IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

Automatic License Number Plate Recognition System(ALNPR)

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ABSTRACT

Basically video surveillance system is used for security Both systems are for monitoring and purpose. But it is difficult to detect moving objects while using video surveillance. For home security, AD, bank / ATM security, traffic control etc., video surveillance systems are used. Detecting and tracking human activity is becoming more widely used as high-quality video surveillance systems become more affordable. As a result, automated techniques have been developed for a wide variety of detection tasks, although human operators of surveillance systems are usually responsible for detecting illegally parked cars. Identifying Indian cars by their license plates has been the most fascinating and difficult study of the last few years. It has been observed that in many countries, automobile number plates come in a variety of sizes, shapes and colors.

The vehicle number plate recognition and identification technology proposed in this project helps in identifying legal and unauthorized vehicle number plates. This project provides a technique based on Sobel's edge detection method and a simple yet effective proforma process. To streamline the process, we will use the bounding box method to hash all of the characters and numbers on the licensece plate. After the license plate has been segmented, the numerals and letters are read using template matching technology. Every individual digit on the keypad has to be clearly separated from the surrounding letters and symbols.

Keywords

Number Plate Recognition (NPR), Support Vector Machine (SVM), Automated Teller Machine, Grey level values

1. INTRODUCTION

1.1 Automatic License Number Plate Recognition (ANPR)

License Plate Recognition (LPR) is a combination of Vehicles may be tracked down by license plate using character segmentation and image processing methods. Since just license plate information is used for identification in this manner, no further hardware has to be placed on vehicles. LPR technology's widespread adoption has been steady, particularly in police and traffic management applications. License plate readers are often used in a variety of applications, including building and parking lot access control, police enforcement, stolen vehicle identification, traffic management, automated toll collection,

and market research.

To capture license plates, LPR applications use image processing and segmentation techniques, and each process requires a large amount of CPU. Government standards embedded in license plates can greatly reduce the amount of computation required and increase accuracy. Because the size, style, and alignment of license plate text can vary widely in photographs, limits specify ranges of values rather than exact measurements.

The following factors should be considered: maximum detection accuracy, short processing times, handling a variety of plate types, maintaining a wide range of image quality, and increasing input data distortion tolerance. LPR systems typically include the following components: Camera: Takes pictures of the front or rear of the vehicle. Typically running on a personal computer, image control, panel analysis and recognition, and interaction with other software and systems, the LPR application is running. Software: Identification and Application Package (MATLAB).

Automatic license plate recognition requires combining several different image processing techniques and algorithms into a single program. Text localization, extraction, optimization, character segmentation and recognition techniques are used to identify the

license plate number in a given image or video frame. Previous studies have only scratched the surface of the many steps involved in a typical LPR system, from image capture to validation. In this research, a fully functional real-time license plate recognition system was built and implemented. A common system step that takes the most time is license plate localization and extraction. In order for LPY systems to find license plates in real time, predictions and optimizations are required. But along with this increase in computing requirements. The above limitations and information are used to minimize this harmful effect. After the license plate region is extracted the region is post-processed for character segmentation and identification. Framework of the proposed system. The described approach is intended to identify license plates from moving objects. An image of the license plate captured by the camera serves as the input to the system, while its output — the recognition of the letters on the license plate resides in a separate notepad window. Vehicle speed estimation, image capture, license plate extraction, license plate segmentation, and license plate recognition are the six main components of the system, which are traditional for LPR system. The first task is to get the image. The second task captures the area where the license plate is located. Similar to Indian license plates, the third function separates letters, letters and numbers (0-9), which recognize or recognize split letters. Optical Flow Technique,

Adaptive Contrast Change Detection, Background Removal Method, Optical Flow Method, Image Acquisition, License Plate Extraction, License Plate Segmentation and License plate segmentation Learn about license plates. License Plate Recognition (LPR) Systems Applications - In every country, there are many uses for license plate recognition systems. These include automated parking attendants and computerized highway toll collection. Law Enforcement, Parking .

1.2 Scope of this paper

Because of the difficulty in choosing the right method, several articles are presented using the processes shown in Figure 1.4 and classified according to the methodology used in each approach. Speed, accuracy, performance, image size and platform of each method are included, if relevant details such as license plate color are available. Commercial items are not always accurately scanned and doing so is beyond the scope of this article. To identify license plates, this research uses several methods. Plate edge detection and feature segmentation methods are explained from the perspective of image extraction. An analysis of what was not done in the ALNPR and what studies could be done serves as the conclusion of the article.

