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Automatic Privileged Vehicle Passing System using Image Processing

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Abstract—
This paper apprise the algorithm and development of an automatic privileged vehicle passing system using image processing to provide security access having no human interaction. This system is independent, as it does not include any use of any magnetic card. This paper presents the indigenous algorithm for extraction of vehicle number from the image. The overall system runs on a pre-programmed task fragmented as vehicle presence detection, automatic image capture, and lastly validating the recognized vehicle number with the database having the list of authorized vehicle numbers.
Keywords- automatic vehicle number plate recognition, image processing, algorithm.

I. INTRODUCTION

There is a need to develop and implement an automatic privileged vehicle passing system to provide security access having less human interaction.

Such a system can be fabricated by detecting the authorized vehicle number by a technology which is reliable and secured. One such technology is to inculcate automatic number plate recognition system using image processing.

Various image enhancement and information extraction techniques have been introduced earlier in such systems. But, some have drawbacks such as time consuming and some are restricted to a certain suitable environment only. There are systems which involves image pre-processing using filter techniques like Gaussian filter, high/low pass filter, etc. In this work, we are using Median filter for image enhancement and smoothing for getting smooth contrast.

For image enhancement, edge detection is the principal operation. There has been various edge detection techniques employed for pre-processing like Sobel, Prewitt, Canny, etc. edge detection [7]. Also, some systems use Hough Transform for edge detection. But, these techniques are low end level techniques which are very elementary and does not provide appropriate enhancement of image. Hence, we use Morphological Operations instead. After these procedures, we achieve an enhanced image ready for number recognition.

But, to recognize the number in the image, we first have to figure out the position of the number plate in the enhanced image. This process is called localization of the number plate in the image. To localize, some systems use threshold, adaptive threshold and equal threshold techniques but they have a limitation that they tend to fail for improper illuminated image. To overcome this drawback, we use the indigenous number plate localization algorithm which supports any illumination factor.

The characters in the image are then detected by an Optical Character Recognition program which uses simple basic algorithm of dividing the image into constituent potential characters and comparing it with a pre-build template database.

Hence, an automatic privileged passing system can be explained collectively by fragmenting it into 4 steps, which are as follows:

1.vehicle presence detection,

2.image processing which itself comprises of-

- Image pre-processing
- Localization of number plate in the image
- Creation of template database
- Optical Character Recognition
- Reducing the Errors

3.Validating recognized vehicle number with database sheet of authorized vehicle numbers.

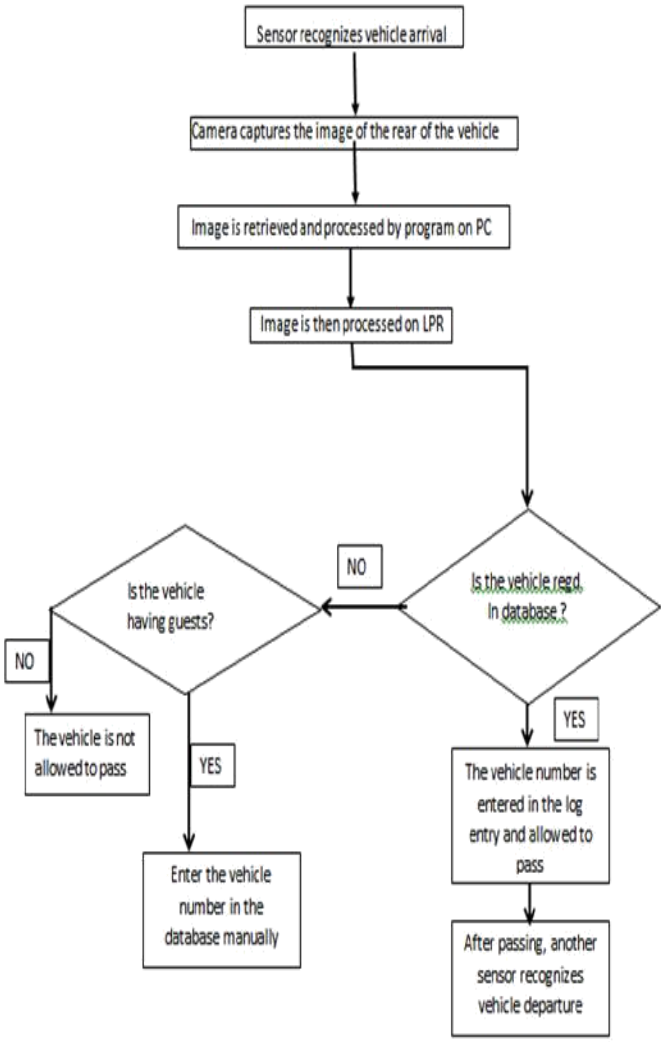
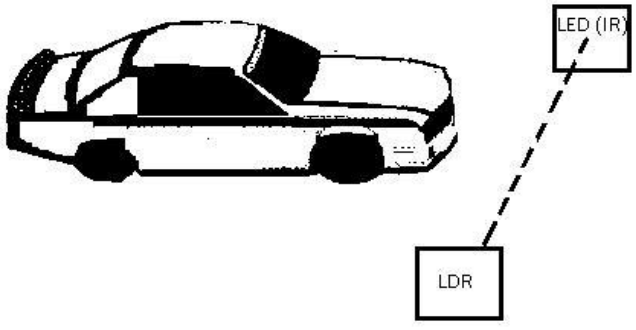


