COMPARATIVE STUDY ON AUTOMATED NUMBER PLATE EXTRACTION USING OPEN CV AND MATLAB

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Abstract

comparative study on Automatic Number Plate Recognition (ANPR) using open CV python and Matlab is an image-processing technology and an important field of research that identifies vehicles based on their licence plates and extracts licence plate information from the vehicle's image or from a sequence of images without direct human intervention. Preprocessing, number plate extraction, character segmentation, and character recognition are the four stages of ANPR. This paper describes an efficient method for extracting number plates from preprocessed vehicle input images by employing morphological operations, thresholding, Sobel vertical edge detection, and connected component analysis, The input image is first converted with an iterative bilateral filter and adaptive data augmentation.

Key Words: *Open CV, K-NN Algorithm, Gray processing, Image Acquisition, Image Binarization*

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1. Introduction

The automatic number plate recognition (ANPR) system is critical in the Intelligent Transportation System (ITS). Vehicles now play an important role in transportation, and their use is increasing as a result of population growth and human needs. These vehicles are effectively controlled using an automatic number plate recognition system. An automatic number plate recognition system (ANPRS) is an image processing technology that identifies vehicles by tracking their licence plate without the need for direct human intervention. There are several other names for ANPR, including automatic licence plate recognition, automatic licence plate reader, number plate tracking, car plate recognition, vehicle number plate recognition, automatic vehicle identification, and so on.

In India, there are two types of number plates:
 1) For private vehicles, the number plate has a white background with black lettering.
2) For commercial vehicles, the number plate has a yellow background with a black border.

People from various countries interact in a multicultural setting to find solutions to men's never-ending problems. Python is one of the outstanding contributions to the scientific world in the Open-Source section. Computer vision research at Intel has yielded a fruit known as Open Computer Vision (Open CV), which can aid in the development of computer vision.

Vehicle use is increasing across the country at the moment. As their primary identifier, each of these vehicles has a unique vehicle identification number. The ID is actually in the licence number, which refers to a legal permit to participate in public transportation. Every vehicle on the planet must have its own number plate, which must be installed. on its body (at least on the back). They must identify the vehicles, which is increasing in tandem with the number of vehicles. This identification system aids in safety, automatic switching, highway speed detection, light detection, stolen vehicle detection, and human and non-human loss collection systems. In the computer system, the auto licence plate recognising system replaces the manual licence plate number writing process.

1.1 OPEN CV

The Open-Source Computer Vision Library is a real-time application platform and set of programming functions. The open CV library includes algorithms for over 500 optimised algorithms. With forty thousand users, it is mostly used around the world. The first languages used in C-C ++ were mostly written in C, making them portable to platforms like the digital signal processor. Python, a recently developed language, has been developed to encourage adoption by a wider audience. These languages' most recent versions include C ++ interfaces. Open CV is a cross-platform library with interfaces in C++, Python, and Java. Open CV is intended to be computationally efficient, with a strong emphasis on real-time applications.

For the time being, open CV supports many of the improved algorithms for computer vision and automated learning that are being distributed on a daily basis . Open CV currently supports a wide range of programming languages, including C++, Python, and Java, and is available on a variety of platforms, including Windows, Linux, OS X, Android, and iOS. Python was used as a coding language in this system. It's known as Open CV Python. We chose the snake because it is more effective and easier to understand. The proposal combines the best features of Open CV and Python.

1.2 NUMBER PLATE EXTRACTION USING MATLAB

The proposed Automatic Car Number Plate Recognition System focuses primarily on red light jumping. If a vehicle runs a red light, sensors are installed to detect the presence of the vehicle. As the vehicle approaches the sensor, the camera will capture an image using MATLAB image processing. The image is then processed, and the number extracted from it. The information will be used to match the registered vehicle number with the numbers of the predefined record. We will be able to track down the owner who violated the red light. Then, a record of rule brokers will be kept, and the challan will be entered in that record and can be punished. Independent plotting, a graphical user interface, and a MATLAB compiler are all included. here for the number plate recognition application, MATLAB is used. The task is to build the algorithm and acknowledges it using MATLAB. MATLAB is extremely efficient because it includes built-in tools for neural network and image processing. Some of the advantages of using MATLAB are as follows, MATLAB's features include platform independence, predefined function and device-independent plotting, graphical user interface, and MATLAB compiler.

