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A Review Paper on License Plate Recognition System

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Abstract: ***The process of identifying the number from the license plate of any vehicle is the task of License Plate Recognition (LPR). It is one of the popular image processing technology. It consists of four basic steps for identifying the number plate: obtain or capture the image from camera, some pre-processing tasks, effective character segmentation and efficient character recognition. Main difficulty arises in identifying license plate is due to environment conditions. Due to harsh environment conditions it is difficult to obtain 100% perfect estimate of numbers. From the literature review we find that some technique provide accuracy to 93.7 while some other 95.5%. This paper provides review of various license plate recognition system implemented so far.***

Keywords: License Plate Recognition (LPR), Neural Network, Region of Interest (ROI).

I. INTRODUCTION

Now a day's Number plate Recognition has become the hotspot issue due to faster growth of transportation system. Identification of License Plate has become more practical in many applications during last few decades. Where the License Plate Recognition has applications in many field like in Automatic toll collection and handling, parking fee payment, traffic monitoring, moving object tracking, in defense also in Automatic Visual Inspection System etc.

The main aim of this paper is to provide the review of various existing techniques for License Plate Verification. To categorize those techniques by comparing and analyzing the advantages and disadvantages of existing technologies. Block diagram of Number Plate Recognition system is shown below in figure 1. Different techniques were proposed by different researchers for each step and each techniques has own pros/cons. The License Plate Recognition (LPR) System mainly contains the three major steps of Region of Interest Extraction, Number Plate Extraction, and Character Recognition.

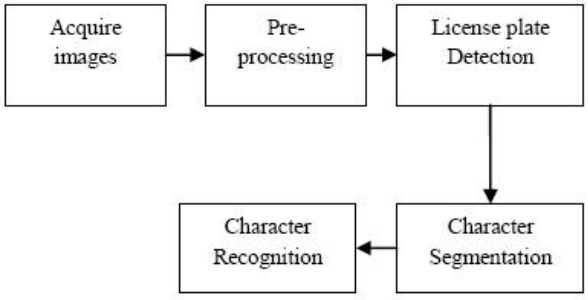


Fig 1: Block diagram of License Plate System

A. Image Acquisition

Initial Phase for License Plate Recognition is Image acquire can be from any method like image analog or digital, where the image can be obtained from any video. Image acquisition is very important step in the number plate recognition, as it is affected by illumination, weather, angle of rotation, resolution of image required etc. [14] Where the Image obtained from any Source can be in any image format like jpeg., Gif, ,tiff but more Jpeg is preferable because further operation can be performed efficiently and easily. Where the image is acquire for further image processing tasks.

B. Pre-Processing & ROI Extraction

Image obtain from any storage can be of any colour, any format or different properties. Here the main first step is pre-processing in which the original or RGB image is converted to Gray Scale [8] [9] [14] [15]. There exist some techniques which were used by

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many researchers like NTSC Standard method [5] [15], Otsu method etc. which are further explained in literature review. After that filtering process is applied in pre-processing task there exist various filtering techniques but more preferably median filtering [5] [6] [9] is used by many researcher for noise removal process.

ROI (Region of Interest) Extraction:-The image obtained after the pre-processing contains the whole background area also including the body of Vehicle and many more area it can which is unused. So the region of interest is need to be extracted for further process.

There are the various existing techniques which were proposed by many researcher for ROI Extraction like binarization using variable thresholding technique [1], Sauvola method [2] where the binarization for the highlighting character & Suppressing background, Edge detection technique [3] [13], Semaring Algorithm [3], Morphological Operations [4], Improved Bernsen algorithm [7], Window filtering method [8] etc. More techniques are explained in the literature review.

C. License Plate Segmentation

The image obtained after the Region of Interest extracted is further need to be segmented. In this process image is further segmented for the character or number recognition purpose. There exist various techniques which provide the task of number plate segmentations like Semering Algorithm [3], Histogram Process [4] [6], Otsu Method [5], Horizontal and Vertical Approach [7] [10] [13], region props function using MATLAB etc. and more techniques are explained in the literature review.

D. Character Recognition

The License plate is now recognized after the segmented process. There exist various techniques for character recognition which are like segmentation based on Neural network [2] [4] [10] [13], Probabilistic Neural Network (PNN) [2], Multi-layer perception model of ANN (Artificial Neural Network) [6], Support Vector Machine (SVM) [7], Statical/Hybrid classifier Approach [4] etc. and more techniques are explained further in literature review. After the character recognition the process of character matching with database take place which is implemented by many researcher by OCR (Optical Character Recognition) which can use the concept of Statical based template matching and further more are discussed in literature review.