Fig. 1 shows the system block diagram

II. VEHICLE PRESENCE DETECTION

The first challenge is to detect the presence of a vehicle at the gate barrier to actuate the camera for number plate detection. This can be achieved by using a simple mechanism of two couples of LED and LDR. When the vehicle trips the light laser formed by the coupled sensor, the resultant will activate the camera to capture an image and the command.



III. IMAGE PROCESSING

a) IMAGE PRE-PROCESSING

Image pre-processing comprises of a step by step image enhancement algorithms. In our work, Image pre-processing comprises of smoothing of the input image using MEDIAN filter. This enhances the image and makes it suitable for further processes. Further, the image is subjected to Morphological operations. Morphological operations include two basic steps namely, image dilation and image erosion [5]. Image dilation is an adaptive creation of a structuring element which varies from image to image and the output is a matrix which is used for erosion of the input image. The next step Image Erosion is simply an application of the created structural element to the input image. A detailed of such pre-processing is explained by a flow chart given below:

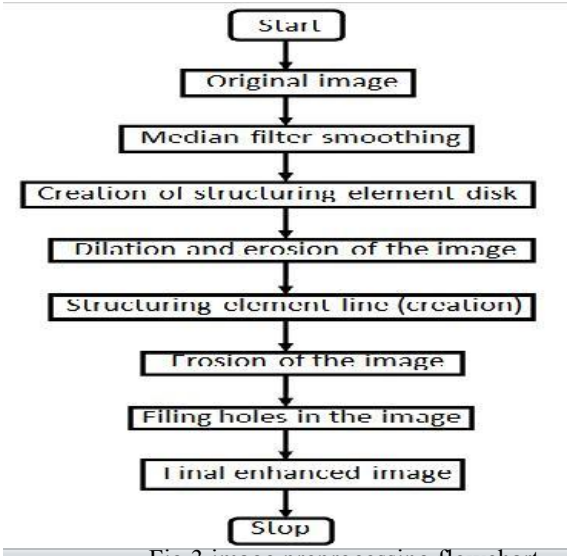


Fig.3 image preprocessing flowchart

b) LOCALIZATION OF NUMBER PLATE IN IMAGE

The numbers in the image usually appear as high contrast. The letters and numbers appears in the same row (i.e. at identical vertical levels), which results in considerable change in the contrast [2]. Hence, an algorithm can be developed which is able to localize the number plate are in the image, since the rows that contain the number plate area are expected to exhibit many sharp variations. Accordingly, the algorithm first determines the dark-to-light and light-to-dark pixel count (known as contrasting count) for each row, while in the second step it selects the most probable horizontal number plate area. Number plates are highly probable to exist in these rows. The variations (contrasting count) are the highest at the letters (black letters on white background); therefore this is where the rate of change of contrast within a

row is expected to be the highest.

This can be well explained with the figure below. It depicts the horizontal row strip having light-dark pixels.