2. NUMBER PLATE DETECTION

Based on different methods, most of the number plate recognition algorithms can be divided into more than one category. The following factors must be considered while identifying a vehicle number plate:

(1) Panel Size: In a car photo, the panel size can be variable.

(2) Plate Location: The plate can be found anywhere on the vehicle.

(3) Plate Background: Depending on the type of vehicle, the plate may have a different background color. For example, the background of the number plate of a government vehicle may be different from that of other public vehicles.

(4)Screw: A screw on a plate may appear as a character.

Identifying probable licence plate areas from photographs of automobiles is challenging because to the large amount of variation in size, shape, colour, texture, and spatial orientation that exists within licence plate regions. The primary objective of any licence plate recognition system is to extract licence plate numbers from pictures of vehicles taken by roadside cameras by identifying prospective licence plate regions and then interpreting those areas via a process called template matching. Since online ALPR systems are able to instantly localize and read licence plates from incoming stationary frames, they may be used for real-time surveillance of moving cars. The photos of cars captured by an offline ALPR system are then stored on a data server where they may be processed later on, including the decoding of licence plate information..

2.1 Gray scale conversion, Dilation, Filling

The R, G, and B components are extracted from the 24-bit colour value of each pixel I j), and then the formula is used to get the 8-bit grey value.

$$Gray(i, j) = 0.59*R(i, j) + 0.30*G(i, j) + 0.11*B(i, j)$$

By allowing objects to expand, stretching emphasizes the shapes and geometry of objects in an image. The simplest structural element is an array of 0s and 1s, which can be of any size and shape. "Holes" are inserted into the magnified image to highlight the area of interest.

2.2 Median filtering

A nonlinear filter called an averaging filter replaces the gray value of a pixel with the average of its adjacent gray values. Eight pixel neighbors and their gray values are obtained using 3x3 masks. This process removes salt and pepper noise from the image.

2.3 Contrast enhancement

Each image's contrast is enhanced with the use of a 256-level grayscale histogram equalisation process (from 0 to 255). The number of pixels with k different shades of grey is denoted by Nk, where N is the total number of pixels in the picture. Therefore, Pk = nk/N may be used to calculate the chance that k shades of grey will appear. The heightened grey level SK is determined by the cumulative grey level repetition frequency k.

2.1 Scope of this paper

Since it is impossible to determine which technique is best, several articles are analyzed based on the steps presented in Figure 1.4 and grouped according to the methodology used in each approach. The speed, accuracy, performance, image size and platform of each method are provided if relevant characteristics such as license plate color are available. Scanning commercial items is beyond the scope of this article as they are not always accurate. This study uses a variety of strategies to identify license plates. Plate edge detection and character segmentation algorithms are discussed from an image extraction perspective. The article concludes with an examination of what has not been done in the ALNPR and what kind of study is possible.

3. NUMBER PLATE DETECTION

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2.4 Gray scale conversion, Dilation, Filling

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Gray (i, j) = 0.59*R (i, j) + 0.30*G (i, j) + 0.11*B (i, j) (1)

By allowing items to enlarge, dilation highlights the forms and geometry of objects in a picture. The simplest structural element is a matrix of 0s and 1s, which may be any size and form. "Holes" are created in the dilated picture to highlight the area of interest..

2.5 Edge Detection

In this effort, we extracted the edges generated by the symbol for use on a vehicle's licence plate. License numbers are printed horizontally, and the vertical borders of the letters are at the same height and at uniform intervals. The design and placement of the vertical edges remain consistent with the format of the licence plate. A licence plate is the only area in which this particular pattern of vertical edges is found naturally. The minimum and maximum sizes of the area are mandatory. It is recommended that the length to width ratio falls between 10:1 and 1:1.

