and signal processing operations. The input may be an image, a series of images or a video [8][9]. The output is usually an image or parameters related to the image.

Fundamental steps of digital image processing

First step is Acquisition of the image in Digital image processing. It is the process of capturing the real world image photons to electrons. The acquisition step also involves preprocessing. The next step is image enhancement which involves enhancing the image for better processing and to make it convenient to use for a specific application. Image restoration involves improving the appearance of a captured image. Color image processing is gaining wide popularity over the internet. It involves further enhancing of images so that they look impressive. Wavelets represent the image in different resolutions.

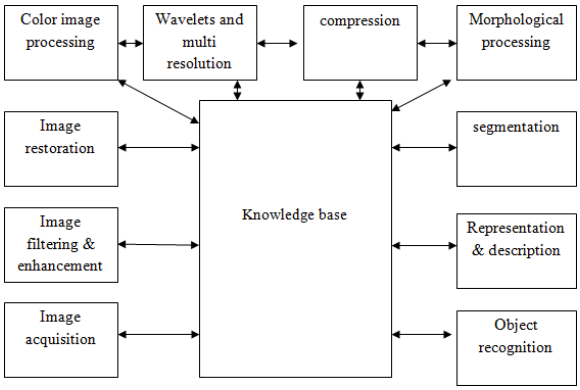


Fig 2: Steps of Digital Image Processing

Compression is a vital step in image processing considering the storage space constraints. It involves reducing the size of the acquired image. Morphological processing involves the image component extraction which is useful in describing the shape of the image [3]. Segmentation involves partitioning of the image into different parts. Representation and description contains an output data consisting of either regions boundary or all the region's points. Recognition is the process of allocating a label to an entity based on what is described about the image. Knowledge base consists of the database about the problem domain.

Contribution & Scope of the work:

Traffic rules are meant to be followed. For mooth flow of traffic and to avoid accidents, following traffic rules becomes important. However there are people who try to break traffic rules thus resulting in various uneventful happenings. Also number plate detection and recognition becomes important for other security purposes also. Hence this project helps to identify vehicles which break the traffic rules.

Breaking of traffic rules can cause many accidents. Hence to avoid them, punishing people who commit such offences also becomes necessary. But when people commit such offences, they fled away and getting hold of such people is not easy. So, implementing devices which capture the number plates of such offending vehicles solves most of the issues. Also some vehicles need to be tracked to keep record of any illegal activities.

II. RELATED WORK

"Automatic recognition system of number plate using the techniques of soft computing" [2] This paper presents a novel approach for fusing various recognition methods and few novelties for recognizing registration plates. This system works on generic images and realistic situation snapshots have been used. This is followed by various image enhancement methods like border removal, artifacts removal, extraction of characters and separation and finally template matching to recognize the characters. The steps of the following algorithm are as follows"

General pre-processing- For implementation of higher order algorithms this is one of the most fundamental steps. For increasing the sped of execution, the image is transformed to gray scale and is resized to 480 x 640 pixels. This step consists of three methods

Gray scale conversion- for increasing the speed of execution

Median filtering- Image may contain salt and pepper noise which is removed by using median filter.

Contrast enhancement- contrast enhancement is attained using histogram equalization technique.

Plate localization- It is approximated that the vehicle to

camera distance is a constant for all images. This paper uses sobel edge detector is used to isolate the registration plate from the image.

Plate reorientation and resizing- the isolated registration plate is not always rectangular oriented, so deformations are considered. This was the motivation for rotational correction using radon transform.

Intensity transformation- this is done to emphasize the character string over the background. The algorithm was implemented in 2 steps: Object enhancement, Binarization.

Noise removal- for proper processing, there is a need for differentiating between useful symbol and potentially existing artifacts. Hence noise removal becomes prominent.

"Automatic number plate recognition based on connected components analysis" [3] The purpose of this paper is to design high efficiency algorithm. First the vehicle is snapped using a camera and then the algorithm detects the acquired image and starts searching for the license plate. Algorithm follows 3 steps, extrication of license plate, partitioning of the plate characters and recognizing the characters by comparing them with the available templates. System is implemented in OpenCV.

Process of license plate recognition- the camera acquires the picture of the vehicle when a signal is sent to it. The system uses a camera with barely 2 mega pixel capacities. The pictures are captured from two or three meter distance. Number plate extraction algorithm is executed on the saved picture.