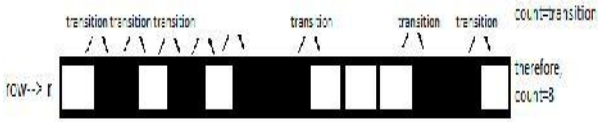


Fig.4 Localisation of no. plate

Consider an enhanced image containing number plate in it. Let 'C(r)' be the count array for a particular row 'r'. For a non-contrasting row (i.e. the row has only black coloured or white coloured pixels), the value of C(r) is zero. But, if the row is contrasting (i.e. the row has both black and white coloured pixels), the value of C(r) would be greater than zero.

The rows, having count more than usual count obtained in the whole image, is recognized as the high contrasting row and have the highest probability of being a part of the number plate area.

It is clearly seen that, the number plate area is more probable to exist between the range of row number 150 – 300. This gives us the top-bottom limit of the number plate.

The same procedure can be used for fetching the left-right limit of the number plate by choosing the column number as the responsible variable instead of row number.

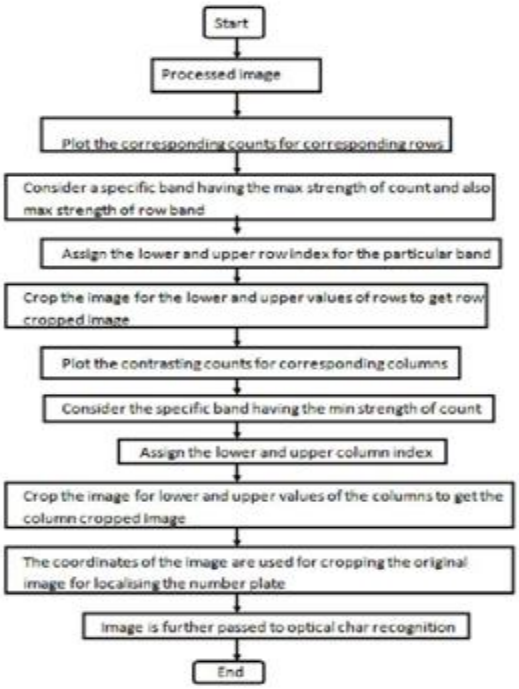


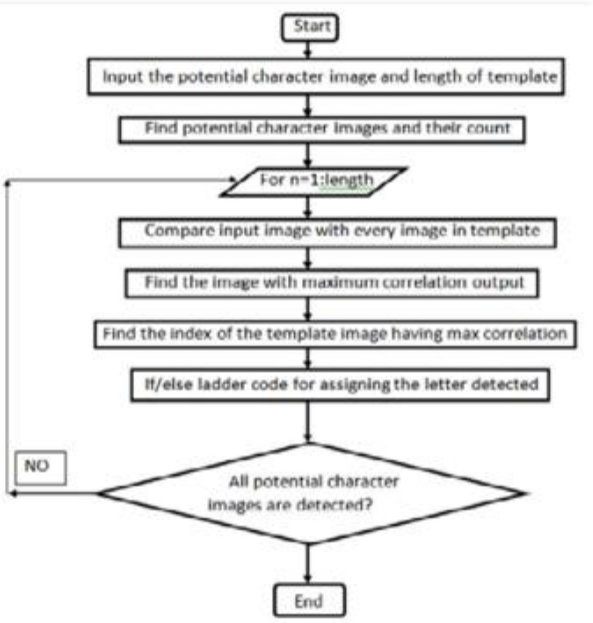
Fig.5 Shows the result of Localization Algorithm

c) CREATION OF TEMPLATE DATABASE

The extracted image achieved by performing image processing is to be compared with a pre-build image database of all letters and numbers [5]. As a character (letter/number) can have any unusual type of font style, there should be that number of images to cover all types of fonts which may create a problem when read. But, it is not necessary to have all types of unusual font for ever character, for example italic ***A*** can be detected by an A. However, to increase the efficiency and remove the error, more types of unusual font images should be used to build the database.

d) OPTICAL CHARACTER RECOGNITION(OCR)

The extracted image is divided into number of images having a probable character [3]. This process is called image segmentation. And then each probable character is compared with the pre-build image database of characters.



Fig, 6 Optical character recognition

e) REDUCING THE ERRORS

Improper illumination during the image capture results in undesired contrast changes in the extracted image which in turn creates additional incorrect probable character image in the segmentation stage.

