Vehicle Number Plate Detection using Sobel Edge Detection Technique

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Abstract
In this paper we detect the number on vehicle plates in the input image. We use simple color conversion ,edge detection and connector measurement technique. Throughout the whole work, we use masking and smoothing operation. The median filter is used as one of the operators. The best results can be obtained by getting the value of connector components more than 17.Various other methods have been proposed so far but we here present simplest of all and with lesser complexity to detect the numbers. The image is stored in the form of a matrix and the output is displayed in the form of detected numbers. The crux of the work is to use Sobel Edge Detection technique.

Keywords
Edge Detection, Median Filter, Smoothing, Connector, Masking, Color Conversation.

I. Introduction

We present a detection algorithm that employs a novel image descriptor and detects license plate. Using covariance matrix for the same purpose to find out statistical and spatial properties could lead to complexity[3] that arises due to neural network. Instead of these methods and techniques, we have used filter convolution and masking operation to detect the number out of the image(as in vehicle's number plate).To minimize complexity(as in covariance matrix), local variance scores have been used and the unique coefficients have been restructured into a feature vector form and multi-layer neural network[3-4],[8]. Since no explicit similarity or distance computation is required in this framework, it is very easily possible to keep the computational load of the detection process low. Moreover, the complexity involved is very less as compared to that in template matching done by using genetic algorithms[5-6]and neural networks. In the current work, first of all the input image is converted into its corresponding RGB format [2]and appropriate filters are applied onto it. In order to smoothen the edges, the technique of convolution is used. Thereafter, the connected components (mx) are detected. The crux of the work lies in extracting exactly all the characters in the number plate when the number of connected components are more than number 17. Finally, the image is stored in the form of a matrix and the output is displayed in the form of detected numbers.

As shown in the fig. 1,first an arbitrary image is considered as input under test whose number is to be detected. Here, the same test has been performed on three different test cases (images) for our reference. In the next stage, the image is converted into rgb (red green blue) image. The concept and need of conversion into rgb format is illustrated in detail in the next section.

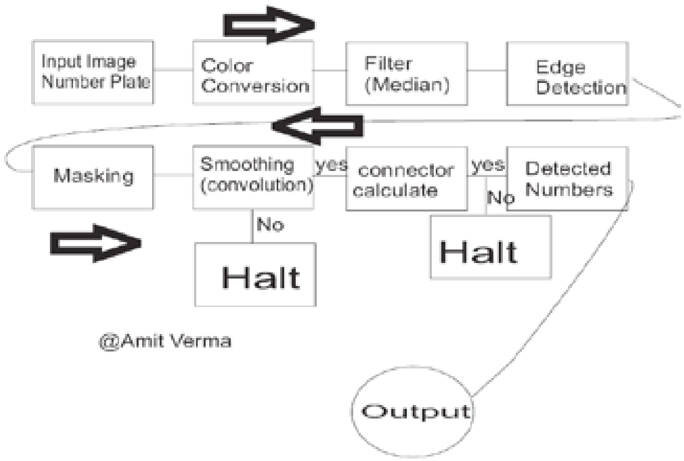

Fig. 1 : Concept of Detection

II. The concept of RGB

Colored image processing requires an understanding of the light as well as perception of the color in the image. Human beings use colors to[14] distinguish objects, food, their material, texture , quality, time etc. Color images occupy much more space as compared to that taken by their corresponding gray scale or binary images. Moreover, the gray scale images are commonly used during image processing techniques and activities due to many other factors that make them simpler and better in terms of calculation and usage.
In the rgb color model, the three basic colors are RED,GREEN and BLUE. RGB is an additive color model from that we can derive further secondary colors such as:
Magenta= Red+Blue,
Yellow=Red+Green,
Cyan= Blue+Green.

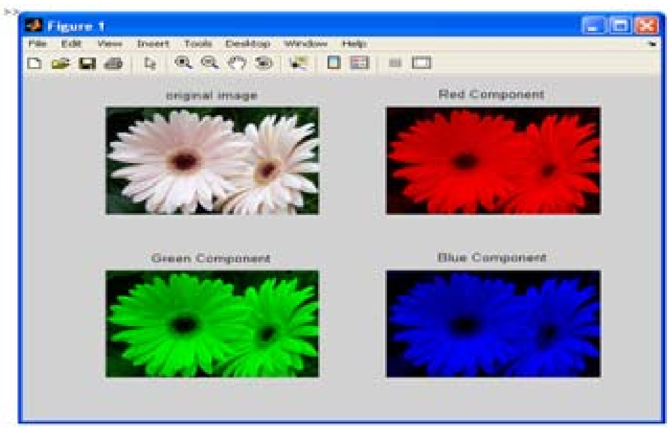

Fig. 2: RED, GREEN & BLUE component by using RGB Model

Fig. 2 shows the actual flower image and then RED,GREEN&BLUE components each by using RGB Model.