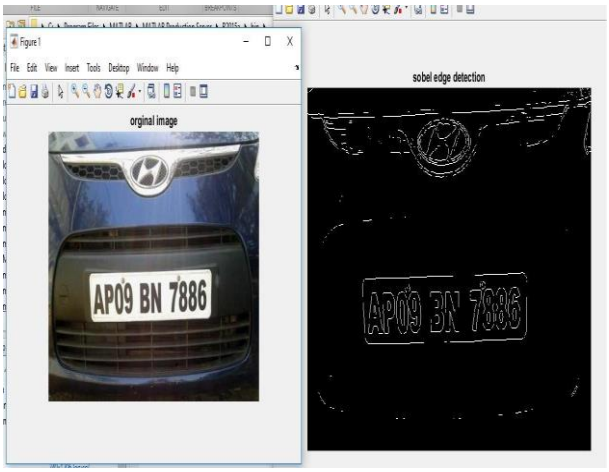

Figure: 2.2.1 Edge Detection example

2.6 Median filtering

Averaging filters are nonlinear filters that take the average of neighbouring grey levels and use it as the new value for a pixel's grey. Using 3x3 masks, we can retrieve the grey values of 8 neighbouring pixels. The procedure cleans the picture of unwanted "salt and pepper" noise..

2.7 Contrast enhancement

Each image's contrast is enhanced with the use of a 256-level grayscale histogram equalisation process (from 0 to 255). The number of pixels with k different shades of grey is denoted by Nk, where N is the total number of pixels in the picture. Therefore, Pk = nk/N may be used to calculate the chance that k shades of grey will appear. The heightened grey level SK is determined by the cumulative grey level repetition frequency k.

2.8 Segmentation

The technique of dividing an image into sections or regions is called image segmentation. The characteristics of the pixels in the image are often the basis of this segmentation. For example, looking for sharp disparities in pixel values, which often indicate edges, is one way to identify regions in an image. Regions can be defined using these edges. An image can also be divided into regions by color values. Blob parsing is used for hashing, which executes the following instructions. The Bwlabel command names a group of linked objects and returns the number of pixels connected serially to create that group. For each associated component, a set of properties is measured by "regionprops". Only area, centroid, and bounding box metrics are calculated using area supports. Both commands are used to label items in a rectangle with a bounding box around them. The letters on the license plate are clipped using the boundary coordinates of each boundary of the given object. In addition to usable LP characters and integers at this point, broken characters may also contain garbage objects; Some redeeming things are useful.

Figure 2.5.1: Segmented Number Plate

2.9 Related work in number plate

detection(commands)

Imshow:

Whether I is grayscale, colour, or binary, Imshow(I) will show it as a form. For binary pictures, Imshow shows black for pixels with a value of 0 and white for those with a value of 1.

. **Imdilate:**

The IM2=imdilate(IM,SE) command dilates a grayscale, binary, or filled binary image and outputs the dilated version IM2. The SE parameter causes imdilate binary expansion if the skeleton element is an object and the structure element is flat; Otherwise, it performs gray scale dilation.

Imfill:

BW2 = imfill (BW) shows a BW binary image on the screen and allows you to interactively select points with the mouse to select the area to be filled.

A BW binary image is filled with holes using BW2 = imfill(BW,"holes"). A gap in background pixels that cannot be filled by working from the edge of the image.

Imerode:

A grayscale, binary or packed binary image is eroded using the formula IM2=imerode(IM,SE) which returns the IM2 eroded image. The SE parameter is an object or array of skeletal elements returned by the strel function.

RESULTS

Results:

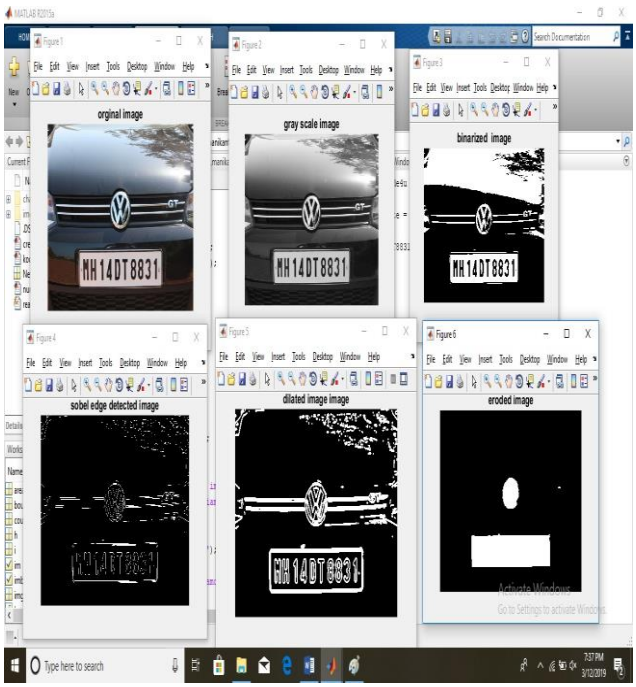

Figure: 2.6.1 Different stages in number plate extraction

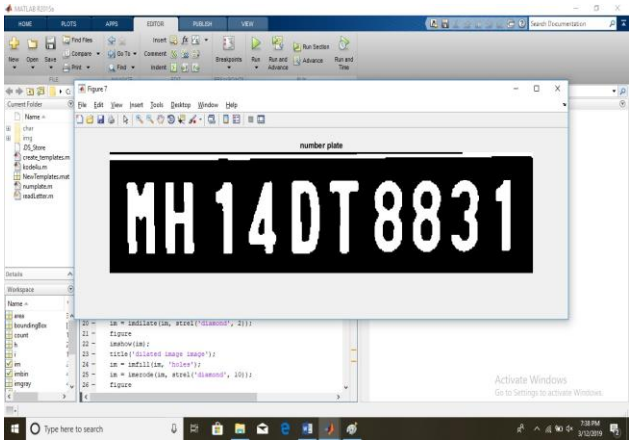

Figure: 2.6.2 segmented number plate

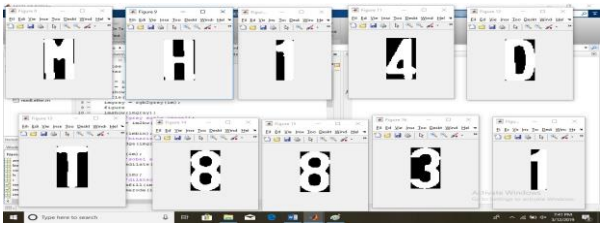

Figure: 2.6.3 segmented characters

Hashing the number pad requires a GHz processor with 111ms processing time and 512MB of RAM .Real time vehicle number plate recognition method. This framework segments the license plate using a small frame detection module. This module consists of three steps: First-generation plate-area filters are used to exclude regions without plates, using gradient features. The second step is the extraction of complex lamina regions, which involves three procedures to separate lamina regions from non-lamina regions.

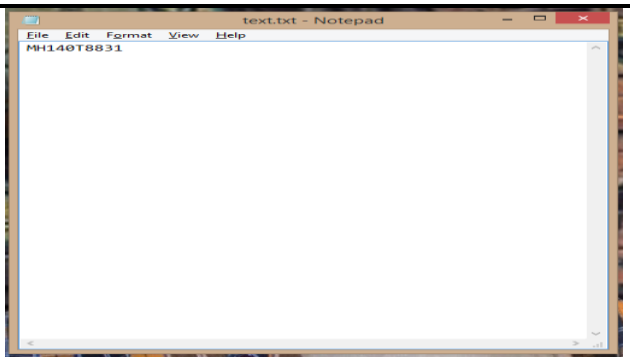

Figure: 2.6.4 Text Converted Number Plate

Plate-validation is used as a third step, to ensure that no non-lamellar regions have been recovered in previous steps. The experiment was performed on a computer with a 1GHz or faster CPU, Intel or AMD. If the number is curved, the plate must be rotated at a certain angle. Determine if the characters span more than one line or column using the character's line number as shown in the figure. 2. (b). The algorithm can handle up to three lines. Identity Templates: Determine if the number pad consists entirely of alphabets, alphabets, and numbers, or alphabets, numbers, and symbols. Letter Formats: Labels a wide variety of letters on license plates. For example, symbols can be represented by the letter S, the alphabet by the letter A, and numbers by the letter D. As a result, the number in Figure 2 is written as AADAADDDD.

(a) Skewed image (b) Number plate with lines

Fig. 2.6.5 Vehicle number plate with first two parameters

VELOCITY ESTIMATION:

Several techniques can be used to calculate the speed of moving objects in video. Intelligent edge detection based on fast estimation of differences between models and images with edge-preserving regularization.