The variations in Number plate types and environments create challenges in Number plate recognition. These can be like that Number Plate Variations can be one of the given below:

1) *Location of Plate:* Number Plate Exist or Not. Having more than one number plate, Different location of Number plate.
2) *Size of Plate:* There can the size of plate can be varying due to capturing of image.
3) *Plate Colour:* Different Plate having different Colour variations in background or also based on capturing device.
4) *Character & Number Font:* Number Plates of different Countries may Contains the data in different format than others.
5) *Occlusion Plate:* Plates may be covered by dust or it can be blurred type.
6) *Other:* where the Number Plate Can Be tilled, a plate having frames and screws etc. Environmental variations:
7) *Different Illumination:* Our taken images may have different types of illumination, Can be due to weather condition, due to environmental condition or due to vehicle own or other lightning etc.
8) *Image Background:* The image background can contains complex figure, the area of plate same as background etc.

II. LITERATURE REVIEW

In the literature Review many Number Plate Recognition methods have been purposed. Where the number plate recognition is the hotspot area of research now a days due to rapid development of transportation systems and from literature review we can see various existing techniques take place for number plate recognition.

In [2004] Number plate recognition method here first used Colour Edge Detection and fuzzy maps then steps taken into account were (1) Pre-processing:- Consists binarization using variable thresholding technique then Connected Component algorithm was applied to binarized plate to eliminate undesired area. Huge transformed was taken into account for alignment of extracted components for further process. (2) OCR (Optical Character Recognition) here the character recognition process takes and task of character categorization accomplished by the compositional semantics of license numbers, Topological Shorting to compute the topological features of characters for further process [1].

In [2006] the method mainly consists the tasks (1) License Plate Segmentation: - binarization with Sauvola Method and use the Sliding Concentric Windows (SCWs) segmentation technique for faster detection of region of interest (ROI). (2) License Plate Processing: - Image was transformed into standard size by bicubic interpolation method. (3) Character Recognition:-Trainable OCR (Optical Character Recognition) System based on Neural Networks was taken into account which used the approach of PNN

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(Probabilistic Neural Network) with two individual probabilistic networks one for the alphabet and other for the number recognition [2].

In [2007] the system mainly accomplice with three major steps (1) Plate Region Extraction: - Image Captured to binary image and then Edge detection technique, smearing algorithms were used for extracting the Region of Interest (ROI). A morphological operation was performed for the dilation of Image (2). Segmentation of characters: - Character segmentation was provided by smearing algorithms, Morphological Operations and some filtering process. (3) Recognition of Characters: - Statistical based template matching provide the best match of segmented character which taken as input. And the accuracy for different step here for Plate Region Extraction tested on 332/340 achieved 97.6% for Segmentation of character over 327/340 images achieved 96.0% and for Recognition of Characters over 336/340 was achieved 98.8% [3].

In [2008] this paper mainly aims to present the various existing techniques to categorize and assess them in general the number plate recognition consist three steps (1) Extraction of a ROI: - edge statistics, morphology, Connected component analysis (CCA). (2) Segmentation of the plate characters: - Using Histogram Processing, Mathematical Morphology, Local/Adaptive Thresholding and Transformations. (3)Character recognition: - Using Statistical/Hybrid Classifiers, Pattern or Template Matching. Better Results have been achieved by using the concept of neural networks and statistical classifier approach but a large amount of learning training sample needed for the better work [4].

In [2010] the algorithm for number plate recognition composed with number of following steps (1) Pre-processing and Plate Recognition: - To improve the image Quality colour image was converted to gray level image using Standard NTSC model then median filtering was applied for noise reduction. Feature-based number plate localization method was implemented for further process. (2) Character Segmentation: - Otsu method for threshold the plate values. (3) Character Recognition: Statistical feature extraction has been implemented for the character recognition process. Performance analyzed for different part of purposed method was 85% for number plate localization, for character segmentation 95% and for character recognition it's was 82%. [5].