We can compel the system to ignore such probable image by applying a condition of relevant probable image. Such a condition is that a probable image containing the probable character can never be

smaller than a specific resolution (even if it is a single vertical line, it greater than 10 rows, 3 columns. If yes, then start the comparison with the pre-build image database. If not, then ignore this probable character image and consider the next probable character image.

Sometimes, due to improper illumination or improper plane angle of the number plate in the original image, the extracted number can be incorrect and make the further procedure behave incorrectly. If such condition occurs, there should be a provision to enter the vehicle number intentionally by human interference. Hence, a user friendly GUI is essential for facilitating the correction of the extracted number for further use even by a layman [6]. For portability of the whole system program a stand-alone .exe application is a better alternative of MATLAB GUI.

IV. VALIDATING RECOGNIZED VEHICLE NUMBER WITH THE DATABASE SHEET OF AUTHORIZED VEHICLE NUMBERS.

To provide automation to a privileged vehicle to pass through the gate barrier, its number extracted from image processing (in text format) is now tallied with the database sheet of authorized vehicle numbers. If the number gets matched, then the vehicle is allowed to pass. This automation can be achieved by communication between the computer and
the microcontroller using serial port bus communication. On receiving the vehicle's authorization signal, the
microcontroller is responsible for opening of the gate barrier. There is also a need to record the log entry of ever vehicle passing through the gate barrier. Such a desire can be achieved by implementing a separate database for log entry noting the system time and the vehicle authorization signal.

V. RESULTS

The figure below shows the performance of image pre-processing of the input image.

Fig 7a. Image pre processing

Here, we can see that the output image specifies and highlights the contrasting content in the image, useful for localization of the number plate in the image.

Localization of the number plate is explained with the next figure result.

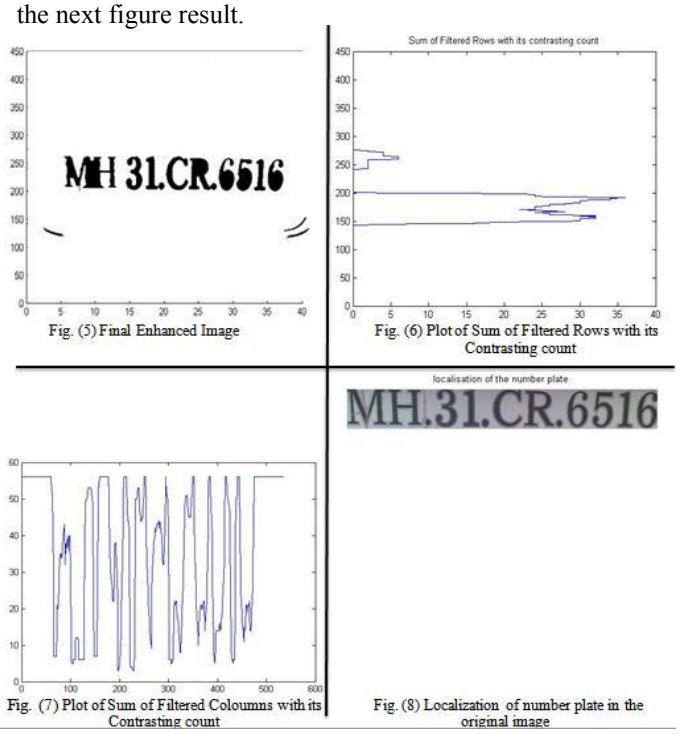


Fig.7b Image preprocessing

Here, the position of the number plate in the image is well depicted from the graph and the estimation does not get affected by different heights

of different vehicles [1].

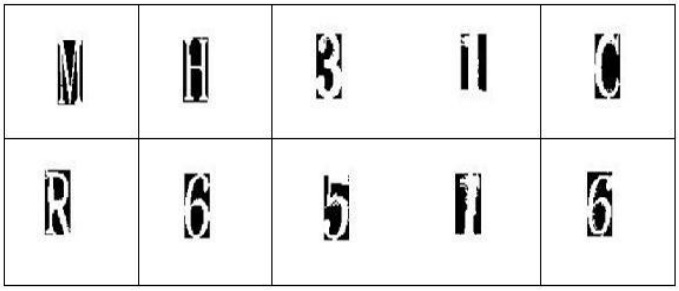


Fig 8. Segmented images.