2.METHODOLOGY

2.1 OPEN CV

To read the image, we can use the OPENCV library, which allows us to read an image and then convert it from BGR to Grayscale. We used the MATPLOTLIB library and the in show function to display the image.

Following that, we performed filtering to remove noise from the image, followed by edge detection to detect edges in the image, and we used the Canny algorithm to detect edges.
Next, we performed contour detection; we are looking for a contour with four points so that we can see a rectangle; we used the find contours function, which searches for contours in our image.
Following that, we will loop through each of the contours to see if they represent a rectangle (Number Plate).

We masked the image and displayed the masked image after specifying the contour locations (number plate) The image's number plate has been isolated. We have to read that text, so we used the easyocr and reader function to do so.
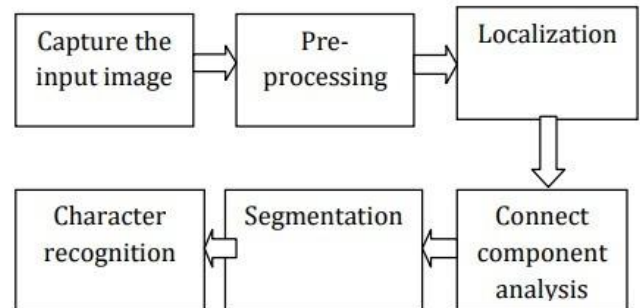

FIG 2.1: Approach using open CV

2.2 MATLAB

This section depicts the proposed method for number plate extraction. This system receives a vehicle image captured with a digital camera as input and outputs the actual number plate portion. Images are captured in a variety of lighting and background conditions. The proposed method's flowchart is shown in Fig, and it consists of the following main steps:
1) Image Capture.
2) Conversion of RGB to grayscale.
Iterative Bilateral Filtering is used to remove noise.
4) Adaptive Histogram Equalization is used to improve contrast.
5) Image subtraction and morphological opening
6) Binarization of images.
Sobel operator detects edges.
8) Detection of candidate plate areas via morphological opening and closing operations.
9) Extraction of the actual number plate area.
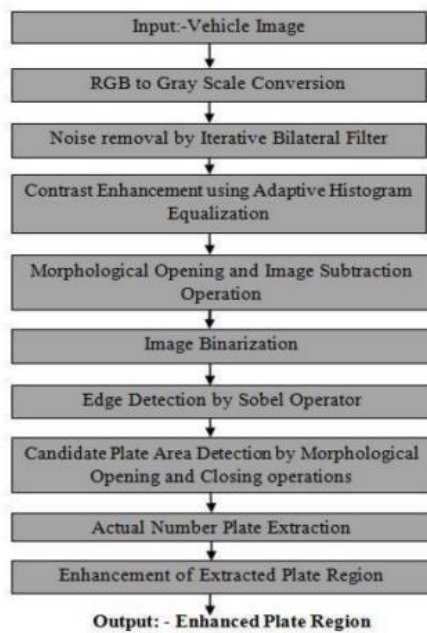10) Extracted plate region enhancement.

FIG 2.2: Approach using MATLAB

3. SOFTWARE IMPLEMENTATION

3.1 OPEN CV

3.1.1. CAPTUERE THE INPUT IMAGE:
A high-resolution camera was used to capture the car's number pad. The resolution of the number plate recognition system is determined by the image captured. The RGB image captured must be converted to a grayscale image.

