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LICENSE PLATE RECOGNITION FOR INDIAN VEHICLES

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Abstract: Unauthorized entries are always major issues affecting security. The task of vehicle identification can be solved by the vehicle's number plate recognition. This paper presents a system to identify the authorized vehicles using their license plates. For the recognition, image processing technique is used. This system can be implemented on highly restricted areas like military zones, top government offices etc. It reduces the cost and difficulty in maintaining the parking facility as compared with the existing system. This system is able to deal with noisy, low illuminated, cross angled and non-standard font number plates. It is very helpful for time saving also. Here, from a captured vehicle image the license plate region is extracted using image segmentation. All the characters and digits in the license plate are recognized using OCR. Then it is compared with the records to check whether parking is allowed or not.

Key words- ***License plate detection, Edge detection, Vehicle number plate recognition, Character recognition, Image processing.***

I. INTRODUCTION

Vehicle recognition and management are the major aspects of security. The License plate recognition or realization using image processing techniques has became a potential research area in smart cities and internet of things. Due to the massive increase in number of vehicles, Number plate recognition technique became very popular research area for all researchers. Automatic License Plate Recognition (ALPR) systems have been implemented in many public places for fulfilling some of the purposes like of traffic management, automatic toll text collection, car parking system and automatic vehicle parking system. In last few years, ALPR or Automatic Number Plate Recognition (ANPR) has been one of the useful approaches for video surveillance also. The unauthorized entries can be prevented by recognizing the vehicle on highly restricted areas. This can be accomplished by identifying the License plate or Number plate of the vehicle. Each entry permitted vehicle will be identified using image processing technique. This system ensures the security from the entrance itself. System also provides an alert about the parking facility of the vehicle.

There are so many ANPR systems which are based on common approaches like artificial neural network (ANN), Probabilistic neural network (PNN), Optical character recognition (OCR), MATLAB, Configurable method, Feature salient, BP neural network, Sliding concentrating window (SCW), Support vector machine (SVM), inductive learning, region based, color segmentation, Fuzzy based algorithm, Scale invariant feature transform (SIFT), trichromatic imaging, Least square method (LSM) and color-discrete characteristics. An ANPR system works in the following way:

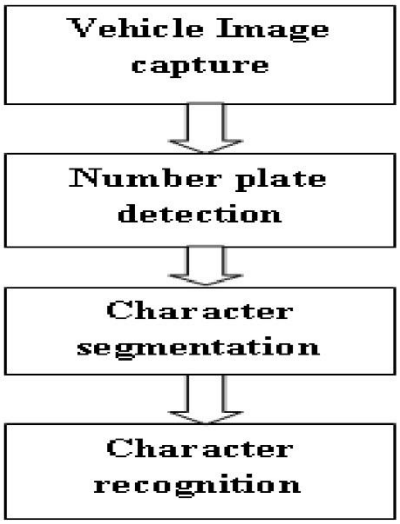

Fig.1 ANPR system

II. EXISTING SYSTEM

Vehicle identification is very important for security management in organization, events and highly secured areas. License plate recognition has become a common approach for this. There are so many traditional and modern methods for license plate recognition. These existing methods have some drawbacks too.

In traditional security control, checking whether a vehicle is authorized or not is very difficult because in most of the cases all the security checks are done manually. This method can be very time consuming. In a busy and crowded environment this traditional approach may not be possible. When we move on to modern methods, in some cases the vehicle image is captured from the video. Sometimes, this may produce inaccurate results. The use of low quality image also cause unsuccessful extraction of the number plate. Wrong extraction of number plate area can lead to unsuccessful character segmentation and character recognition. This may not result in proper recognition. Another drawback of existing system is that, most of them is implemented for foreign number plates and cannot work for Indian number plates.

III. PROPOSED SYSTEM

The objective of the proposed system is to prevent unauthorized entries in the entrance security control itself. From the captured vehicle image along with its number plate/license plate, the number plate region is detected and extracted using image processing techniques. From the extracted information, all the characters are recognized are recognized and compared with the records to determine whether the vehicle is authorized or not. If the vehicle is identified then the system will provide an alert message indicating the allowance of parking. Otherwise it will provide an alert message indicating no entry or parking.