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III. Median Filter

The median filter is a canonical image processing operation, best known for its salt and pepper noise removal property. It is also the foundation upon which more advanced image filters like unsharp masking, rank-order processing, and many morphological operations [7]are built. Higher-level applications include object segmentation, recognition and detection of speech and writing, and medical imaging. However, the usefulness of the median filter has been limited by the processing time it requires. Its nonlinearity and non separability make it unsuited for common optimization techniques. A brute-force approach simply builds a list of the pixel values in the filter kernel and sorts them. The median is then the value situated at the middle of the list. In the general case, this algorithm's per-pixel [9]complexity is O(r2 log r), where r is the kernel radius. As a matter of fact, median filter are statistical non-linear filters that are often described in the spatial domain. As in our case, median filter smoothens the image by utilizing the median of neighborhood. We perform filtering by performing the following tasks that find value of each pixel in the processing image:

1. All pixels and the neighborhood of the pixel in the original image (which are identified by the mask) are sorted in the ascending order
2. The median of the [14]sorted value is computed and chosen as the pixel value for the processed image. From the Fig. 3 we can see the effects on the image after removing noise by using 3*3 and 5*5 median filter and hence the smoothing effect.

In our test case, we use 5*5 median filter.

When we take the median value the pixel value which are very different from their neighborhood pixels is replaced by a value equal to neighboring pixel value. Hence a median filter is capable of reducing maximum gray and minimum gray value. We use median filter to minimize the random occurrence of black and white pixels.(i.e salt and pepper noise)

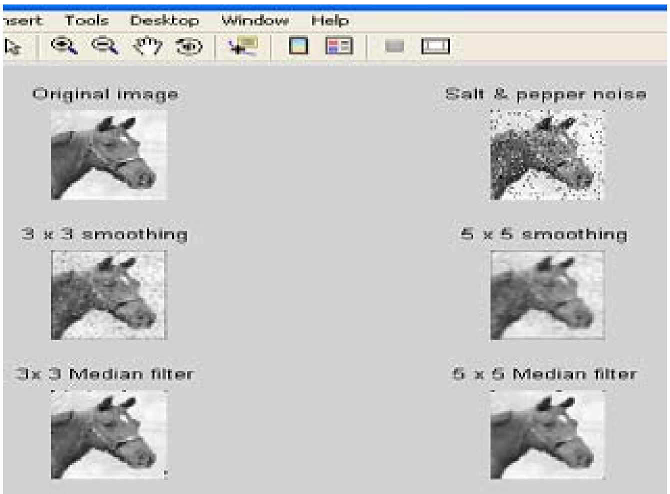

Fig. 3:Median filter and smoothing

IV. Edge Detection

Edge detection techniques transform images to edge images benefiting from the changes of grey tones in the images. Edges are the sign of lack of continuity, and ending. As a result of this transformation, edge image is obtained without encountering any changes in physical qualities of the main image[13-15]. Objects consist of numerous parts of different color levels. An Edge in an image is a significant local change in the image intensity, usually associated with a discontinuity in either the image intensity or the first derivative of the image intensity. Discontinuities in the image intensity can be either 'Step edges', where the image intensity abruptly changes from one value on one side of the discontinuity to a different value on the opposite side, or 'Line Edges', where the image intensity abruptly changes value but then returns to the starting value within some short distance. Steps in Edge Detection Edge detection contain three steps namely Filtering, Enhancement and Detection.

The overview of the steps in edge detection is as follows:

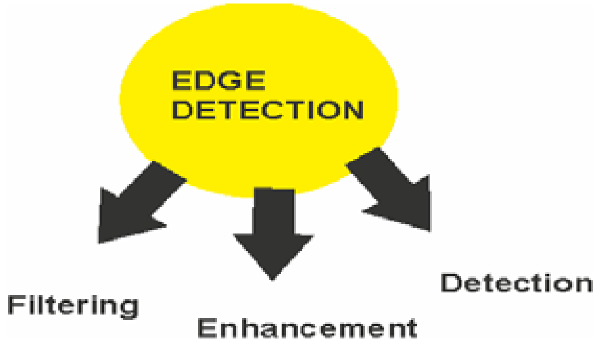

Fig. 4: Edge detection

As from Fig. 4, images are often corrupted by random variations in intensity values, called noise. Some common types of noise are salt and pepper noise, impulse noise and Gaussian noise. Filtering is done to reduce noise results in a loss of edge strength[10]. In order to facilitate the detection of edges, it is essential to determine changes in intensity in the neighborhood of a point. Enhancement emphasizes pixels where there is a significant change in local intensity. Frequently, thresholding provides the criterion used for detection.

V. Edge Detection Methods

Three most frequently used edge detection methods are used for comparison. These are

(1) Roberts Edge Detection
(2) Sobel Edge Detection
(3) Prewitt edge detection.

