ASSESSMENT OF NUMBER PLATE IDENTIFICATION AND RECOGNITION USING DIFFERENT SMOOTHING TECHNIQUES

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ABSTRACT
A method of image processing called "number plate detection" uses the vehicle's licence plate or number plate to identify it. Recognition of vehicle licence plates is crucial in many contexts, including the military, governmental organisations, and others. In this study, we investigate number plate recognition using a range of smoothing filters, including the Gaussian and Bilateral filters, as well as a number of colour models, including the HSV and YCBCR colour models. The image is first converted into a YCBCR image, then into a binary image and subjected to morphological operations. The modified image is then subjected to a bilateral filter and contour detection to identify the number plate. In a different study, we are removing the bilateral filter and replacing it with a Gaussian filter and observe the changes in other analysis we are using HSV colour model and apply same process by using bilateral and Gaussian filters.
Keywords: Bilateral filter, Gaussian filter, HSV colour model, YCBCR colour model, inverted adaptive Gaussian thresholding, MATLAB.

1. INTRODUCTION

Using optical characters on an image, the Automatic Number Plate Detection system scans licence plates on moving automobiles. They are employed by various security agencies, police departments, and as a way of electronic toll collecting on payments to monitor traffic behaviour and operate as a red light at a junction. This technique performs pre-processing on an automobile image as its input. By reducing unwanted distortions and increasing some visual aspects that are important for further processing, pre-processing is used to enhance image data. The processed image is subjected to segmentation.

In most cases, image segmentation is used to locate objects and boundaries (lines, curves, and so on) in images. Binarization is an image processing technique for detecting edges. Image segmentation can be as simple as thresholding. Thresholding can be used to create binary images from a grey scale image, and the image is then cropped. An extraction method is applied to the cropped image. Morphological image processing is a set of non-linear operations on an image's shape and morphology.

Morphological processes, which rely solely on the relative ordering of pixel values rather than their numerical values, are well suited to the processing of binary images. Edge detection was performed on that morphological image. It will be simple to extract the required section of the image from that softened image. The licence plate will be removed from that photograph, and the number plate will be displayed. The rate of detection of the number plate will be increased as a result of this operation

2. NUMBER PLATE DETECTION

The contemporary research landscape is dominated by pattern recognition and image processing. For the past thirty years, many scholars from all around the world have been working on automating operations in various fields. The number of automobiles has risen dramatically in recent years. As the number of cars grows, more attention must be paid to effective traffic management. Vehicle control is crucial for a variety of reasons, including security concerns; thus, intelligent vehicle management systems must be developed. As a unique identifier for the vehicle, each vehicle has a license plate. Vehicle recording by hand is inefficient, time-consuming, and expensive. As a result, automating the process of detecting vehicle

license plates is always beneficial. The identification of vehicle license plate information from a picture or sequence of photographs of automobiles is known as Vehicle Number Plate Detection (VNPD). NPD is a machine-based approach for detecting a vehicle registration number. VPNs are roughly grouped into two categories: stationary and mobile VNPDs, based on how and where the cameras are installed. Stationary VNPD systems employ high-resolution infrared cameras in non-moving sites. Sign boards, street lights, telephone poles, entry-exit gates, and other permanent items found on the road can all be used to mount the readers. The cost-effectiveness of stationary VNPDs has long been established.
Mobile VNPD, on the other hand, refers to cameras mounted on moving vehicles. With the movement of cars, the photos for the license plates are recorded. Mobile VNPD systems have been found to record an average of 1000 license plates per hour and to follow mobile cars more effectively. The technology recognizes the pixel pattern and converts the identical letters and numbers on the plate to a digital format whenever the picture of the license plate is acquired, whether from a fixed reader or a mobile reader. This information is also supplied to VNPD databases. The time that data is stored in databases varies depending on the system that is configured to use the VNPD, whether it be for days or years. The modern technological era needs reliable vehicle number plate detection. Security control, toll collecting, parking management, access control, criminal investigation system, border control, and road patrol are among the challenges it solves. The NPD is a potential study field that has piqued the curiosity of many scientists throughout the world. Due to the variety of license plates and non-uniform lighting circumstances during vehicle picture capture, this is a difficult challenge.

3. EXISTING METHODOLOGY

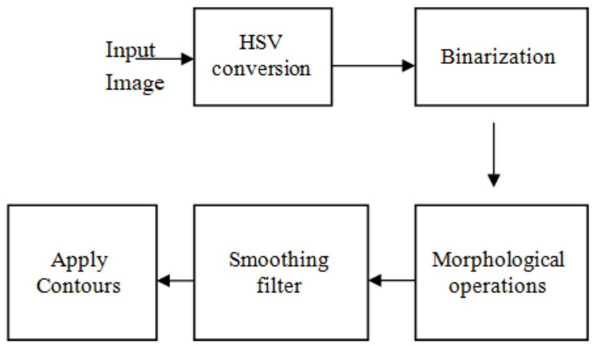


Figure.1: Block Diagram for Existing Method

In the current process, the input picture is first converted to HSV (hue, saturation, values) form (we know the input image is an RGB image), and then the HSV transformed image is binarized (turned to black and white using thresholding). Top-hat and bottom-hat operations are morphological procedures done on the binary image. After smoothing, we eliminate noise with a bilateral and Gaussian filter, and then use contours to recognize the picture and extract the characters from the number plate.

