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VEHICLE LICENSE PLATE ESTIMATION TECHNIQUES: A COMPARITIVE STUDY

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Abstract: Vehicle license plate recognition is the most interesting and challenging topic for past few years. It is shown that the license plates are of different shape and size and also have different color in different countries but in existing system it can only detect for fixed size and fixed shape license plates. They have achieved the detection of license plates using various techniques and methods. In the traffic control and security management framework, license plate recognition methodology plays a important role, which manages more responsibility for high security. Identifying the moving vehicle's license plate is a complex task, because of the existence of noise and differing illumination and angles. So they executed the system with enhanced techniques and methods for accurate and reliable detection of license plate numbers. This paper briefs about the challenges and advantages of various methods in vehicle license plate estimation.

Index Terms **- OCR, ANR, Segmentation, De-blurring and Machine Learning.**

I. INTRODUCTION

India is a developing country and its advancements is reflected on a number of things. In last few years the culture and life style of Indian people has rapidly changed. In addition to that they started using different products to match with the current life style.

Among these life style products the vehicle has become one of the most essential part of our day-to-day life. But the impact of this fast and luxurious life style has occurred in different areas such as leaving places and traffic around us. In order to deal with this increasing traffic and the upcoming traffic, a number of different techniques and management skills are employed. Among them the automatic vehicle number plate recognition is a requirement of new generation traffic management and control.

The ANR (Automatic Number plate Recognition) plays a important role in many systems like traffic monitoring system, Crime detection system, Stolen vehicle detection, Child kidnapping, Crime in parking areas [1]etc. Thus, ANR is used by city traffic department to monitor the traffic as well as to track the stolen vehicle. Though ANR is a old research area in image processing but still it is evolving year by year, because detecting the number plate from the image or from video is not that easy task as like counting the vehicle from stream of video[4].

So far many of the researchers came with their own algorithm to detect the number plate, but each has some limitations. For some images it works perfectly, and for some images it is not working properly. That's the reason this area is still growing and still need enhancement. Detecting the number plate is the challenging task as the number plate writing style is different from country to country. In case of India the number plate writing style changes from state to state. In India the number plate is different for two wheelers and four wheelers. For four wheelers the number plate's background is a different i.e. yellow for tourist and white for private car. These are the basic challenges kept in mind before implementing the ANR system. ANR has predefined four basic steps to recognize the number plate as explained in the various research paper and journal paper [6] is shown in figure 1.

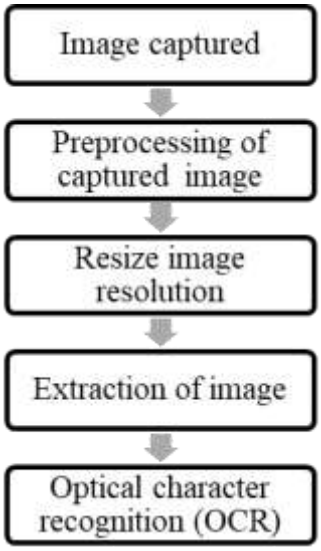

Fig 1: image processing technique

The steps in ANR includes,

1. **Image captured**: In this steps vehicle Image has to be captured by any standard camera or by extracting the interested frame from stream of video from CCTV live footage. Capturing the image from video stream and CCTV requires an additional work.
2. **Image preprocessing**: Once the interested image is being captured in which number plate clearly visible and fine texture pattern, then the further processing of the image is carried out. It has many steps: resize the image resolution, removal of noise from image, and conversion of the image from RGB to gray and then Binary (black and white).
3. **Extract images**: After preprocessing the vehicle number plate region from the image will be extracted.
4. **Optical Character Recognition (OCR)**: Electronic conversion of handwritten or printed text images into machine-encoded text. Here OCR used to detect the number from the image.