This license plate recognition system consist of the following steps:

1. Capture the vehicle's image
2. Extract the license plate region
3. Extract characters for the from the license plate image
4. Recognize the characters and identify the vehicle
5. Allowing whether to enter or no

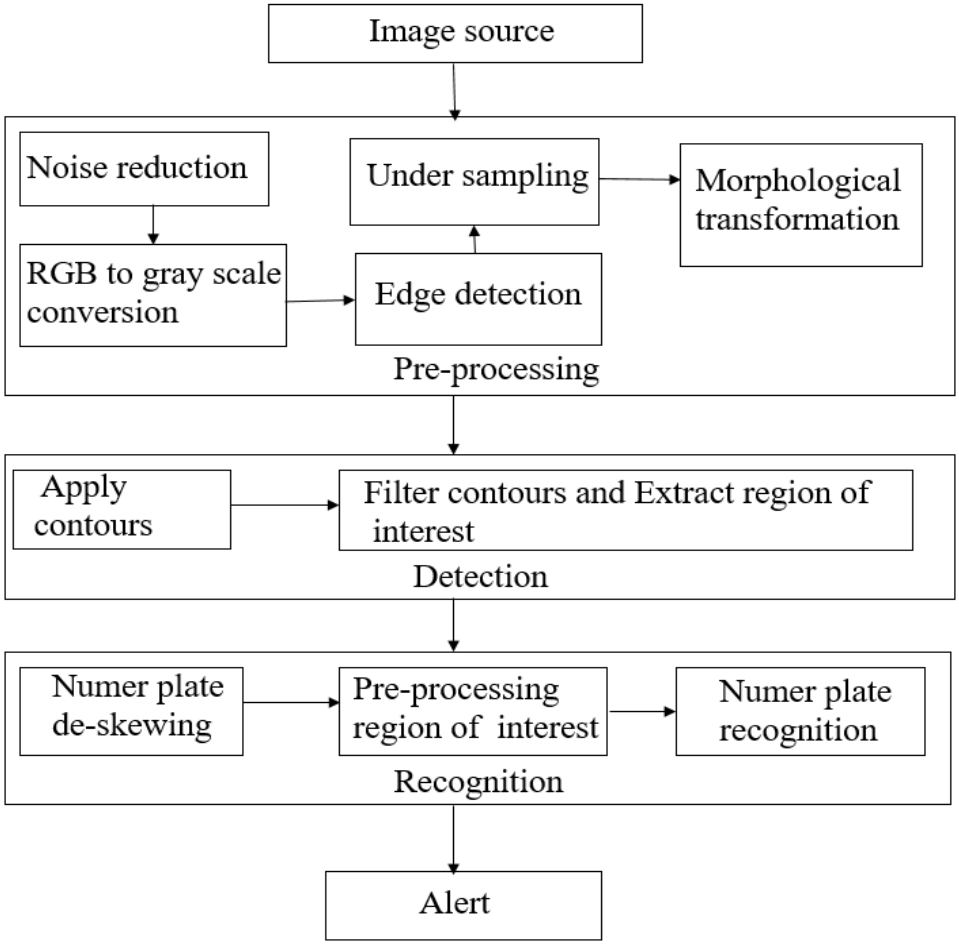

Fig. 2 Architecture of proposed system

The proposed system methodology consisting of four phases viz., pre-processing, detection, recognition and alerting are shown in Fig. 2

i. PRE-PROCESSING

The input is vehicle image. Before the Number plate detection, the image source must be made for suitable for further processing. Fig. 3 shows some sample images used in the system.

Fig. 3 Sample images

The image processing techniques are applied in the following order:

1) Noise reduction

Gaussian smoothing is also known as Gaussian filtering. It uses a linear Gaussian function. The objective of gaussian smoothing is to reduce the noise and detail. When we apply Gaussian filter to an image it has the added advantage of preventing aliasing artifacts. In Opencv, the gaussian smoothing can be applied using the following:

```
cv2.GaussianBlur (image, (5, 5), 0)
```

Here (5,5) indicates filter size and '0' indicates the model to find the value of standard deviation.

2) RGB to HSV conversion

Converting a RGB image to gray scale can save lot of time since we have to perform convolution of the image with sobel filter over only one 2D matrix rather than RGB image having 3 channels and making complicated. Another reason for this conversion is, in the case of edge detection in image we are focused on observing the intensity change and it is very easy to analyze it in a gray scale image.

3) Edge detection

Edge detection is done using sobel edge detection method. Here, calculating the gradient of image intensity at each pixel within the image. It can find the direction of the largest increase from light to dark and the rate of change in that particular direction. In Opencv, cv2.Sobel(imag2,cv2.CV_8U,1.0,ksize=3) is used to perform the edge detection using the kernel size of 3.

4) Image under-sampling

For high resolution images, image processing algorithms tend to work slowly. It is unnecessary to consider high resolution images. The image under sampling stage reduces the resolution if it crosses a predefined threshold.

