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License plate localization method based on vertical edge analysis using SVM technique

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ABSTRACT

There are different types of license plates being used, the requirement of an automatic license plate recognition system is different for each country. Support vector machine is a machine learning algorithm with good performance, its parameters have an important influence on the accuracy of classification, and parameters selection is becoming one of the main research areas of machine learning. This dissertation adopts SVM to recognize the characters of the license plate. Then a number plate recognition algorithm is proposed for character segmentation and recognition. This algorithm employs an SVM to recognize numbers. The algorithm starts with a collection of samples of numbers from number plates. Each character is recognized by an SVM, which is trained by some known samples in advance. In order to recognize a number plate correctly, all numbers are tested one by one using the trained model. Our experimental results depict that our proposed technique has a great extent of recognition accuracy and excessive processing speed as compared to traditional SVM which depended upon the multi-class classifier. This new technique gives a superior direction for automatic number plate recognition. Experiments show that the proposed algorithm has higher recognition accuracy than others, the character recognition accuracy of the training set is greater than 99.95%, and character recognition accuracy of test set reaches 99 %. Therefore we can conclude SVM is a better technique than any other supervised learning.

Keywords— *LPRS, Vertical edge detection, Localization*

1. INTRODUCTION

LPR is a combination of image processing, character segmentation and recognition technologies used to identify vehicles by their license plates. Since only the license plate information is used for identification, this technology requires no additional hardware to be installed on vehicles. LPR technology is constantly gaining in popularity, especially in security and traffic control systems. LPR applications apply image processing and segmentation algorithms for license plate extraction, and each operation involves lots of computation. Government regulations and standards employed in the license plates can reduce the computational requirements substantially and improve the accuracy. Constraints and value ranges can be built on top of this prior knowledge and used for extraction as well as validation of license plates [1]. Constraints contain a range of values instead of exact measures, since the license plate text size, style and orientation can vary substantially in different images.

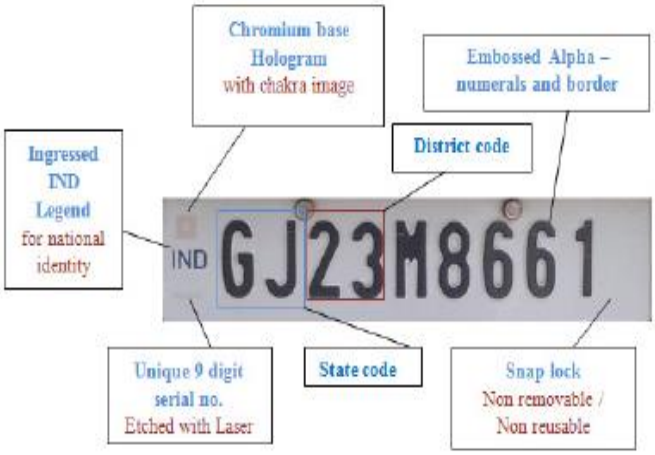


Fig. 1: License plate number description

In recent years, with the increase of terrorist activities around the world, security has become a major concern. The demand for security-related services has been higher than there ever was, and there is a great need to find a new way to protect ourselves or improve the existing methods by using information technology [2-3]. One area of interest has been automated surveillance systems controlled by computers that could work independently with minimal human intervention. An automated system that could identify suspect vehicles passing through can issue alerts or report such incidence to corresponding authorities immediately. This will speed up response time and can save lives. An LPRS will take as input images of the passing automobiles, captured using a high-speed camera at specified gateways. Then the captured images will go through the system that will identify the license plate number of the vehicle without human intervention [4]. The retrieved identity and the original image taken can be stored for review. Since vehicle information has already been detected at the time of storing, the information of interest can be indexed for fast retrieval and easily searched. The system can be completely automated by including a motion sensor to trigger the image capturing device and a database system for storage. License plates have different size, character format, the base material and color standards throughout the world. Generally, license plates are characterized by the high contrast between characters and underlying background. However, license plates in some countries may contain background texture and images, which introduces extra complexity in localization and extraction of license plate information. Recent improvements in technology like infrared imaging and high-resolution cameras and utilization of high reflective backgrounds in license plate manufacturing have improved the accuracy of LPR systems. Sensors and other hardware peripherals are used to improve the image acquisition and remove irrelevant details [5-6]. A typical LPR system is composed of several hardware and software components as illustrated in figure 2.