In [2011] the approach mainly based on Artificial Neural network while the steps proposed was (1) Plate Localization: - Canny Edge Detector used for the image localization purpose. (2) Character segmentation: - Histogram approach was taken into account for Contrast extension while median filtering for noise reduction (3). Feature Extraction: - Artificial Neural Network (ANN) was proposed in this process. Two separate ANN used one for Character and other for character extraction because confusion was high when combined approach was applied to both character and numbers so to increase the success rate separate ANN was implemented. (4)Character Recognition: - Multi layered perceptron (MLP) model of ANN was used for the character recognition purpose. Test was taken on 259 vehicle images and out of which 247 was recognized and overall accuracy was achieved near about 95.36% [6].

In [2011] Algorithm for number plate verification mainly accomplice four steps (1). Licence Plate Location: - Local Otsu and Improved Bernsen Algorithm was implemented (2). Licence Plate Detection: - Connected Component Analysis (CCA) based on Pixel Connectivity (3). Character Segmentation: - Horizontal and Vertical Correlation approach was taken into account for segmentation of characters. (4). Character Recognition: - Feature Extraction for character Recognition, feature extraction for number recognition has been implemented using Elastic Mesh approach which use the concept of Support Vector Machine(SVM) [7].

In [2011] Automatic Number Plate Recognition system mainly use the techniques of Edge finding method and Window filtering method. Where the localization of Plate consists the step of converting the Original Colures image to the gray level image. Identification of no. plate horizontally take place in which row represents the peak value of the region and then high change region was selected and vertical approach was applied. Then combined region was selected for the further process [8].

In [2012] Number plate recognition system was composed of mainly these steps (1) Pre-processing:- Image converted to gray scale from Original was goes for further process and median filtering was applied for noise removal (2) Plate Localization: - Morphological Operations were performed for Number plate localization (3) Character Segmentation: - the process of character segmentation take place using regionprops functions which take place into MATLAB. (4) Character Recognition: - Where the character recognition task was performed by the functions of MATLAB using OCR (Optical Character Recognition) Approach [9].

In [2013] vehicle license plate recognition System was per posed which contains mainly four steps (1). Pre-processing and Edge Extraction: - firstly the simple pre-processing of image take place and then edge extraction without filtering takes place. (2). Licence Plate Localization: - Use the Micron position technology and edge image was calculated by horizontal and vertical direction. (3)Character Segmentation: - Vertical area Projection Method was implemented for the character segmentation approach. (4). Character Recognition: - Character recognition process step implement the Artificial Neural Network approach and then at last

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Template matching algorithm was taken into account and best matched value was returned as a result[10].

In [2013] real time vehicle plate recognition was implemented mainly in two steps which can be further divided (1). Plate Location Detection:-this paper presents the implementation view of Vertical edge techniques and then detected lines were binarized. Verification of Upper number plate area was taken into account, Horizontal border, Excluding of border lines (2). Licence Plate Recognition: - Histogram technique was implemented for localization of plate and then character recognition take place by Normal factor (NF) Calculation. RLPR Test was taken on 250 images and out of which 231 images exact was recognized with accuracy rate 92.4% 17 were unrecognised and 2 were misrecognised [11].

In [2014] License Plate Automatic Recognition System was developed which consists six steps (1) Image Acquisition: - Image was taken from Digital or anlog Camera for further process. (2) Image Pre-processing:- Edge Detection Technique used for the image processing purpose then (3). License Plate Locating: - Mathematical Morphology techniques use for the licence plate localization which use the concept of shape, size etc. features of image not work on numeric type values. (4). Character Segmentation: - Vertical and Horizontal approach was consider for Character Segmentation (5). Character Recognition: - The further process of character recognition was take place with the help of Neural Network [12].

In [2014] Vehicle License Plate Detection and Recognition System here composed of four major steps (1) Preprocessing:- where the original or RGB image is converted to Gray Scale image using NTSC Standard method. (2).Localization:- Morphological Operation were performed and huge transformation was taken into account for edge detection Process. (3). Segmentation: - Horizontal Projection was applied for segmentation process. (4). Recognition: - Template matching process take place in which the pixel values of the matrix of segmented character and the template matrix were compared and best match value was returned as output. [13].

In [2015] Automatic License Plate Recognition using Matlab was proposed by P. Sai Krishna. In this thesis work, simple colour conversion edge detection and removal of noise with the application of median filter as one of the operators is attempted. This thesis work presents an approach using simple but efficient morphological operations, filtering and finding connected components for localization of Indian number plates .It proposes the identification of stolen cars .The algorithm has been tested on 20 samples and is found to extract both alphabets and numbers from vehicle license plates images with an accuracy of 90% for four wheeler license plates [14].