High resolution camera takes a lot of processing time. To avoid this, the algorithm presents a solution by cropping the image, hence reducing the processing data. To capture images of moving vehicles, a high quality camera is used. Alignment plays an important role since this method uses template matching. Misalignments may produce inaccurate results [10]. To solve this problem we can use affine transformation.

III. PROPOSED WORK

The proposed system involves five steps. The image acquisition which includes capturing the image from a camera. The preprocessing step involves BGR to HSV conversion and noise reduction. The next step is character segmentation which involves segmentation of the image. License plate detection involves extracting only the license plate from the entire car image. This phase involves edge detection and plate extraction. The next step is character recognition by using KNN algorithm try to find characters on the number plate [11]. Character matching involves comparing the portions of images against the training images. The matching technique is applied printed characters are identified and displayed [12][13].

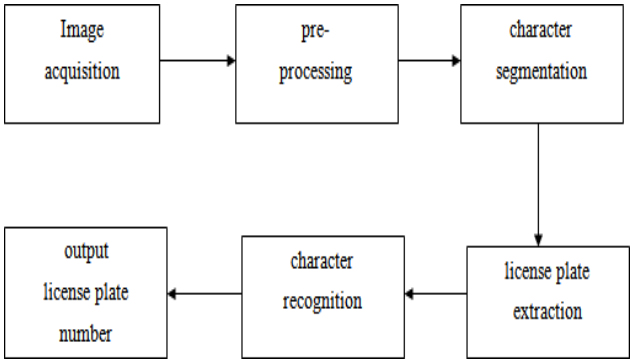


Fig 3: Architectureof the work

A. Methodology

The following steps are to be performed for the proposed system:

Image Acquisition: Input to the proposed system is the captured car image containing the number plate. It is acquired using a camera. The image will be captured in varying weather conditions as the light falling on the image will alter its brightness and contrast also changes, which makes the computing a challenging task [1].

Pre-processing: The captured image consists of many artifacts which cause problems while computation and also decreases the performance of the system hence we perform the following operations.

Noise Reduction- It is not possible to avoid the artifacts and noises in the original image. Hence, to eliminate such artifacts and noises, median filtering is used. Usually the vehicle license plates exhibit salt and pepper characteristics. So, to remove such type of noise median filtering is used [11].

Image blurring: Image blurring is usually achieved by using a low pass filter kernel for convolution of image. This is useful for removing noise. The high frequency contents are removed from an image resulting in blurring of the edges. OpenCV provides different types of filtering techniques. In this project Gaussian filtering is used which is discussed in detail below.

Gaussian filtering: In this approach, a box filter of equal co efficient can be used but instead a Gaussian kernel is used. The kernel width and height must be specified which should be odd and positive. Also in X and Y direction, the standard deviation should be specified as sigma and sigmaY respectively. When only sigmaX is specified then sigmaY will be considered as equal to sigmaX. If both are given as zero, then it is decided from the kernel size. The most effective form of noise removal is Gaussian filtering [13].

Conversion of BGR to GRAY:BGR color model is same as RGB except that the order of areas is reversed [12]. The least

significant area is occupied by red, green occupies the second and blue occupies the third.BGR to GRAY conversion is done because the R, G, B components of an object in an image will be coordinate with the amount of light which hits the object and therefore object discrimination becomes difficult. Therefore description in terms of GRAY saturation and value becomes more relevant.

Character Segmentation: Here, the license plate characters from the image are segmented. To segment the characters from the image we use image thresholding.

License plate detection: When an image is captured, it consists of the surroundings along with the license plate information. The license plate can be located anywhere in the captured image. Hence the detection becomes the most challenging task [14]. The license plate can be distinguished by the features of license plate. Therefore the system, instead of processing every pixel, processes only those pixels that have these features. Color, rectangular shape, presence of characters etc. are some of the common features [15]. The main goal of detection is to validate the number plate by marking an area with maximum probability of having a number plate.

B. Character Recognition

KNN Classifier: The k-nearest neighbor (kNN) is one of the methods which are used for both classification and regression. In both of these situations, the feature space consists of k-closest training examples as input. KNN is instance based learning. Knn is the simplest algorithm when all the machine algorithms are considered and is a non linear classifier. The output of the algorithm depends on if KNN is used for classification or regression.