3.1.2. PRE-PROCESSING:
Pre-processing is a set of algorithms that are applied to an image to improve its quality before it is converted to a binary image. The image is smoothed before being converted to a binary image to reduce noise. The threshold algorithm can perform pre-processing. There are various types of thresholds, such as
• Global threshold
• Threshold for adaptive mean
• Gaussian adaptive threshold Global criterion:
The threshold is a nonlinear process in which two levels are assigned to pixels that are smaller or larger than the specified threshold value. The threshold value is fixed. According to the formula, the grayscale image is converted to a binary image. Dst (x, y)=max value if $src(x,y)>T(x,y)$ 0 else Where $T (x, y)$ is the threshold calculated for each pixel individually. The average adaptive threshold is: The threshold value is the average area of the neighbourhood. Threshold Gaussian Adaptive: The sum of the values of the values of the neighbourhood where the weights are a Gaussian window is the threshold value. The adaptive threshold method is then used to convert the grayscale image to a binary image. The threshold is the most basic way to separate objects.

3.1.3. NUMBER PLATE LOCALIZATION :
A shape analysis or a colour analysis method is used to extract the licence plate. The General License Panel is shaped like a rectangle. As a result, algorithms seek geometrical shapes with a rectangular proportion. Because most licence plates in India are white or yellow, colour analysis can also be used. Before you can find the rectangle in an image, it must be in binary format or the image's edges must be detected. Then you must locate and connect the relevant rectangular corners. Finally, all rectangular areas of interest are extracted and the areas connected to the box are connected.

3.1.4. CONNECT COMPONENT ANALYSIS:
The algorithm of the component connected to the binary filter is used first to remove the unwanted image space. To determine the characters in the image, the connected component is parsed. The basic idea is to traverse the image in search of a connected pixel. Each component (dots) is identified and extracted separately.

3.1.5. SEGMENTATION:
Once the license plate has been extracted, each character must be fragmented. For component division, the component label is used to see the computer in order to discover the connected areas in binary digital images. The label of connected components works by scanning a pixel-in-pixel image from top to down to find connected pixels and connected pixel cards.

3.1.6.CHARACTER RECOGNITION:
The segmented characters in the licence panel must match the templates that have already been created in order to be identified. The licence number is returned in ASCII format and saved in a text document by the recognition process. There is a two-track process in this recognition. The first pass attempted to identify each word individually. Each acceptable word is fed into the adaptive workbook as training data. The adaptive workbook is given the opportunity to learn the text more thoroughly.

3.2 MATLAB

3.2.1. Image Acquisition:
The first step is to obtain the vehicle input image. A digital camera was used to capture the image. Images are captured in a variety of lighting conditions and at varying distances from the camera. The image of the input vehicle is shown in Fig.

3.2.2. Pre-Processing:

In basic aim of pre-processing is to improve the contrast of the input image, to reduce the noise in the image, hence to enhance the processing speed. In pre-processing RGB image is converted into gray level image and then into binary image. The contrast enhancement is done by histogram equalization, contrast stretching etc. Various filters are used to remove noise from the input image. In the proposed approach for number plate extraction, the input image is enhanced by applying adaptive histogram equalization technique and noise is removed by iterative bilateral filtering.

1) RGB to Gray Scale Conversion:

The RGB format of the captured input image is used. The first step in the preprocessing process is to convert the RGB image to a grayscale image. The primary goal of colour conversion is to reduce the number of colours. The R, G, and B components of each pixel's I j) 24-bit colour value are separated, and an 8-bit grey value is calculated. The grayscale image is shown in Fig.

2) Noise Removal by Iterative Bilateral Filter:

The primary goal of filtering is to remove image noise and distortion. Noise can occur during camera capture and as a result of weather conditions. For noise removal, the proposed method employs an iterative bilateral filter. Non-linear filter is iterative bilateral filter. It provides a mechanism for noise reduction while more effectively preserving edges than the median filter. Figure 3 shows the outcome of applying an iterative bilateral filter to a grayscale image. 3) Contrast Enhancement Using Adaptive Histogram Equalization: Contrast is defined as the difference in intensity between the lowest and highest levels. Histogram adaptive image. is a technique for more effectively spreading the histogram of pixel level. Adaptive histogram adaptive image. outperforms histogram adaptive image.in terms of contrast. The figure depicts contrast enhancement via adaptive histogram adaptive image.

3.2.3. Morphological

Operations for Image Subtraction and Opening Using a disc-shaped structuring element, a morphological opening operation is performed on a contrast-enhanced grey scale image. The morphological opened image is subtracted from the contrast enhanced grey scale image in image subtraction. Fig shows the outcome of an opening operation on a contrast enhanced grey scale image using a disk-shaped structuring element, and Fig shows the outcome of an image subtraction between a contrast enhanced grey scale image and an opened image.