Fig. 2: LPR system

2. LITERATURE SURVEY

Many different features are utilized to find the location of the license plates, e.g. shape, color, orientation, and frequency. Colors and shapes of the objects are among the most popular features that are utilized. Some systems change the color space to find more robust representations. Projection profiles are used in Dai's work and Wu's work to find the locations. Edge detection is often used to help locate license plates. Systems detect vertical edges to find two parallel edges on each side of the license plate, or to find characters. After localization, the region of interest is segmented so that each individual character is separated [7]. For segmentation, projection profiles are popular among LPR systems. Zhang's system used Hough transform to aid the horizontal profile projection segmentation to achieve a better result. In addition, the skew correction system for the license plate is proposed to solve the tilting problem. Changing camera viewing angles usually cause the tilting. Horizontal skewing is compensated using direction angle histogram. The image is divided into a set of non-overlapping blocks and orientations of blocks are computed. After localization and segmentation, the characters are recognized to generate text labels. Template matching is popular among LPR systems to recognize individual characters. The distance measure of the templates is usually Euclidean or correlation. However, other distances could be used to achieve more generalized comparison, like Hausdorff distance. To increase speed, neural networks and SVMs are trained for classification. In Sirithinaphong's system, license plates are located using the regulations in terms of shapes, colors and aspect ratios. The detected license plate is segmented using projection techniques. Each character is recognized using a four-layer neural network. Chang et al. proposed to use Kohonen's neural model to recognize characters. The ambiguous characters are further distinguished using additional minor comparison. Naito et al. suggested a Japanese license plate recognition method for passing vehicles under the outside environment. They have used adaptive binarization, extraction of the character region, hypothesis generation of registration numbers and then template matching for each hypothesis. Their algorithm is very efficient and able to process rotated and low contrast images.

3. PLANNING OF WORK/METHODOLOGY

The license plate recognition process can be roughly divided into three steps as shown in figure 3:

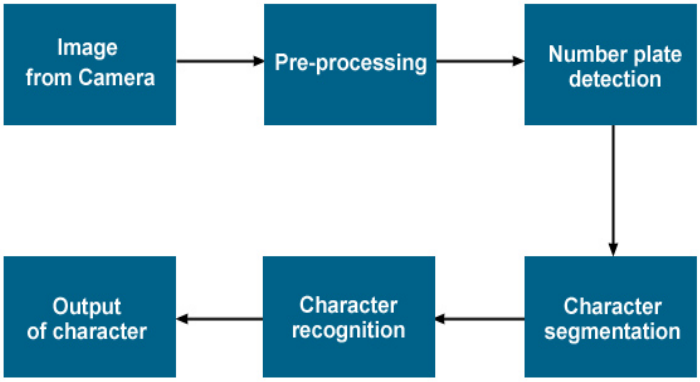


Fig. 3: License plate recognition processes

- Plate Localization
- Character Segmentation
- Character Recognition.

Each step will be carried out by an independent module. An input image submitted to the system is first examined and processed to obtain the vehicle license plate region, then the plate region is processed to locate each individual digit and character, these are then submitted to the final Optical Character Recognition (OCR) process to determine the identification.

3.1 Plate Localization

To extract license plate regions from background images, techniques based on combinations of edge statistics and morphology can achieve good results. In [6], they applied edge operators on a gray image after smoothing and normalization to extract horizontal and vertical edge maps. Statistical analysis of edges was then performed to detect the rectangle of the license plate. The procedure was performed in a hierarchical manner at different scales. Several license plate regions were left after the rule-based fusion. The final decision was made based on the connected component analysis (CCA). They claimed that their algorithm can achieve a 99.6% detection rate from 9825 images. Many other license plate detection algorithms [7, 8] also follow similar procedures. However, such methods are typically based on a hypothesis that the edges of the license plate frames are clear and horizontal. If the license plate frames were not clear or they had some affine transformation, these algorithms may not produce reliable results.