II. Number Plate Detection Systems

2.1. Skew Correction Method of License Plate Detection Estimation

Chi Toan Nguyen et al[1], proposes reliable detection and skew correction method of license plate for real-time license plate recognition under PTZ cameras. The license plate detection method works well in various environment and runs fast enough so as to operate in real-time. The skewness problem in license plates is also studied in this. The skewness affects the processing of character segmentation and classification, negatively. He proposed a comprehensive deskewing method dealing with rotation in depth as well as rotation in plane by utilizing planar homography. The robustness of the proposed method will be more secured by the more robust estimation of corner points obtained by the intersection of the line segments in the distorted license plate images. In addition to this pattern, detected license plate region, one can calculate the tilting angles of the estimated bottom or top horizontal boundaries of the license plate. Then, if the calculated tilting angle is small, then one can continue to processing of character segmentation. If not, the deskewing method should be applied. Without skew correction it provides accuracy of 15.23%. The tilting rotation provides accuracy of 64.76%. The accuracy obtained by skew correction is 89.57%.

2.2 De-blurring Technique of Detection Estimation

P. S. Prashanth Rao et al[2], Q. Lu et al[12], presents another technique which is a new parametric de-blurring method to accurately determine the kernel involved in blurred license plate images. He did this with the aim of handling significant blur in images captured by traffic surveillance cameras to give a very good quality de-blurred images which can help in recognition of the license plate. For estimating the kernel angle, they used a method involving the Hough transformation while for the kernel length, they introduce a robust cepstral method to accurately estimate kernel length. When they found these parameters, they determined the linear motion kernel responsible for causing the blur and de-convolute their blurred image using a simple NBID algorithm. They provided an accuracy of 82.8%.

2.3 ANPR Based Detection Estimation

Chao Gou et al[6],address an effective approach for vehicle license plate detection and recognition, based on character-specific region extremal regions(ERs)and hybrid discriminative restricted Boltzmann machines(HDRBMs). Automatic Number Plate Recognition is a technology that uses optical character recognition on images to read vehicle registration plates to create vehicle location data. It can use existing closed-circuit television, road-rule enforcement cameras or cameras specifically designed for the task [3]. This method is used to remove the dirty number plate and extract the characters alone[13].This technique is also used for electronic toll collection on pay-per-use roads.

Character Segmentation

They achieved fantastic performance in all-day surveillance environment with different illumination conditions and complicated backgrounds. The approach can be effortlessly generalized to license plates from other countries as long as the character layouts are given. However, this proposed method still has limitations. For the recognition step, the recognition rate highly depends on correct extractions of character regions. Some extracted or inferred character regions with low probabilities can be relocated. Actually, they have tried to extract features on raw pixel data by using deep architectures but have not got ideal results.

A large scale of training data set for recognition task will be collected and the proposed framework will be generalized to license plates of other countries. This method achieves good average performance with LDR = 91.9% CRR = 90.2%,OVR1= 85.9% and OVR2 = 72.1%.

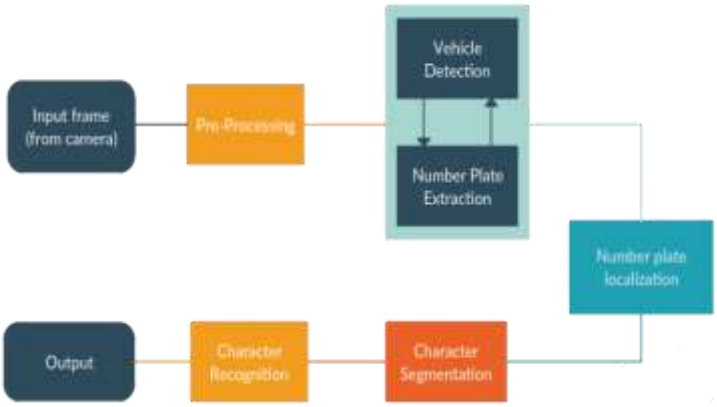

Fig 2: character segmentation technique

From the Figure 2 the vehicle Image has to be captured by any standard camera or by extracting the interested frame from stream of video from input image. Capturing the image from video stream requires an additional work. Once the interested image is being captured in which number plate clearly visible and fine texture pattern, then the further processing of the image is carried out. It has many steps: resize the image resolution, removal of noise from image, removal of unwanted images and conversion of the image from RGB to gray and then Binary (black and white) then preprocessing the number plate region from the image will be extracted. Electronic conversion of handwritten or printed text images into machine-encoded text. Here OCR used to recognize the number from the image. Thus after character segmentation and recognition the output will be shown.