3.2.4. Image Binarization:

The subtracted grey scale image is converted into a binary image in this operation. To begin, Otsu's method is used to calculate the threshold level. In MATLAB, the graythesh function is used to determine the image's threshold level, and the subtracted grey scale image is converted to black and white using the im2bw function based on the calculated threshold. Figure depicts a binarized image.

3.2.5. Edge Detection by Sobel Operator:

Sobel operator detects vertical edges, and the result of applying Sobel operator to binarized image is shown in Fig.

3.2.6. Candidate Plate Area detection by Morphological Opening and Closing Operations:

Unwanted objects in the image are removed using morphological operations. In order to detect a candidate plate area, a dilation operation is first applied to a detected sobel edge image, and then the hole is filled using the MATLAB imfill function. The results of applying the dilation operation and filling holes are shown in Fig. Then, for precise detection of candidate plate area, morphological opening and erode operations are used.
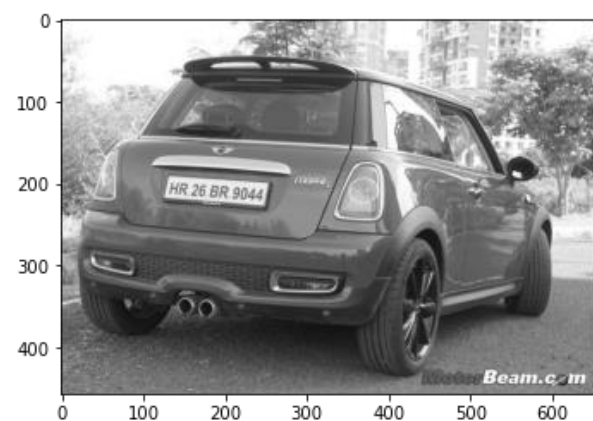
4.OUTPUT
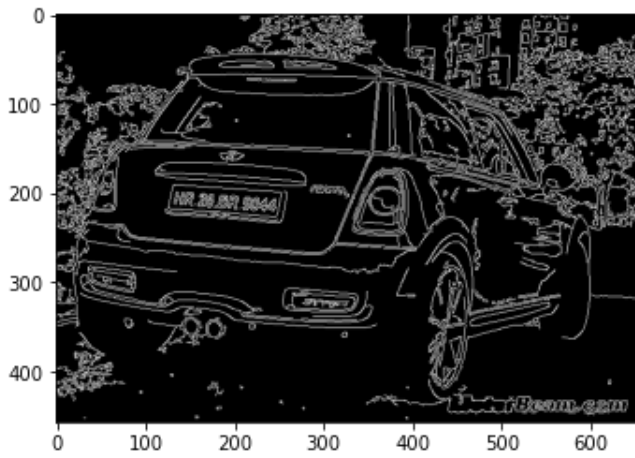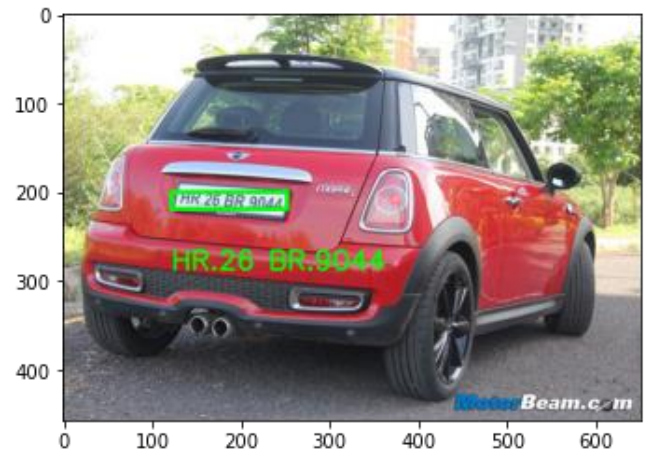### 4.1 OPEN CV