5) Morphological transformations

Top-hat and black-hat filters are part of the Morphological transformations that are some operations which can be performed on the binary images. Black-hat operation is also known as bottom-hat operation. It is used to enhance dark objects of interest in a relatively bright background. The top-hat operation is used to enhance bright objects of interest in a relatively dark background. The difference between the opening of the image and the image is the top-hat, and the difference between the closing of the image and the image is the black-hat. The top-hat method is used here.

ii. DETECTION

After the pre-processing stage the number plate detection is done. This stage making the use of contours. That is, marking the number plate only. The following techniques are applied on the image in the given order:

1) Applying contours

Contour tracing is also known as border following. It is the algorithm used to generating contours. Counter is a link of equal intensity points along the boundary. In Opencv finding a white object from the black background is called finding contours. So during the Gaussian thresholding stage, the inversion operation has to be applied.

2) Filtering contours and extracting the region of interest

In small regions, mainly in sharp edges and noise outliers, the contours are applied. Initially, the Bounding boxes were applied to each contour. For each contour the following factors such as minimum contour area, minimum contour width and height, minimum and maximum possible aspect ratios were considered. And this could result in filtering of most of the unnecessary contours, propelling us near to our objective to detect the number plate.

iii. RECOGNITION

After detecting and extracting the number plate region, the next step is to recognize the characters in the detected number plate. For that recognition purpose the following operations are to be performed:

1) **Number plate de-skewing**

The amount of rotation required to return the image to horizontal and vertical alignment is called skew. De-skewing is done in the opposite direction. It is a process where the skew is removed by rotating an image by the same amount as its skew. It can result in a horizontally and vertically aligned image where the text runs across the page rather than at an angle. In this proposed system deskewing done using ratio_and_rotation().

2) **Pre-process region of interest**

As in the case with the number 'zero', it is possible that two or more contours may completely overlap with each other. If the inner contour detected in the contour process, may lie completely inside its outer contour. Because of this phenomenon, during the recognition process both contours may get recognized as separate characters. If needed, before doing the recognition step we also resize the image

3) **Number plate text recognition**

The Python-tesseract is an optical character recognition (OCR) tool used for Python. By using this , we can recognize and read the text embedded in images. To obtain the text present in the de-skewed, filtered contour, this tool is used.

iv. ALERT

Now the vehicle number plate is detected and recognized, and the next step is to provide alert and searching for vehicles. From the registered vehicles, the system provides entry allowance message to the authorized vehicle and no entry to the other vehicles. The techniques performed on this stage include the following:

1) Sorting

To make searching and alerting more efficient, sorting operations are performed on the detected texts. This can be done by a quick sort algorithm. Quick sort follows divide and conquer approach. Quick sort is not stable and does in-place sorting.

2) Alerting

Alerting is performed using binary search. Binary search is a divide and conquer algorithm that works on a sorted array or list. Binary search works better than linear search in the case of more images in the dataset. Figure 4 (a) shows the resulting user interface for license plate recognition. Figure 4 (b) shows message displayed in the user interface for authorized vehicles. Figure 4 (c) shows message displayed for unauthorized vehicles.

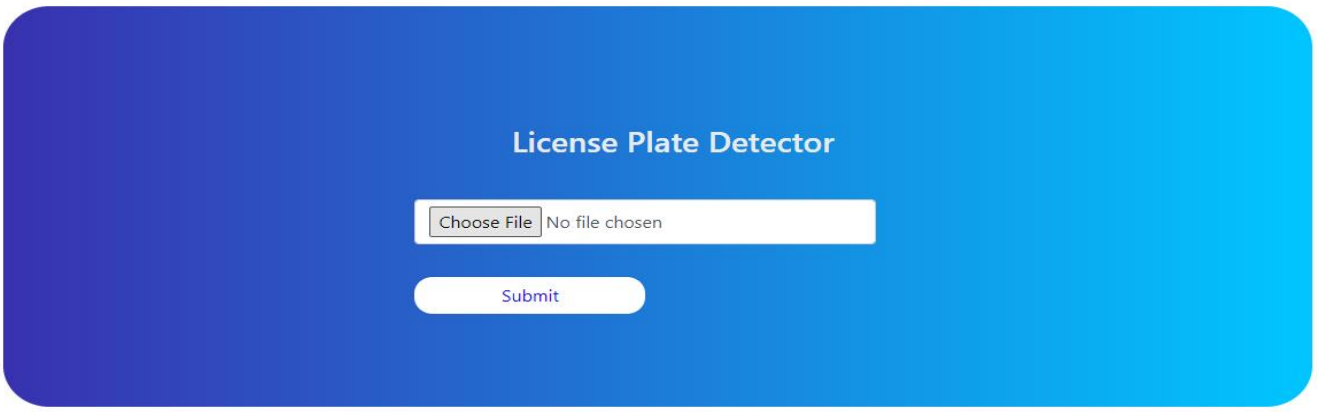

Fig. 4 (a)