Introduction to MATLAB:

MATLAB is a high-performance programming language designed for use in scientific and engineering computations. The system is user-friendly, combining calculation, visualization, and programming, and both the problems and their answers are provided in standard mathematical notation. Common applications include scientific and technical visualisation, data analysis, exploration, visualisation, scientific and technical graphics, application development, and graphical user interface design, as well as mathematics and computing, algorithm development, modelling, simulation, prototyping, data analysis, exploration, and visualisation.

There are both A and B variants of R2009, R2010, R2012, R2013, R2015, and R2017. It supports object-oriented

programming, control flow data, functions, data structures, input/output, and input/output at a high level. It allows for both speedy development of huge, complicated, whole-application programmes and the development of tiny, quick and dirty applications, or "programming in the big" and "programming in the small," respectively. By default most data is stored in

matrices of double class in MATLAB. These arrays have double-precision (64-bit) floating point values as their data format. With these matrices, all MATLAB operations and features are compatible.

However, MATLAB-supported graphics file formats do not benefit from this data structure. There may be too many pixels in this picture; a 10001000 image, for instance, would contain 1,000,000 pixels. Given that at least one matrix member is needed to represent each pixel in the picture, storing it as a double will need about 8 gigabytes of RAM. To reduce file sizes, MATLAB supports the storage of picture data in arrays of the uint8 and uintl6 types.. These arrays contain 8-bit or 16-bit unsigned integers as data. Unlike data in binary arrays, these arrays use only one-eighth or one-fourth of the memory.

MATLAB has several tools for annotating and generating simple line diagrams with vector data shown as lines. These functions differ in the way they automatically scale the axes to fit the data after accepting input in the form of vectors or matrices. A command-and-browse grid matrix produces a 3D surface image of the data. The visual appearance of the skin can also be controlled through skin object settings, which include edge line styles, header tags, face coloring, lighting, and featured images. To remove a number plate from a car photo without a background image, there are seven steps to follow.

An important approach is used to capture a vehicle number plate, with important elements including shape, texture and color. Red, green and blue (RGB) images of rectangular vehicle number plates were analyzed by the authors using Hogg transform (HT) to detect vertical and horizontal lines (HIS). The license plate is split at the end. MATLAB is used to implement this technique on a Pentium-IV 2.26GHz computer with 1GB RAM.

The algorithm used to recognize license plates has been improved. This technique is used in situations such as uneven lighting and is very effective in removing shadows. To obtain excellent accuracy, the authors used local threshold binary differential method, local Otsu method and global Otsu method. Unlike the traditional Bernsen approach, our algorithm effectively removes the shadow and detects the license plate. The experiment was conducted on a Windows computer with a 2 GHz Intel Core processor and 8 GB RAM. Python, C or Visual C++ was used to create the algorithm.

A method is proposed to efficiently localize license licence plates from surveillance video by using a tweaked version of a previously developed tracking and recognition approach on video sequences. The authors suggested a workaround that would allow for a varying camera distance and illuminance. License plate recognition entails four stages: form detection and related components, rectangle area selection based on size and aspect ratio, basic learning of adaptive camera distance/height, histogram-based localization, gradient processing, and nearest average classification. When all of these conditions are met, the final result of trace detection is delivered. Think about charge-coupled device (CCD) cameras, complementary metal-oxide-semiconductor (CMOS) cameras, and infrare.

3.2 Discussion

To implement character recognition with a high degree of accuracy, character segmentation is critical. Character segmentation errors can sometimes prevent characters from being recognized. Character fragmentation is not fully covered in some ALNPR literature. Character segmentation can be improved using methods such as binary image segmentation, CCA, vertical projection and horizontal projection.

4. CHARACTER RECOGNITION

Selecting image text and converting it to editable text is made easy with character recognition. Most number plate recognition algorithms use only one method to recognize characters. This section describes each technique. In India, every motor vehicle is identified by its registration or license number. The Regional Transport Office (RTO), the state's apex decision-making body on transport issues, assigns the vehicle registration plate number (also known as number plate) at the district level. Both the front and rear of the car are covered with license plates. By law, all panels must be written in contemporary Hindu Arabic and Latin letters and numbers. Other rules include limiting the lines that can be used and lighting the board at night. Vehicles with foreign license plates are prohibited from entering restricted areas in various states including Sikkim. International Vehicle Identification Number in India is IND.