2.4 Horizontal and Vertical Edge Estimation

Soojey Deshpande et al[4], presents the number plate detection algorithm which has employed Horizontal & Vertical Histogram, that signifies column-wise & row-wise Histogram correspondingly. Those Histograms represents an addition of variations in Gray Values amongst adjacent pixels of an image, column-wise & row-wise. The Horizontal Histogram is computed initially within previous stage. The outcome of Segmentation procedure is that every part of the area which possess highest possibility of compressing License Plate[14]. The entire area is treated Row-wise & Column- wise for discovering mutual areas containing the highest Horizontal & Vertical Histogram worth. This method gives 72.63% of efficiency with the total sample images of 554 and locating number plates of 552.

2.5 Hybrid Cascade Structure Estimation

Chunsheng Liu et al[5], present another techniques based on hybrid cascade Structure for License Plate Detection in Large Visual Surveillance Scenes. They included three parts: the cascaded CST-pixel detector, the cascaded CC-Haar like detector, and the cascaded ConvNet detector. Comparing with the traditional cascades based on AdaBoost or CNN, cascading various detectors together can avoid overtraining and detect license plates with different resolutions in high accuracy. The cascaded CST-pixel detector is designed to fast reject backgrounds and is robust to ambiguous shapes.

Then, the cascaded CC-Haar-like detector is designed for further background rejection; and in this process the small and vague license plates are highly tolerated. After the detection of the cascaded CST-pixel detector and the cascaded CC-Haar like detector, there is a relative small number of background subwindows needed to be rejected. The cascaded ConvNet detector is designed to accurately detect license plates. The result of the validation experiments show that the presented hybrid cascade is able to detect license plates with different resolutions and different sizes in large and complex visual surveillance scenes. The results that this method can achieve the highest average precision of 81.6% and the second highest average recall of 86.4%.

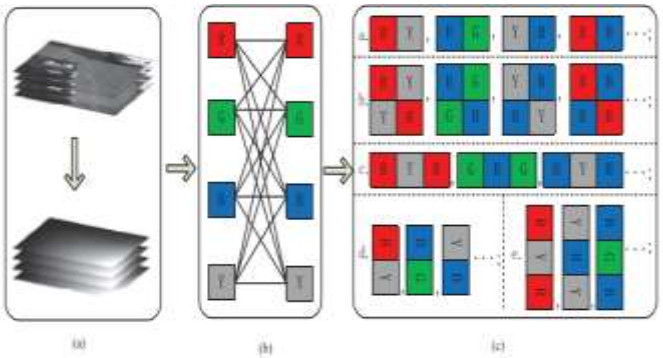

Fig 3: Contrast-color Haar-like features

From the figure 3 a grayscale image is one in which the value of each pixel is a single sample representing only an amount of light which is used to carry intensity information , that is it carries only intensity information. Grayscale images contain number of pixel image a kind of black-and-white or gray monochrome, are composed exclusively of shades of gray. The contrast ranges from black at the weakest intensity to white at the strongest. Thus there is a conversion of the image from RGB to gray scale.

III. Algorithms to Analyze License Congestion

There are various algorithms that are used to analyze license data set among which the following are the latest and advanced algorithms. These algorithms results more accurate data.

3.1 K-NN

The K-nearest Neighbors (KNN) Algorithm is a simple, easy-to-implement supervised machine learning algorithm that can be used to solve both classification and regression problems.
Even with such simplicity, it can give highly competitive results. KNN algorithm can also be used for regression problems. The only difference from the discussed methodology will be using averages of nearest neighbors rather than voting from nearest neighbors. KNN can be coded in a single line on R.

3.2 Fuzzy PID

The system realizes license character segmentation, which has good accuracy and fast processing. The process is divided into pre-process, edge extraction, automobile license location, character division and character recognition, which can be implemented separated by using MATLAB and fuzzy PID. The license is recognized at last. At the same time, the problems are also analyzed and solved in the process. The method of recognition to the automobile license is found. Automobile experiment indicated that the system work effectively and stably.