4. PROPOSED METHODOLOGY

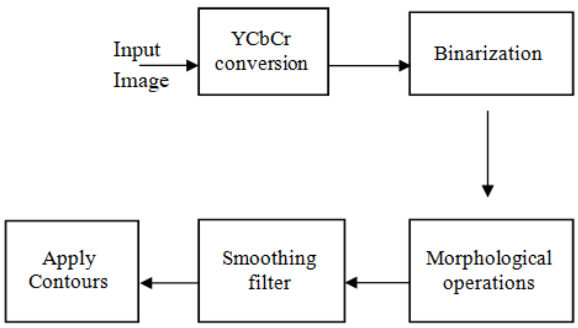


Figure.2: Block Diagram for Existing Method

The input picture is first transformed into YCbCr (luminance, chrominance) form (we know the input image is an RGB image), then the YCbCr converted image is binarized (turned into black and white using thresholding) in the suggested manner. The binary image is subjected to morphological procedures, such as top-hat and bottom-hat operations. Following that, we smooth the picture and apply contours to identify the image and extract the characters from the number plate, using the bilateral and Gaussian filters to eliminate noise and apply contours to detect the image and extract the characters from the number plate.

IMAGE ACQISITION

The process of making sense of a picture is referred to as image acquisition. The capture of images is the initial stage in the detection of vehicle number plates. We can't process or save the image in RGB format, therefore we use color models to transform it.

Figure.2.1: Input Image

COLOR MODELS

When we look at an image, we perceive a variety of colour combinations (s). Cones are the colour sensors in the human eye that are responsible for colour vision. Approximately 65 percent of all cones are responsive to red light, 33 percent to green light, and the remaining 2% to blue light. Blue cones, on the other hand, are the most sensitive. Red, Green, and Blue are the primary hues of our palette.

The secondary colours — magenta, cyan, and yellow – may be made by mixing the basic colors together.

RGB COLOR MODEL

Variations in color between 0 and 255 are the values of Red, Green, and Blue. As you go closer to 0, the colors get darker, and as you get closer to 255, they get brighter. In the Cartesian coordinate system, this scenario is discussed. The origin point (0, 0, 0) is black, while the point (1, 1, 1) is white. Any color may be created by combining the colors red, green, and blue with certain coordinate system coefficients. Gray is a hue that combines diagonal corners and is above white and black.

HSV COLOR MODEL

We can identify colors based on one or more factors or characteristics:

Brightness

This specifies the output's intensity or quantity.

In terms of a practical illustration, this is what we see in films prior to the 1930s.

Hue denotes the dominating wavelength in a combination of all light waves, as well as the predominant color as seen by an observer.

The quantity of white light blended with the color is represented by saturation.

Chromaticity is the combination of hue and saturation. As a result, the chromaticity and intensity of a color may be used to describe it.

V = max (R, G, B)

$S = \frac{V - \min(R,G,B)}{V}$

$H = \frac{G-B}{6S}$, if V = R

$H = \frac{1}{3} + \frac{B-R}{6S}$, if V = G

$H = \frac{2}{3} + \frac{R-G}{S}$, if V = B

Figure.2.2: HSV Converted Image

YCBCR COLOR MODEL

In YCBCR and Y′CBCR, which are a plausible approximation to colour processing and perceptual uniformity, the fundamental colours, roughly comparable to red, green, and blue, are processed into perceptually meaningful information. The digital format is YCbCr.

MPEG compression, which is used in DVDs, digital television, and video CDs, uses the YCbCr coding (Mini DV, DV, Digital Beta cam, etc.)

One of two major colour spaces is used to represent digital component video (the other is RGB). The distinction between YCbCr and RGB is that YCbCr represents colour as brightness and two colour difference signals, whereas RGB represents colour as red, green, and blue. In YCbCr, the Y stands for brightness (luma), Cb for blue minus luma (B-Y), and Cr for red minus luma (R-Y) (R-Y).

$$Y = 0.257 \times R + 0.504 \times G + 0.098 \times B + 16$$
$$CB = -0.148 \times R + 0.291 \times G + 0.439 \times B + 128$$
$$CR = 0.439 \times R - 0.368 \times G - 0.071 \times B + 128$$

Figure.2.3: YCBCR Converted Image

BINARIZATION

A binary image is a computer picture in which each pixel can only have one of two potential values. A binary picture is usually made up of two colours: black and white, however any two colours can be used. The colour of the item in the photograph is the same as the background colour. The foreground colour dominates the picture, while the backdrop colour dominates the remainder. A bit map, or packed array of bits, is commonly used to store a binary picture in memory.

Binary images are two-dimensional integer lattice subsets.

This image has had a big influence on the field of morphological image processing. The picture is binarized using the thresholding approach. Because rectangular plates are the most common, it is required to identify the margins of rectangular plates. Adaptive thresholding is a method of calculating the threshold value for smaller regions, resulting in different threshold values for various regions. The weighted sum of neighbourhood values, where the weights are a Gaussian window, is the threshold value.