4.1 Artificial Neural Network (ANN)

An associative system of artificial neurons is referred to as an artificial neural network (ANN), sometimes called a neural network. In ANN, several algorithms are based. 180-180-36 Topology of Two-Layer Probabilistic Neural Networks. Letters were recognized in 128 ms. To classify letters, an ANN model called Multilayer Perceptron (MLP) is used. It consists of an input layer used to make decisions, a hidden layer used to calculate more complex correlations, and an output layer used to present the final choice. ANN is trained using feed-forward backpropagation (BP) technique. HNN is used to reduce ambiguity between characters that are similar to each other like 8, B, 2, Z and so on. The authors claim that they have a recognition rate of over 99%.

4.2 Template matching

Template matching is important for this purpose since it allows for the recognition of characters with a consistent size. Medical image processing isn't the only area where it may be put to use, however; it can also be put to use in recognising faces and other objects. Another two are feature-based matching and template-based matching. It is helpful to utilise a feature-based strategy when the template picture contains exceptional characteristics, and a template-based method otherwise. To achieve a character recognition rate of 85%, statistical feature extraction is used. According to the training roles, several features are retrieved from [15] and the most important ones are calculated. To ensure that all letters are the same size, a linear normalization procedure is used. On a total of 1176 images, the recognition rate reached 95.7%. For the purpose of feature extraction, Chinese, Kana and English numeric characters are combined. For numbers, kana and address

recognition, the book's success rates were 99.5%, 98.6% and 97.8%, respectively. In [16], a model-based strategy is proposed. To deal with low quality images such as 4×8, the authors used a low resolution template matching approach. To determine how similar the samples are, the authors used a similarity function. By using statistical functions, general features of an image can be examined:

- Computing the mean or standard deviation
- Displaying an image histogram.

The data matrix, X, is combined with the color map matrix to form the map, index image. A map is an m x 3 double class array that holds floating point values between [0, 1]. Red, green and blue components of the same color are marked in each row of the map. A "direct mapping" of pixel values to color map values is done in the index image. The relation of the Image Matrix values

to the colour map is specified by the Image Matrix class. Since row 2 is represented by the value 2 in a double-class image matrix, row 1 is represented by the value 1. If the image matrix is of type uint8 or uint16, the value 0 represents the first row of the colormap, while the value 1 represents the second row. You can utilise offset in graphic file formats to store more colours if you need to. That previous picture has a dual type image matrix.

4.3 Other methods

Optical character recognition (OCR) software is sometimes used in algorithms to perform character recognition. There are various types of OCR processing software available. Tesseract [74, 75], an open source OCR software maintained by Google that supports multiple languages, is one such tool and can be accessed at [76]. To recognize letters, it uses [14]. To get a character recognition rate of 98.7%, the author changed it. In [43], the authors used Markov Random Fields (MRF) to represent character extraction, with randomness to reflect uncertainty in pixel assignment. For further probabilistic improvement, personality extraction is performed as an optimization problem based on prior information. Then the computational cost is reduced by using a greedy mutation operator. Personality classification, topological sorting and self-organizing (SO) recognition are the three components of the strategy proposed in [49]. Character classification is used to group characters into alphanumeric categories. The second step consists of computing the topological properties of the input character and comparing them with previously saved character templates. A character template most similar to the input character is selected from the test set of compatible templates. SO tests the character recognition technology template. Self-organizing neural networks use Kohonen's self-organizing feature maps to handle unpleasant, corrupted, or missing characters. In order to tell between words that may seem similar, the authors constructed a disambiguation set consisting of the digits 0 and the characters 8, B, and D. (O, D). As can be seen in the diagram, each letter in the set is broken down into distinct components. Third, a brief comparison is drawn between the unnamed and the classified figure once the unknown is shown to be a member of the secret organisation. Then, in drawing parallels, only the most blatant characteristics of the characters are emphasised. The authors' rate of correct identification of licence plates in photographs was 95.6%. An overview of ACR techniques is covered in [77]. According to Anju K. Sadashivan and T., there is a fundamental difficulty in defining personality.

Usability: With a basic understanding of the concepts, the user can enter an image of intermediate clarity and understand the result.

Performance: The proposed system processes data faster and more reliably after receiving required inputs.

Supportability: The system can be further developed to include potential additional collaborative elements. The proposed system works without any problems anywhere.

