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Vehicle License Plate Detector Using OpenCV

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ABSTRACT: An embedded real-time technology called Automatic License Plate Recognition can automatically identify a car's license plate. Numerous uses exist, spanning from intricate security frameworks to communal spaces, parking authorization, and urban traffic management. The intricate features of automatic license plate recognition (ALPR) stem from a variety of factors, including light and speed. This project offers an alternate approach to building ALPR systems with the Open Computer Vision Library and Python, two free software programs. The license plate is recognized by the system using Haar cascade algorithm.

KEYWORDS: License plate, ALPR (automatic license plate recognition) Computer vision, Haar cascade

I. INTRODUCTION

The scientific world is deploying research in intelligent transportation systems which have a significant impact on peoples´ lives. Automatic License Plate Recognition (ALPR) is a computer vision technology to extract the license number of vehicles from images. It is an embedded system which has numerous applications and challenges. Typical ALPR systems are implemented using proprietary technologies and hence are costly. This closed approach also prevents further research and development of the system. With the rise of free and open-source technologies the computing world is lifted to new heights. People from different communities interact in a multi-cultural environment to develop solutions for mans never ending problems. One of the notable contributions of the open-source community to the scientific world is Python. Intel's researches in Computer Vision bore the fruit called Open Computer Vision (OpenCV) library, which can support computer vision development. 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].

II. RELATED WORK

Dr. K. Deepa Thilak, 2020,[13] 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 trafficcontrol 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. So far many of the researchers came with their own algorithm to detect the number plate, but each has some limitations.
Gou, Chao & Wang, Kunfeng & Yao, Yanjie & Li, Zhengxi. (2015).[6] 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.

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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 .

III. METHODOLOGY

Input Image

The input is vehicle image. Before the Number plate detection, the image source must be made for suitable for further processing.

Preprocessing

Converts the image into grayscale and removes the noise. Noise reduction Gaussian smoothing is also known as Gaussian filtering. It uses a linear Gaussian function. The objective of gaussian smoothing is to reduce the noise and detail. When we apply Gaussian filter to an image it has the added advantage of preventing aliasing artifacts.
In Opencv, the gaussian smoothing can be applied using the following:
RGB to HSV conversion Converting a RGB image to gray scale can save lot of time since we have to perform convolution of the image with sobel filter over only one 2D matrix rather than RGB image having 3 channels and making complicated. Another reason for this conversion is, in the case of edge detection in image we are focused on observing the intensity change and it is very easy to analyze it in a gray scale image.
Edge detection Edge detection is done using sobel edge detection method. Here, calculating the gradient of image intensity at each pixel within the image. It can find the direction of the largest increase from light to dark and the rate of change in that particular direction. In Opencv, cv2.Sobel(imag2,cv2.CV_8U,1.0,ksize=3) is used to perform the edge detection using the kernel size of 3.
Image under-sampling For high resolution images, image processing algorithms tend to work slowly. It is unnecessary to consider high resolution images. The image under sampling stage reduces the resolution if it crosses a predefined threshold.
Morphological transformations Top-hat and black-hat filters are part of the Morphological transformations that are some operations which can be performed on the binary images. Black-hat operation is also known as bottom-hat operation. It is used to enhance dark objects of interest in a relatively bright background. The top-hat operation is used to enhance bright objects of interest in a relatively dark background. The difference between the opening of the image and the image is the top-hat, and the difference between the closing of the image and the image is the black hat. The top-hat method is used here.