Output image(x, y) = 0 , input image(x, y)>T(x, y)
255 , otherwise.

T(x, y) is a threshold function.

Figure.2.4.1: Binary image for HSV

Figure.2.4.2: Binary image for YCBCR

MORPHOLOGICAL OPERATIONS

Top-hat and black-hat transforms are techniques used in morphology and digital image processing to extract small features and details from provided images. The difference between the input image and its opening by some structuring element is characterized as the top-hat transform, whilst the difference between the closing and the input image is defined as the black-hat transform.

$$T_{hat}(f) = f - (f \circ b)$$

$$B_{hat}(f) = (f.b) - f$$

These transforms are used for a variety of tasks in image processing, including feature extraction, background equalization, image enhancement, and more. The top-hat filter is used to draw attention to brilliant things against a dark background. The black-hat technique is used to highlight dark things of interest against a bright background.

Figure.2.5.1: Top-hat Image for HSV

Figure.2.5.2: Bottom-hat image for HSV

Figure.2.5.3: Top-hat Image for YCBCR

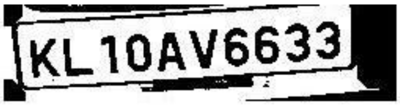


Figure.2.5.4: Bottom-hat Image for YCBCR

GAUSSIAN FILTER

A Gaussian Filter is a low-pass filter that reduces noise (high-frequency components) and blurs picture regions. To achieve the desired effect, the filter is built as an Odd sized Symmetric Kernel that is passed through each pixel in the Region of Interest. Because the pixels in the kernel's centre have greater weightage towards the final value than those in the periphery, the kernel is not sensitive to extreme colour changes (edges).

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

A Gaussian Filter is a Gaussian Function approximation. When applying a Gaussian Filter to a picture, the size of the Kernel that will be used to demise the image is first determined. Because the sizes are typically odd, the overall results can be computed on the middle pixel. The Kernels are also symmetric, with the same number of rows andcolumns on both sides. TheGaussian function is used to calculate values inside the kernel.

Figure.2.6.1: Gaussian Filtered Image for YCBCR

Figure.2.6.2: Gaussian Filtered Image for HSV

BILATERAL FILTER

A bilateral filter is a smoothing filter for pictures that is non-linear, edge-preserving, and noise-reducing. It uses a weighted average of intensity data from surrounding pixels to replace each pixel's intensity. Importantly, the weights are based on the radiometric discrepancies as well as the Euclidean distance between pixels (e.g., range differences, such as color intensity, depth distance, etc.). Sharp edges are maintained as a result.

$$I^{filtered} = \frac{1}{W_p} \sum_{x_i \epsilon \omega} I(x_i) f_r(||I(x_i) - I(x)||) g_s(||x_i - x||)$$

$$W_p = \sum_{x_i \in \omega} f_r(||I(x_i) - I(x)||) g_s(||x_i - x||)$$

Figure.2.7.1: Bilateral Filtered Image for HSV

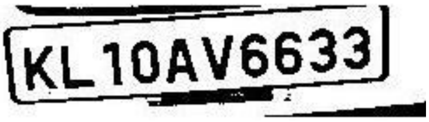


Figure.2.7.2: Bilateral Filtered Image for YCBCR

APPLY CONTOURS

The algorithm for producing contours is contour tracing, often known as border following. A contour is a line drawn along a border that connects equal intensity points. Discovering a contour is similar to finding a white object in a dark room.

5. RESULTS AND DISCUSSIONS

Figure.3.1:HSV Image**Figure.3.2:** YCBCR Image

Figure.3.3: Gaussian Filtered Image **Figure.3.4:** Bilateral Filtered Image

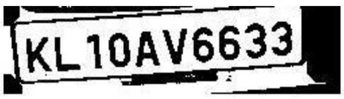
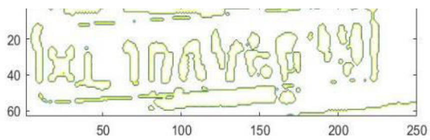


Figure.3.5: Bilateral Filtered Image **Figure.3.6:** Gaussian Filtered Image



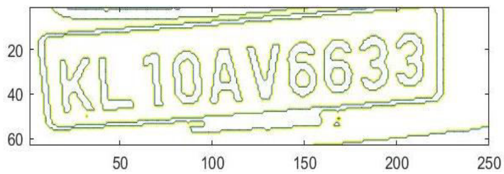


Figure.3.7: HSV Contoured Image **Figure.3.8:** YCBCR Contoured Image

CONCLUSION

We have incorporated the detection of authorised number plate cars into the proposed system. Testing number plate identification with various colour schemes and smoothing filters. First, the image is chosen, and then it is converted into a colour model using the YCbCr and HSV colour model. Next, binarization must be performed using inverted adaptive Gaussian thresholding, followed by morphological operations like top-hat and bottom-hat, and finally, a smoothing filter is used to remove noise and find the image's interesting regions. Finally, the licence plate location is extracted by using contours.

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