FIG 4.1.1: Gray scale Image

Fig 4.1.2: Edge Detection

Fig 4.1.5 Render Result

4.2 MATLAB
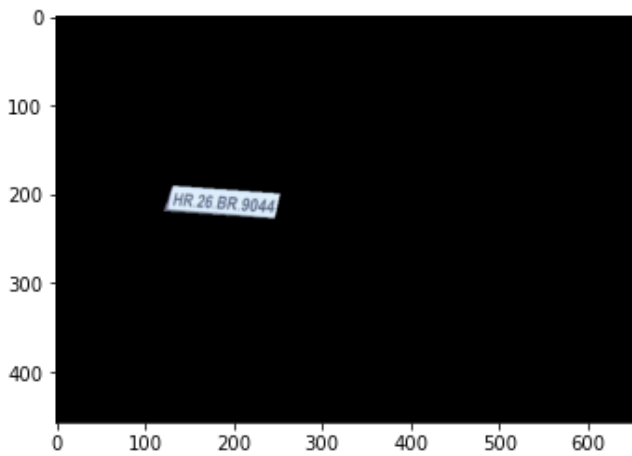
Fig 4.1.3: Contouring

Fig 4.2.1: Gray Scaling

Fig 4.1.4: Masking

Fig 4.2.2: Noise removal
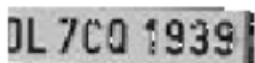
Fig 4.2.3: Noise removal
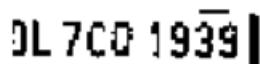

Fig 4.2.4: Noise removal

Fig 4.2.5: Noise removal

4. CONCLUSIONS

At the moment, open CV is a fantastic open-source library for computer vision with a large user base. Open CV has far more capabilities for viewing the computer than MATLAB [2]. Many of their operations are handled by the GPU. The library is constantly being updated (a new version is released every 3 to 4 months). In general, the open CV C ++ programme executes faster than the MATLAB code. Open CV has more computer-viewing functions than MATLAB. Many of their operations are handled by the GPU . The C ++ Open CV code is usually faster than the MATLAB code, but when compared to open CV C ++, open CV is far superior.

Python is better and easier to learn than other programming languages such as C ++ when it comes to computer vision. What a useful tool you should become acquainted with. Computer vision engineer / programmer – As of now, we have the option of using

Open CV in C++, Open CV in Python, or Open CV in MATLAB. There were no good libraries to see the computer in the past. We discovered these studies using relevant books and began coding the special library of special algorithms for computer vision.

Open CV, like MATLAB, is designed for image processing and is used as an alternative tool that is much faster than other simulations. Each function is designed in Open CV, and the function structure and data are coded using image processing software. On the other hand, we can get almost anything in the world in the form of Matlab toolboxes. MATLAB is a relatively simple language, but in some cases, this high-level programming language has become slower. In such cases, open CV performs better and yields more accurate results. Similarly, handling some code to model the idea of processing your images can be very simple. Python is one of the Open-Source community's outstanding contributions to the scientific world.

5. REFERENCES:

[1] D. M. TELLA PAVANI, "Number Plate Recognition by using open CV- Python," IRJET, p. 6, 2019.

[2] H. S. A. S. N. A. N. G. N. N. Jameson, "Multiple Frames Combination Versus," Journal of Information Assurance & Security, , VOL 8; 2019.

[3] B. Z. a. 1. Fiusser, ""Image registration methods"," Image and Vision Computing, vol. 21, no. II, pp. 977-.

[4] M. K. P. a. M. G. K.] S. C. Park, "Super-resolution image reconstruction: a technical overview"," IEEE, vol. 20, pp. 21-36, 2013.

[5] M. M. A. A. M. T. Amr Badr, "Automatic Number Plate Recognition, Mathematics and Computer," CSS, Vol 38(I),2020, 62-71.

[6] M. Singh, ", A New and Efficient Method for Vehicle License Plate Detection," International Journal of Advanced Research in computer science and software engineering , December - 2019, pp. 1002-1006.

[7] R. E. W. a. S. L. E. Rafael C. Gonzalez, "Digital Image Processing using MATLAB," IEEE.