3.3 Genetic Algorithm

A genetic operator is an operator used in genetic algorithms to guide the algorithm towards a solution to a given problem. There are three main types of operators (mutation, crossover and selection), which must work in conjunction with one another in order for the algorithm to be successful. Genetic algorithm is used to detect a location of the license plate (LP) symbols. An adaptive threshold method has been applied to overcome the dynamic changes of illumination conditions when converting the image into binary.

3.4 Tesseract ocr

This algorithm is able to accurately decypher and extract text from a variety of sources. As per it's namesake it uses an updated version of the tesseract open source OCR tool. We also automatically binarize and preprocess images using the binarization so tesseract has an easier time decyphering images. optical character recognition engine with open-source code, this is the most popular and qualitative OCR-library. OCR uses artificial intelligence for text search and its recognition on images. Tesseract is finding templates in pixels, letters, words and sentences.

Table 1: Comparison of methods to estimate license plate detection

S.NO	NAME OF THE SURVEY	ADVANTAGE	DISADVANTAGE
1	Hybrid Cascade Structure for License Plate Detection in Large Visual Surveillance Scenes	(I)Easily it can removed vague images in number plate. (II)Fast number plate detection technique It is used segment character in accurate manner	(I)It cannot be detected blurred images. (II)Various shape can't be detected. It should be run on some particular platform. It does not detect various form of shape and size.
2	A New De-blurring Technique for License Plate Images with Robust Length Estimation	(I)Good performance in handling largely blurred vehicle with balanced de-blurred result. Part based object detection is done for high efficiency and can be detected under various weather condition.	(I)Different angle inclination of vehicle license plate may not be detected. Rear lamps may not detected if they are repainted with other colors.
3	Fast Traffic Sign Recognition via High-Contrast Region Extraction and Extended Sparse Representation	Detect and recognize multiclass traffic sign with high speed and accuracy and also partly robust to color changes	Detect and recognize multiclass traffic signs in high resolution image alone
4	Accurate Detection and Recognition of Dirty Vehicle Plate Numbers for High-Speed Application	Dirty number plate can be extracted and produce output. Speed detection also applicable.	Its can only detected dirty number plate, angle inclination cannot be detected.
5	Localization of License Plate Number Using Dynamic Image Processing Techniques And Genetic Algorithms	It is used to detect dynamic images number plate system. It is used to extract images only	Genetic algorithm is not much effective when compared to other technique. Accuracy level will be low.
6	Use of Horizontal and Vertical Edge processing technique to improve number plate detection	Edge detection process will be done in these technique	It can detect only Edge position processing.

IV. Discussion

It could be observed that almost, all implemented algorithms, do not properly work in real time and does not provide much accuracy level. It can be seen, the detection of number plate uses several Machine Learning techniques. They uses several algorithm such as Fuzzy PID, KNN, Tesseract ocr, Genetic Algorithm etc. They uses different techniques such as skew correction, De-blurring, horizontal and vertical edges, coarse to fine strategy, hybrid cascade structure. Now a days, a lot of vehicles are found with different sized, shaped and colored number plates .So they must be captured and segmented properly. Also we found that:

- Most of the current technique requires long span of time to detect vehicle number plate. Expenditure incurred in number plate detection is greater in most of the existing techniques.
- Most of the existing technique cannot detect the number plates with different colour, shape and size and also it cannot detect inclined number plate.
- No standardization has been done in detecting a number plate because it may vary from one country to country.
- Existing techniques performs more effectively only when the number plate is fixed to the vehicle properly
- From the review it is observed that the accuracy rate arrived through the existing techniques need to be improved.

V. Conclusion

This paper reviews the various attempts in vehicle number plate detection and summarizes their significant outcomes. The summary of contributions by various researchers highlights the different algorithms, techniques and other features handled for vehicle number plate detection. In our future we will focus on continuing the study of number plate detection to improve current algorithms with an improved accuracy using different techniques.

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