III. CONCLUSION

In this study various License Plate Recognition techniques has been discussed in details which were used by many researcher. The License Plate Recognition (LPR) System mainly contains the three major steps of Region of Interest Extraction, License Plate Extraction, and Character Recognition using number of different techniques which are disused in paper clearly. License plate recognition is challenging in case of different weather conditions and differ number plate formats. There are number of LPR techniques purposed in previous years.

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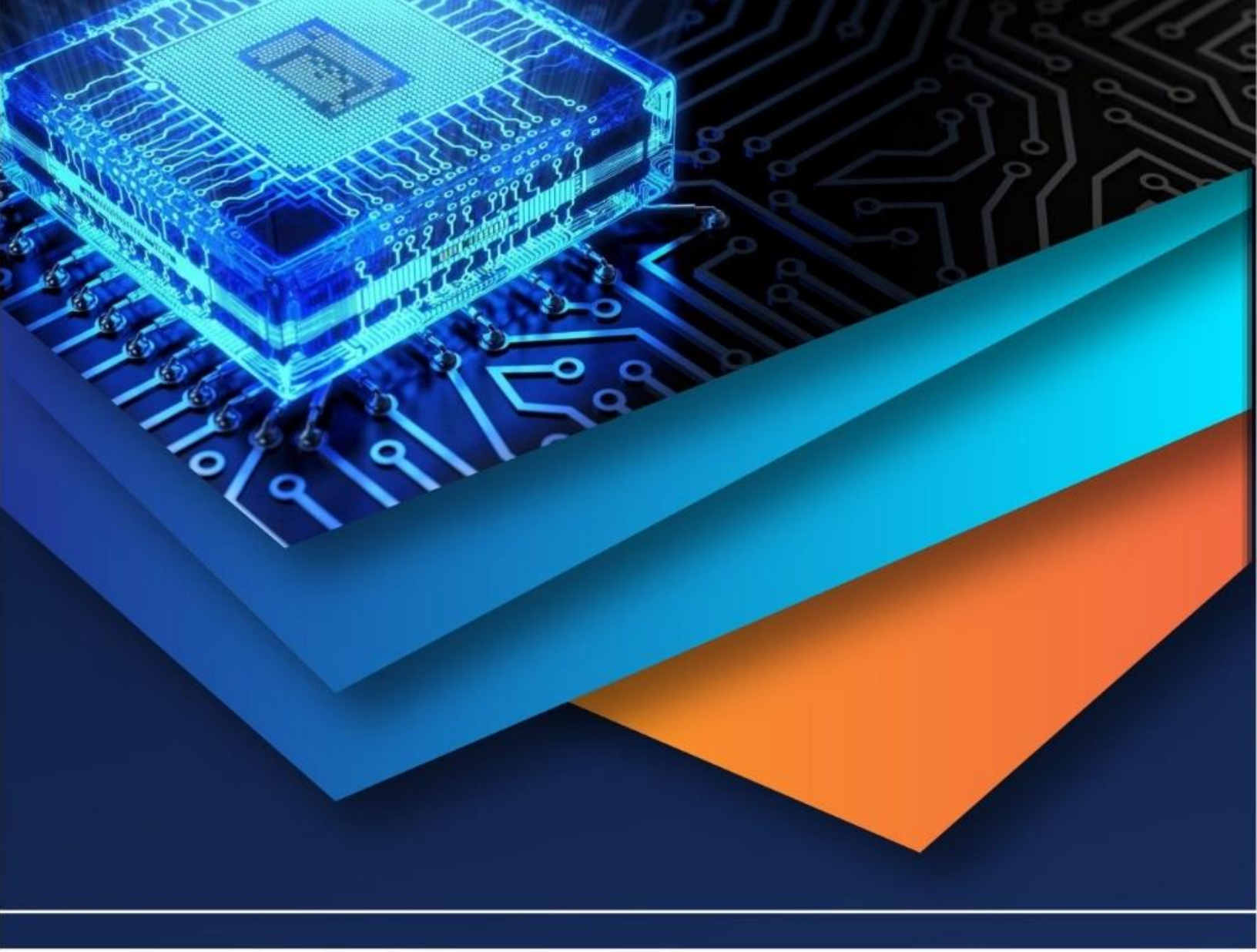
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