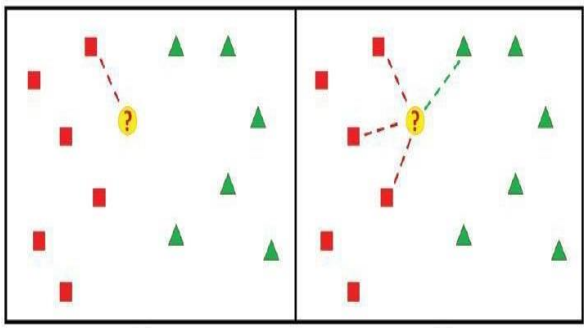


Fig 4: **Illustration of KNN classifier**

IV. TABULATION OF RESULTS

Success rate of license plate extraction and detections is found to be 100% which means that all the sample license plates are extracted and detected. However in the character recognition step, out of 10 images only 8 are correctly recognized. Hence the accuracy is found to be 80%

Table 1: showing the success rate (%) for different stages of ANPR

Stages of ANPR	Total Number of Input Images	Success	Failure	Success Rate (%)
License Plate Extraction	10	10	0	100%
License plate detection	20	20	0	100%
Character recognition	10	08	2	80%

Fig 5: Image original Scene

Fig 6: Image gray scale scene

Fig 7: Image Threshold Scene

Fig 8: Possible characters in the scene

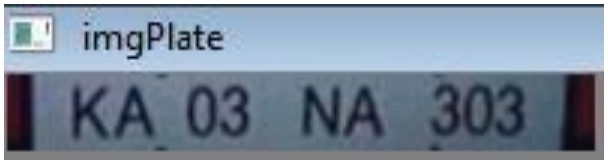


Fig 9: Image Plate

V. CONCLUSION

The project implements a system that recognizes number plate. Various image processing algorithms are used in detection of license plate from the acquired car image. Through survey it is found that license plate detection has become an interesting topic of discussion mainly because of the increasing traffic which causes problems like traffic violations. Hence the method of license plate extraction from an acquired car image is implemented. The results show that the method is robust and efficient. Experiments have shown satisfactory results and are suitable for use in real life situations of surveillance.

REFERENCES

[1] Sarbjitkaur and sukhvirkaur. "An efficient approach for automatic number plate recognition system under image processing"(IJARCS) International journal of advanced research in computer science, Vol 5, 2014 .

[2] Mohitkumarpandey. "Automatic vehicle registration plate recognition system using soft computing techniques", international journal of computer and electronics research, Vol 3(5) October 2014.

[3] Sarmadmajeedmalik and rehan hafiz. "Automatic number plate recognition based on connected component analysis technique", 2nd international conference on emerging trends in engineering and technology (ICETET 2014), may 2014

[4] G.T Sutar and Prof. A.V Shah. "number plate recognition using an improved segmentation", international journal of innovative reasearchin science, engineering and technology, Vol 3(5), may 2014.

[5] P.I Reji and V.S Dharun. "License plate detection and recognition using vertical based edge detection algorithm and radialbasis function neural network", Indian Journal of Science And Technology, Vol 8(26), October 2015.

[6] RajshreeDhruw and Dharmendra Roy. "Automatic Number Plate Recognition System", international journal of computer science and mobile computing, Vol (3), july 2014.

[7] Dinesh Bharadwaj and Sunil mahajan. "review paper on automated number plate recognition techniques", international journal of emerging research in management and technology, Vol4(5), may 2015.

[8] L, G. (2019). Anomaly Detection in NFV Using Tree-Based Unsupervised Learning Method. International Journal of Science, Technology, Engineering and Management - A VTU Publication, 1(2), 27-31. Retrieved from http://ijesm.vtu.ac.in/index.php/IJESM/article/view/232.

[9] Celilozkurt and faith camci. "automatic traffic density estimation and vehicle classification for traffic surveillance systems using neural networks", mathematical and computational application, Vol14(3), 2009.

[10] Bhavin. A. patil and Ashishsinghadia." Automatic number plate recognition system using improved segmentation method", International Journal of Engineering Trends and Technology(IJETT), Vol16(8), October 2014.

[11] Garima.RYadav and H.K Waghmare. "Automatic licenses plate recognition system", IJCTA, Vol5(3).

[12] Avanijoshi and dhirendramishra. "Review of traffic density analysis techniques", international jounal of advance research in computer and communication engineering, Vol4(7), july 2015.

[13] Anishagoyal and rekha Bhatia. "Automated car number plate detection system to detect far number plates", Vol18(4), august 2016.

[14] Usha Rani et al. "extraction of vehicle number plates using edge detection and morphological operations", international journal of advances in computing and informational technology. ISSN 2277-9140.

[15] Debosmith Ray. "edge detection in digital image processing", june 6th 2013.