License Plate Detection through Haar-like features

In image processing techniques, Haar-like features are used to recognize objects from image . If our proposed system is selected to detect only license plates then the Haar-like features are used for this purpose and no further processing is done. This technique is old and laborious and more over needs a large database to store the collected samples nearly about 10000 images of the plates and characters 2.3.2.2 License Plate Detection through Edge Detection In the other case, if our proposed system has to recognize license plates, then the binary image is created from the image. After that following steps are performed to extract license plate from binary image:
1. Four Connected Points are searched from binary image.
2. Width/Height ratio is matched against those connected points.
3. License Plate region is extracted from image.
4. Transformation of extracted license plate is performed. Then the extracted license plate is passed to next component for further processing. This approach is quick and takes less execution time and memory with high a efficiency ratio. That's why we have adopted this technique in our project Character Segmentation In this part further image processing is done on extracted license plate to remove unnecessary data. After character segmentation, the extracted license plate has only those characters that belong to license number. This also achieved with the width height ratios matching with the contours detected on extracted number plate.
Haar Cascade Algorithm

This involves Four Stages that include:
1. Haar Features Calculation
2. Integral Images Creation
3. Adaboost Usage
4. Cascading Classifiers Implementation

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1. Haar Features Calculation: Gathering the Haar features is the first stage. Haar features are nothing but a calculation that happens on adjacent regions at a certain location in a separate detecting window. The calculation mainly includes adding the pixel intensities in every region and between the sum differences calculation.

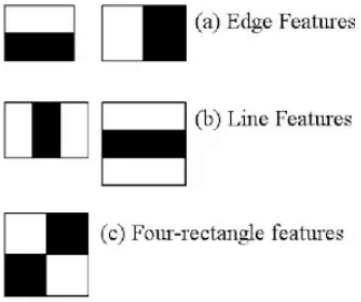


Figure 1: Haar cascade calculation

This is arduous in the case of large images because these integral images are used in which operations are reduced.

2. Integral Image Creation: Creating Integral Images reduces the calculation. Instead of calculating at every pixel, it creates the sub-rectangles, and the array references those sub-rectangles and calculates the

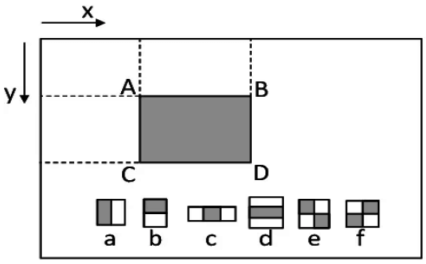


Figure 2: Integral Image Creation

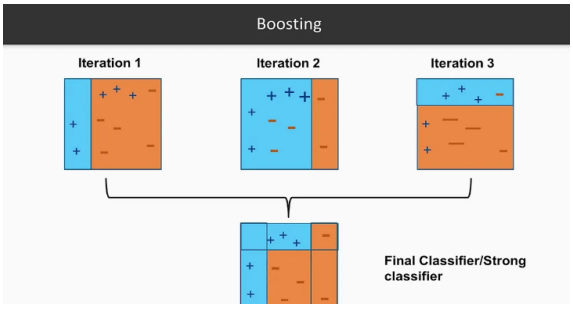
The only important features are those of an object, and mostly all the remaining Haar features are irrelevant in the case of object detection. But how do we choose from among the hundreds of thousands of Haar features the ones that best reflect an object? Here Adaboost enters the picture.

3. Adaboost Training:

The "weak classifiers" are combined by Adaboost Training to produce a "strong classifier" that the object detection method can use. This essentially consists of selecting useful features and teaching classifiers how to use them.

By moving a window across the input image and computing the Haar characteristics for each part of the image, weak learners are created. This distinction stands in contrast to a threshold that can be trained to tell objects apart from non-objects. These are "weak classifiers," but an accurate strong classifier needs many Haar properties. In the final step, weak learners might be combined with strong learners.

4. Cascading Classifiers Implementation



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Every sage at this point is actually a group of inexperienced students. Boosting trains weak learners, resulting in a highly accurate classifier from the average prediction of all weak learners.
It depends based upon the prediction. The classifier decides for indication of an object that was found positive or moved to the next region, i.e., negative. Because most windows do not contain anything of interest, stages are created to reject negative samples as quickly as feasible.
Because classifying an object as a non-object would significantly hurt your object detection system, having a low false negative rate is crucial.