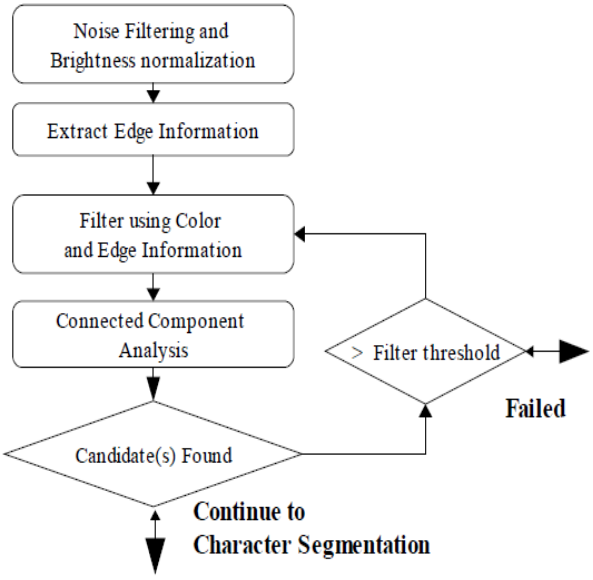


Fig. 4: Flow diagram of plate localization

3.2 Vertical Edge based License Plate Registration: Abbas proposed a method of vertical edge based car license plate detection method. Their algorithm is based on the contrast between the grayscale values. They have used adaptive thresholding for binarization, an unwanted line elimination algorithm followed by vertical edge detection using 2 * 4 mask and finally candidate region extraction for license plate detection. Figure enlists these steps involved in license plate segmentation.

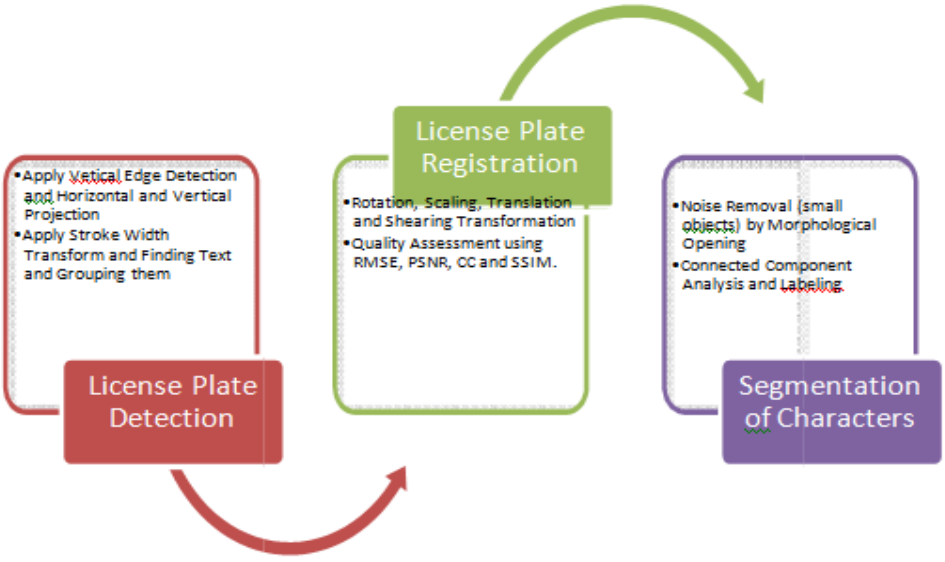


Fig. 5: Steps involved in license plate detection, registration and segmentation

3.3 Adaptive Thresholding

The basic thresholding technique will choose fixed threshold and compare each pixel with that. Fixed thresholding method often fails when illumination varies spatially in the image, so adaptive thresholding technique can be used.

Adaptive thresholding (AT) is an adaptive binarization technique which produces a black and white image. It will convert grayscale variation of illumination changes into binary. Bradley [11] suggested this method using the integral image. The main difference between this two methods is different threshold is computed for each neighborhood rather than a fixed threshold. AT is more robust to illumination changes. In adaptive thresholding, a single pass of scanning is required and each pixel is compared with an average of the neighboring pixels and the approximate moving average is calculated by traveling from left to right and top to bottom. If the current pixel value is T percent lower than the average then it is set to black, otherwise, it is set to white. This method will preserve hard contrast lines and reject short gradient changes. The rectangular window size can be calculated from the width of the input image. It can be one-eighths of the image width.

$$s = N/8$$

Where N is the width of the image and s is the local window rectangle size s X s.

$$S_1 = \frac{S}{2}$$

4. SOFTWARE USED AND SIMULATION RESULT

4.1 Software

It is powerful software that provides an environment for numerical computation as well as a graphical display of outputs. In Matlab, the data input is in the ASCII format as well as binary format. It is a high-performance language for technical computing integrates computation, visualization, and programming in a simple way where problems and solutions are expressed in familiar mathematical notation.