We apply the Sobel Detection, in which the Sobel operator performs a 2-D spatial gradient [14]measurement on an image and thus, it emphasizes regions of high spatial frequency that correspond to edges. Typically it is used to find the approximate absolute gradient magnitude at each point in an input grayscale image. The operator consists of a pair of 3x3 convolution kernels as shown in Fig. 5. The value of one kernel is simply equal to value of the other rotated by 90o.This is very similar to the Roberts Cross operator [27]. The convolution masks (in present system) are as shown below.

Msk = [0 0 0 0 0;
0 1 1 1 0;
0 1 1 1 0;
0 1 1 1 0;
0 0 0 0 0;];

The convolution masks of the Sobel detector and the output is as shown in Fig. 6

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Fig. 5: 3x3 convolution kernels

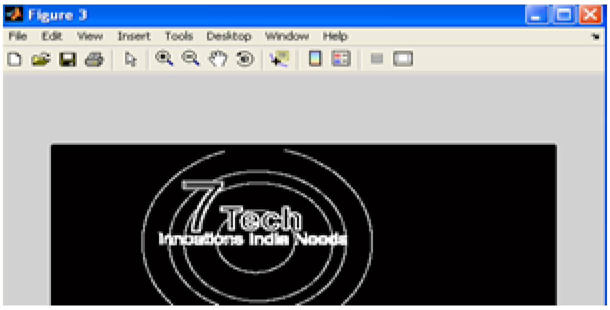

Fig. 6: Ouput of sobel detector

VI. Connected components

After that we find the connected component and mark it with mx. If the value of mx is more than 17, then we can extract all the characters in the number plate correctly and exactly. As(picture taken from [1]) from the Fig. below the value of mx=17, and from the output, it is quite clear that the number is PB6065.

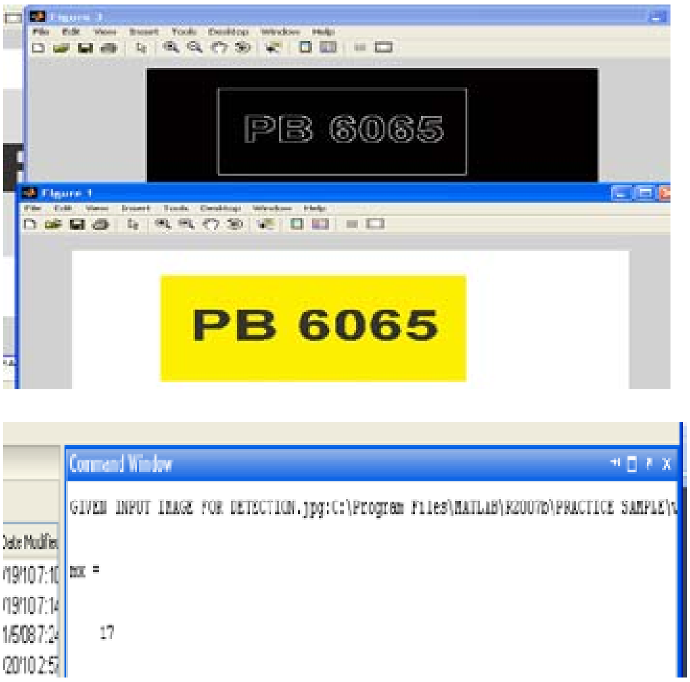

Fig. 7: Extracted Number

Also from the Fig. 8, the input image (car under test with number plate) 35 AG1799 is given to our present system and output is shown in the Fig. 9. from median filter and then from Fig. 10, we can detect the extracted number.

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Fig. 8: input image under test

Fig. 9: Median filtering the image to remove noise

Fig. 10: Extracted Number and thus the detected number is 35 AG1799.

VII. Conclusion and Future Work

With the help of presented technique in this paper, we can detect the number of any plate just by giving as input the image of the plate, and number gets extracted as shown in the Fig. 11. The extracted number are PB 13 F 6062,but in the image below, we can see that the detection is not that clear and proper, which we find , is due to improper light segment or varying illumination effects[11-12]. So the scope of the work lies in enhancement of the resultant image under variable illumination. The same work further can be extended in the detection algorithms for faces.

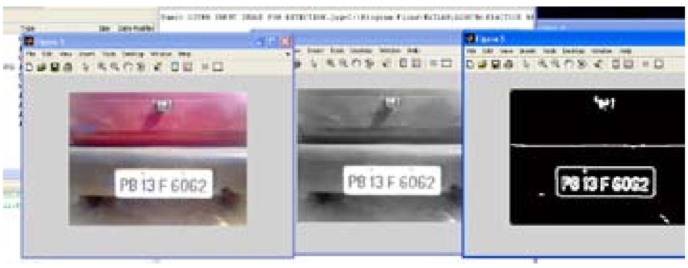

Fig.11:Variable Illumination

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