IV. SYSTEM ARCHITECTURE

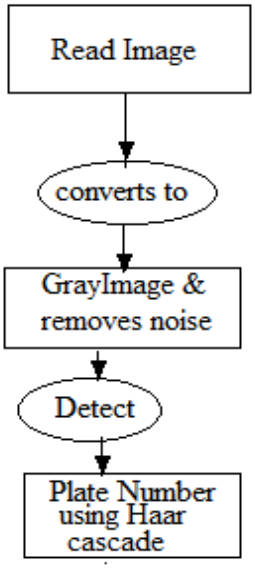

Figure 4: System Architecture

V. IMPLEMENTATION

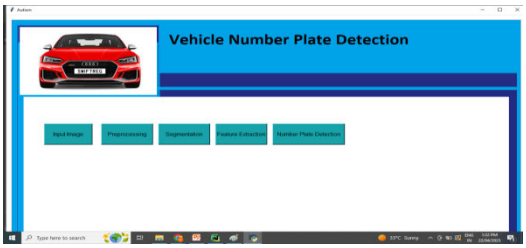

Figure 5:Menu

Figure 7:Grayscale and Noise Removed and
Feature extraction Image

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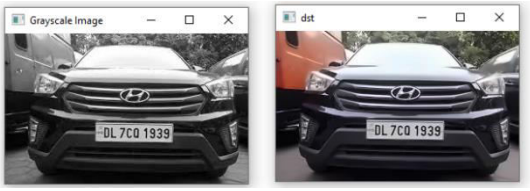

Figure 8: Edge Detection

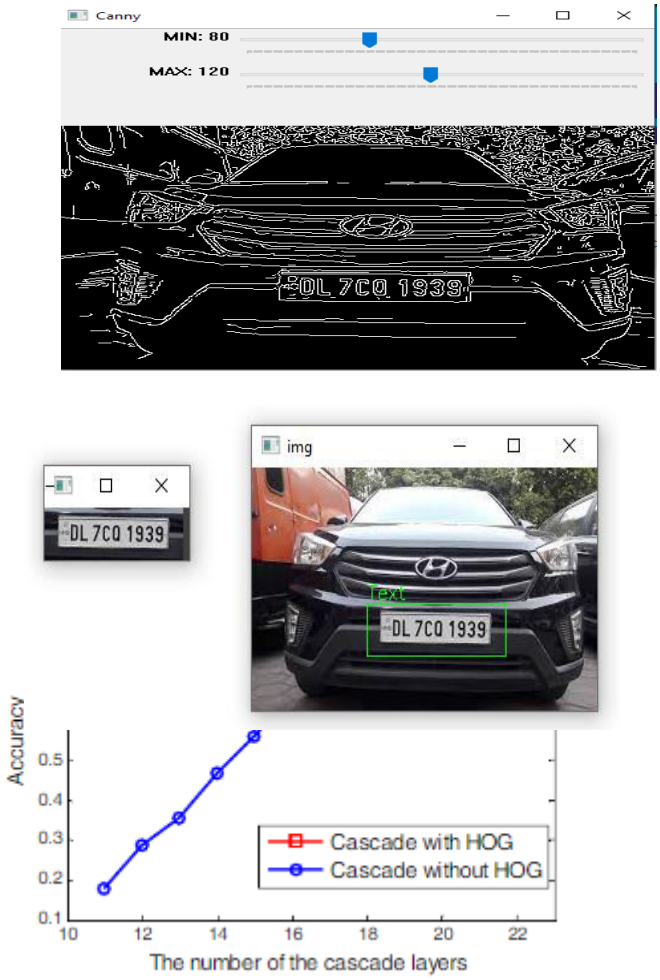

Figure 9: Performance comparison between the two methods (cascaded classifiers with or without HOG).

VI. CONCLUSION

The message of this research is to show that free and open source technologies are matured enough for scientific computing domains. The system works satisfactorily for wide variations in illumination conditions and different types of number plates commonly found in India. It is definitely a better alternative to the existing proprietary systems, even though there are known restrictions .

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