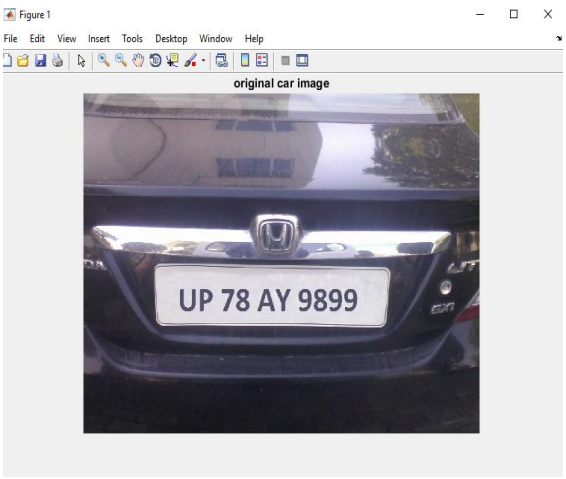


Fig. 6: Original car image

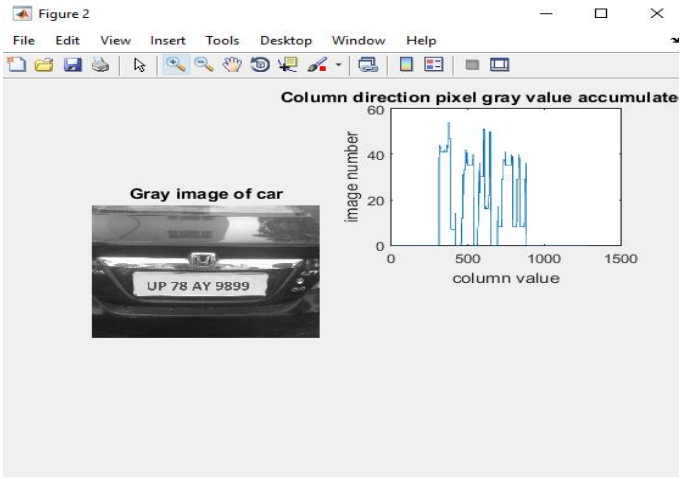


Fig. 7: Gray image and column direction pixel gray value

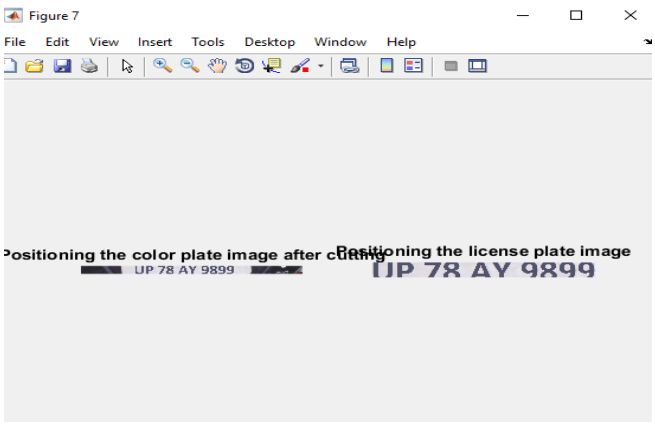


Fig. 8: Positioning the license plate image

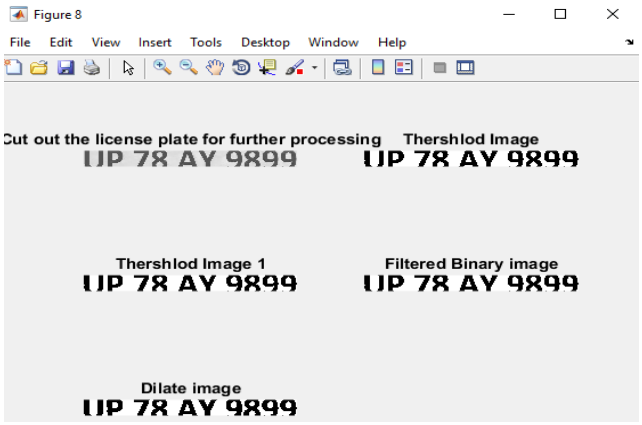


Fig. 9: Threshold and dilate image

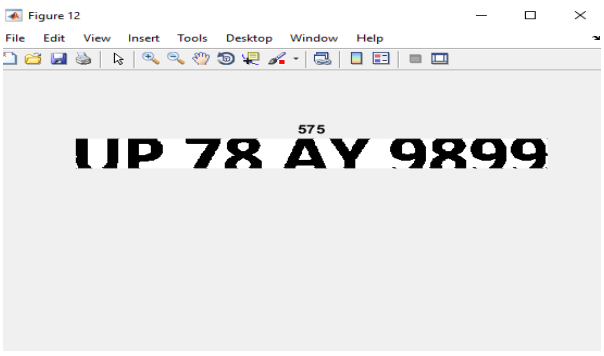


Fig. 10: Plate binary value

Fig. 11: License plate detected

4.2 SVM Technique Result

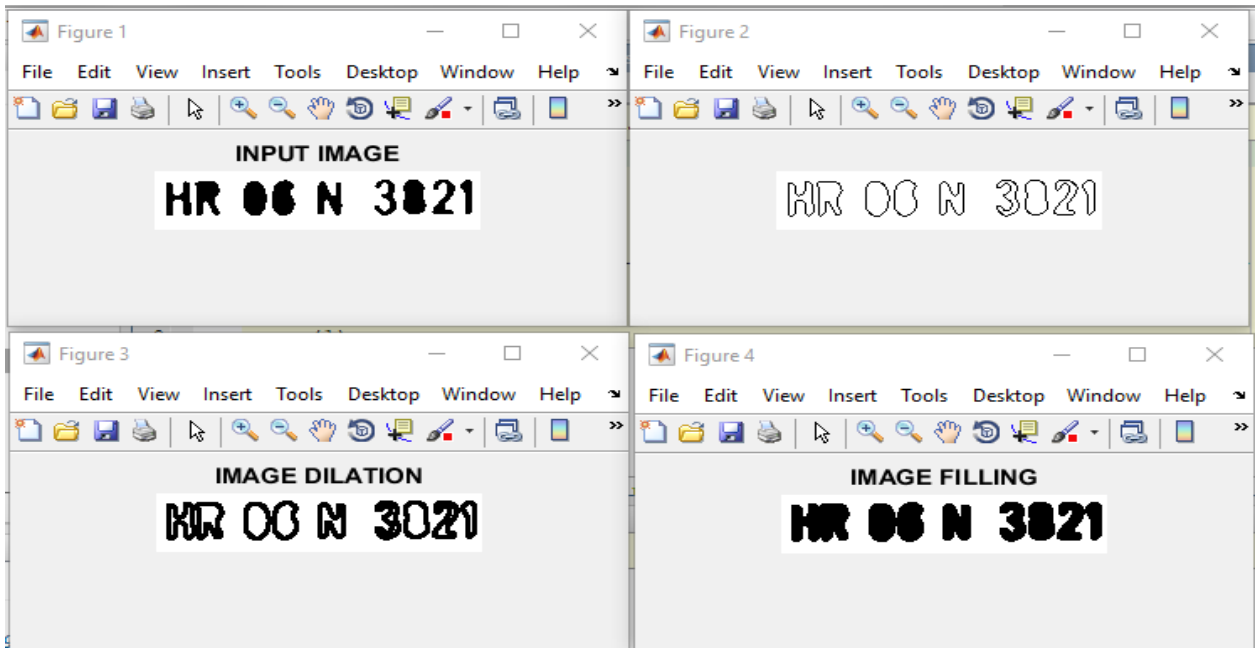


Fig. 12: Operation on license plate number

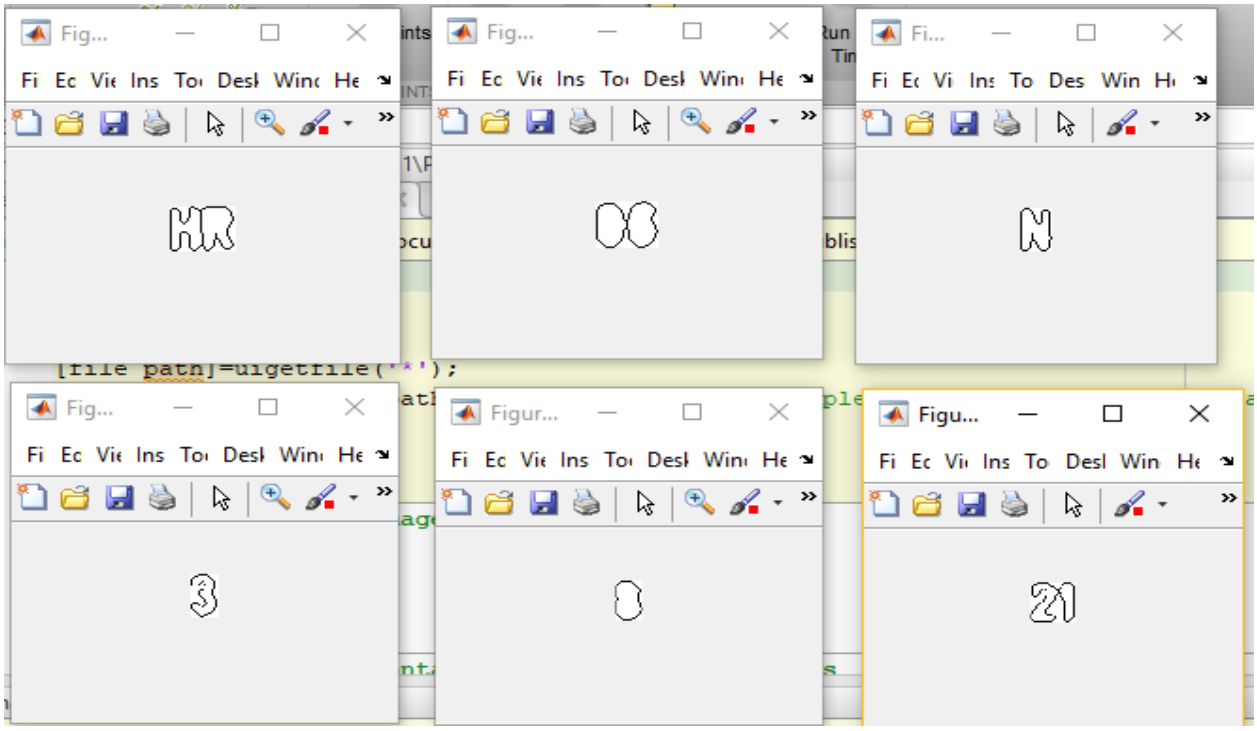
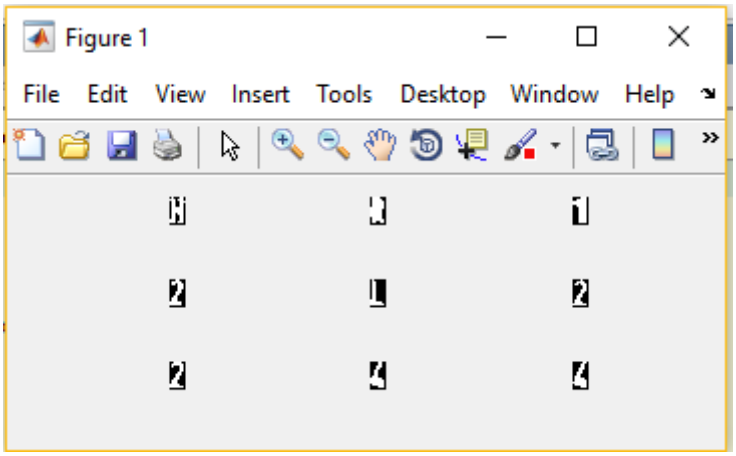


Fig. 13: License plate number detected

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testing
Final Accuracy
   100
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Fig. 14: License plate number detected

5. CONCLUSION

In our dissertation work our main objective is to detect license plate using vertical edge detection and besides this many other functions are also used like license plate area, erode function, filter image, the positioning of the license plate, threshold image, Sobel edge detection dilate image. There are various techniques to detect license plate and there is so many factors on which it depends how smoothly it can be detected. Basically, there are three parts generally we use for detection that is image localization, segmentation and then recognition. The advantage of the vertical edge detection method is that it is able to process complex background and low-resolution images. It becomes difficult to segment characters when the license plate is tilted. Extend the current system to also recognize uncharacteristic plates and additional character set. Improve the recognition ratio by using alternative hybrid algorithms. Further new advanced technology can be implemented like Artificial Intelligence, IoT, Machine Learning and Neural Network to enhance the accuracy

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