The above figure shows the segmented images having probable characters in them. The figure below shoes an example of an efficient database having the font images is given below in the figure.

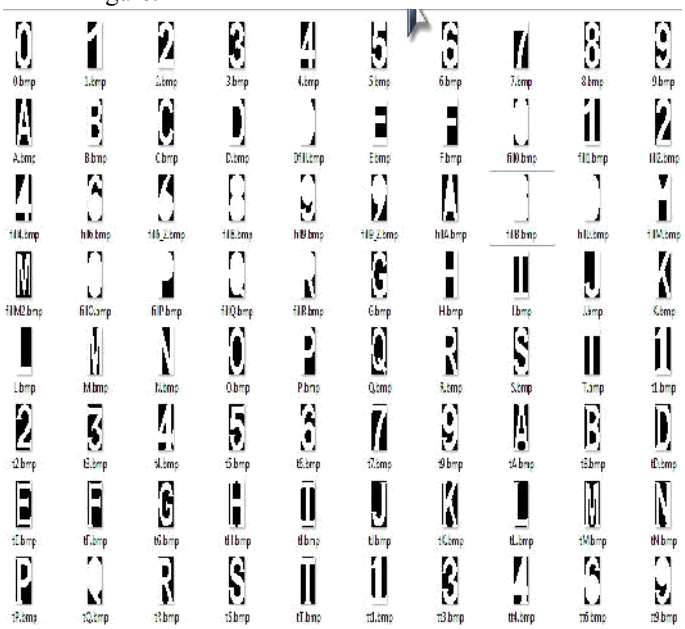


Fig 9. Optical characters

A user friendly environment, so that even a layman can interact with the system, is necessary and should have all the provision facility like passing the vehicle manually,
updating the database with a particular new vehicle number, and viewing of the database and indication of the vehicle's
authority.

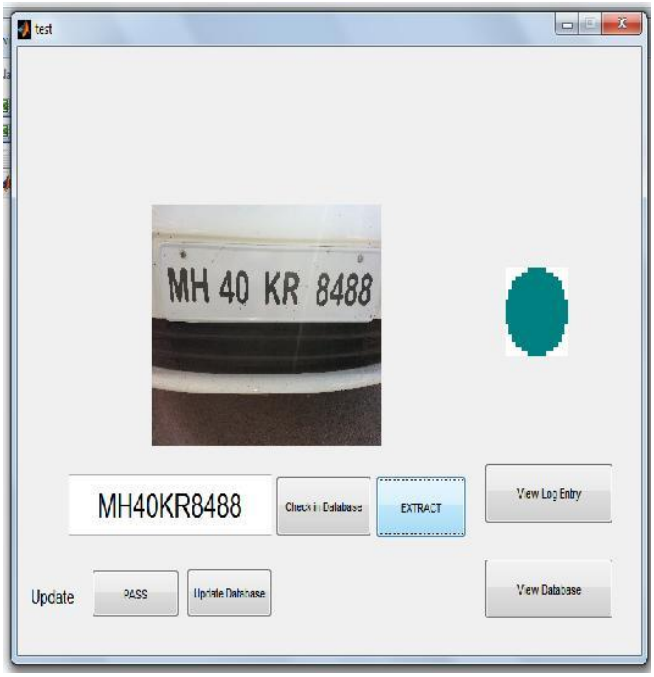


Fig 10. Graphical user interface

VI. CONCLUSION

The presented algorithm can determine the location of the number plate area in the enhanced image which is the most important task to achieve. This algorithm deals with the frequency of the change in the contrast levels of the image pixels, and hence is suitable for detection of any height of the vehicle as well as any size of the number plate, unlike other algorithms.

VII. FUTURE SCOPE

ALPR systems are widely implemented for automatic ticketing of vehicles at car parking facilities, tracking vehicles during traffic signal violations and related applications with huge saving of human energy and cost. In an online ALPR system, the localization and interpretation of license plates take place instantaneously from the incoming still frames, enabling real-time tracking of moving vehicles through the surveillance camera. An offline ALPR system, in contrast, captures the vehicle images and stores them in a centralized data server for further processing, i.e. for interpretation of vehicle license plates.

VIII. ACKNOWLEDGEMENT

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