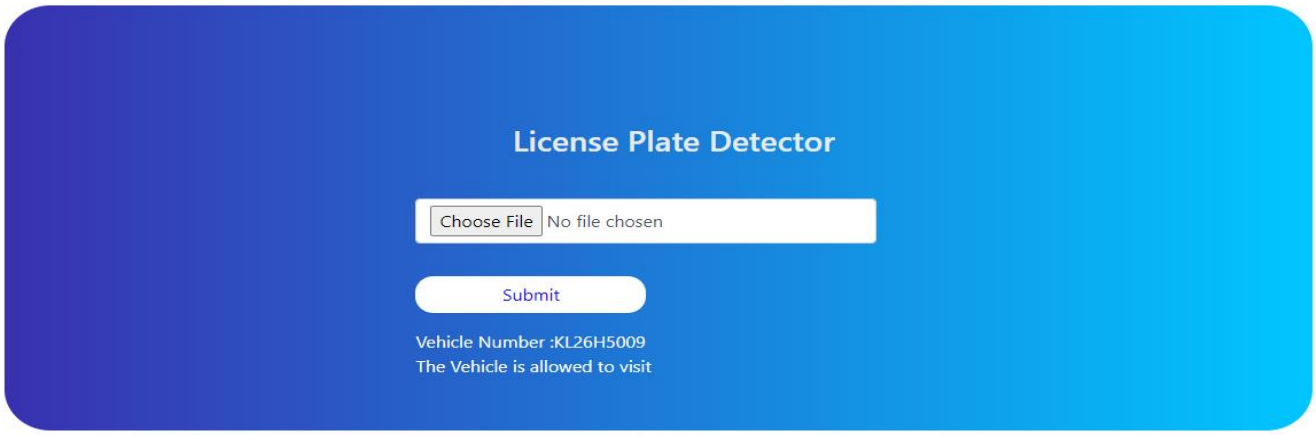

Fig. 4 (b)

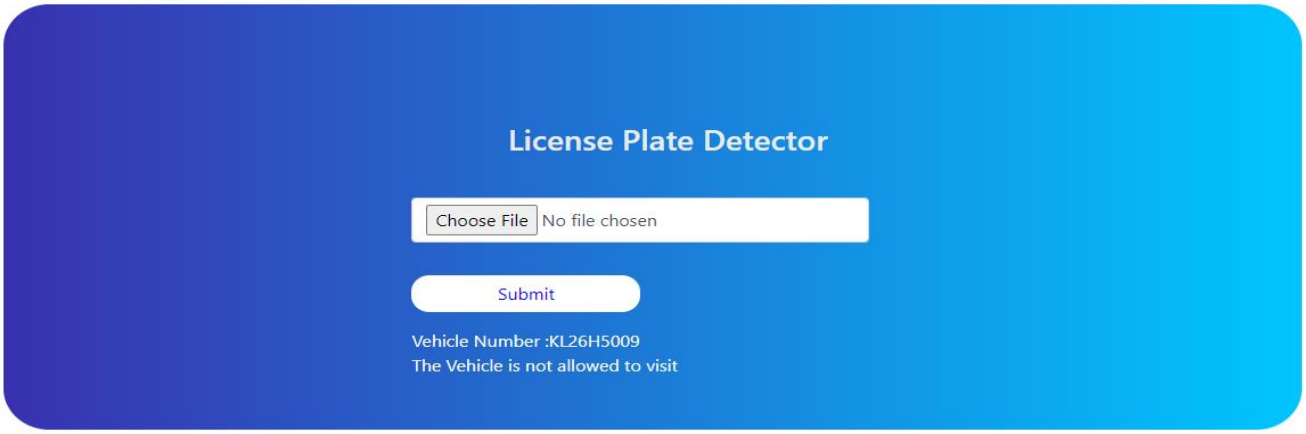

Fig. 4 (c)

IV. CONCLUSION

Automatic license plate recognition is a field which can be implemented using different algorithms and techniques. In this proposed system we are able to deal with the noisy, low illuminated, cross angled, non-standard font number plates. This proposed methodology initially does the pre-processing steps which include noise reduction, RGB to grayscale conversion, edge detection, under-sampling and morphological transformation. Next for number plate detection, contours are applied and filtered. After extracting the region of interest, de-skewing is performed and the characters are recognized using OCR. The system will work efficiently if implemented in housing society/ apartments and highly restricted areas to allow resident's or authorized vehicles inside and almost all the challenges we faced while solving the problem are resolved to a good extent.

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