Since character segmentation is a part of the pre-processing phase of character recognition, the recognition system must be able to deal with unclear, jumbled, or garbled characters that are returned from this stage. The use of ANN with self-organizing (SO) detection has shown positive results. Table 2 provides a summary of the information. OCR is now a widely used and popular technology, so ANPR engineers focus on increasing OCR accuracy rather than completely redesigning ANPR. As explained in the section above, many developers are improving open source OCR such as Tesseract for greater accuracy. Expanded to multilingual ANPR to automatically recognize character language based on training data when compared to searching for vehicle owner registration data, this may offer many benefits including traffic safety enforcement and security – ease of use and speed of information availability – should the vehicle engage in questionable activity.

5. CONCLUSION

5.1 Future work

Select specific letters from a board with different colored backgrounds using government templates that will be applied in future work.

It is mostly used to control traffic without human assistance in high traffic areas. It can be used to monitor car parking. To punish those who violate traffic laws by

speeding, running red lights or using unlicensed cars.

Additional uses of ANPR include vehicle location monitoring, vehicle owner identification, vehicle model identification and traffic management. Any country can do this manually and affordably. Some image enhancement techniques are suitable for low-resolution images, such as super-resolution [30], [31]. You should pay attention. Most ANPR systems focus on processing a single vehicle's number plate, but in reality many vehicles may have number plates at the time of image capture. Images of multiple vehicle number plates are taken into account for ANPR in [5], while most other systems use offline images of vehicles retrieved from Internet databases such as [78] as input. As a result, the exact results may differ from those shown in Tables 1 and 2. A coarse-to-fine technique [56] is used to segment several vehicle license plates.

5.2 Summary

It is clear that ALNPR is a challenging technique due to the number of different steps involved, and since each step depends on the one before it, it is currently not possible to reach an overall accuracy of 100%. The effectiveness of ALNPR is affected by many factors such as different lighting conditions, vehicle shades, non-uniform size of license plate letters and different font and background colors. Some systems can only work in these specific conditions and may not provide accurate results in difficult situations. Table 3 excludes systems where no country is mentioned. Table 3 shows that only a small percentage of ANPR [34], [7] is produced for India. Therefore, a country like India has a lot of scope to build such a system. Scholars involved in these developments may benefit from this paper's detailed analysis of current trends and future developments in ANPR.

Table 2. Character recognition rate with method and type of category

Ref	Method	Success Rate (in %)	Type of Category
[5]	Two layer PNN	89,1	Letters
[34]	Statistical feature extraction.	85	Not reported
[15]	Feature salient	95,7	Not reported
[19]	SVM Integration with feature extraction	93,7	English characters, Chinese, Numeral, Kana
[16]	Template matching	Not reported	Letters, digits
[6]	multi layered perceptron (MLP) ANN	98,17	Letters, digits
[7]	multi layered perceptron (MLP) ANN	Not reported	Letters, digits
[14]	Open source OCR Tesseract	98,7	Letters, digits
[8]	BP neural network	Not reported	Korean Letters, digits
[18]	BP neural network	Not reported	Chinese letters, English lettersand digits
[43]	MRF	Not reported	Letters, digits
[49]	character categorization, topological sorting, andself-organizing (SO) recognition	95,6	Letters, digits
[52]	Hierarchical Neural Network(HNN)	95,2	Letters, digits
[11]	PNN	96,5	Letters, digits
[10]	BP neural network	93,5	Letters, digits

Table 3. Different ANPR systems with country supported

Ref	Country(In which ANPR isapplied)
[5]	European
[17]	USA, China, Singapore, Australia, SouthAfrica
[34]	India
[15],[35],[18],[23], [22],[40]	China
[7]	Nigeria, Cyprus, Denmark, Germany, Estonia, Finland, France, India, Norway, Portugal, U.S.A, Bulgaria, Czech Republic
[44]	Dutch
[45]	Israel, Bulgaria
[47],[26],[51]	Korea
[52]	Multi-country
[20]	Turkey
[21]	Australia
[53],[24]	Iran
[27]	USA
[28]	China and 104 Countries

6. ACKNOWLEDGMENTS

The authors acknowledge Mr. Baba F Ali for giving them the advice they needed to carry out this study. The resources required to carry out this survey were provided by VTU University, which the authors are very grateful for.

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