Vehicle Number Plate Detection Using Sobel Edge Detection Techniques by MATLAB

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Abstract

Detection of vehicle number plate is very interesting and also challenging topic for research. Since identification of a particular vehicle can be possible through its number plate, therefore each vehicle contains its own unique number plate. Characters are nothing but the different shapes of lines or edges; hence, edge Detection is the most important step for number plate extraction. Edges can be defined as the change in intensity of pixel, where each pixel value is set on average value with its neighborhood pixel. Bright-pixel gets brighter and dark-pixel gets darker hence characters are clearly visible which results into proper segmentation and helps in number plate extraction. This paper presents an optimized method based on Edge Detection Technique to identify the number plate of vehicle. As the number of vehicles is increasing on the road, this calls for the need of traffic management, by this method one can find whether the vehicle is registered or not. This also helps to maintain smooth traffic movement and method used here simplifies the image characters, i.e. numbers and alphabets, present in a number plate.

Keywords: Sobel Edge Detector, Number Plate Recognition (NPR) System, Number Plate Extraction.

1. INTRODUCTION

Number plate of vehicle is a unique identity in order to detect respective vehicle. Large number of algorithms that have been developed for number plate detection, but each algorithm has its own function either they are developed by different soft- ware platform or introduced different methods [1] [2].

Each of those has some advantages and disadvantages over the existing methodologies. As MATLAB is precise as it contains advanced toolbox hence, it provide the desire atmosphere to develop this algorithm. Generally pixels are represented either in (Red green blue) RGB or in YCbCr format. In a RGB format, all three components Red, Green and blue together transfer the information about image in terms of brightness and color of each pixel. YCbCr format has two component namely, Y and Cb/Cr, which stand for light intensity and chroma component respectively and each component consumes some memory.

The input image should be of good quality
otherwise some operation for image enhancement has to be applied on an image. Some factors that affect the captured image like lighting conditions, movement of vehicle, damages in number plate, climatic changes and so on [3][10]. Due to the above mentioned factors, system needs an effective method that can process the image faster and reduce the computation time.

This algorithm consists of various steps like Morphological operations, Image Enhancement operations such as Erosion, Dilation, Edge Processing, Filtering[3][4]. Edge processing is quite interesting and the most important step for vehicle number plate detection.

This paper shows an optimized algorithm for vehicle number plate detection by using advance image processing techniques. An image taken by a camera is used as an input for the developing algorithm. The input image used must be of small size because the main purpose of the method is to reduce computation timing and calculate result faster than existing methods. Every image is used to transfer some require information in visible format. An image is simply described as a specific arrangement of small element called pixels, in two or three dimension plane. Each and every pixel contains some useful information about image in the form of different parameters like intensity, color, brightness and so on.

2. PROBLEM FORMATION

As we know in our daily life transportation plays a strong role. Everyone wants to reduce their time generally wasted in traveling, hence the number of road accident and cases of breaking traffic rules are increasing day by day, which needs a smart and portable monitoring system to detect the action of vehicles. To detect particular vehicle on road, it is required to have a unique identity of the vehicle that is vehicle number plate. The method which is proposed here provides a better and authorized way in order to reduce the timing of detection period. Optimization techniques have been used to develop this algorithm, which takes less time and gives more efficient results.

The motivation for this work comes from the problem which arrives, when we face the effects of existing monitoring systems, as we need a system which can handle Management of the traffic systems installed on freeways to check water the speed of moving vehicles is in permissible limit or not according to the law. One of the components of these systems is a vehicle and there is a lot of scope for improvement. In order to computerize and make these processes more useful, a monitoring system is required to identify a vehicle properly [8][9].

The main objective of this paper is to offer develop optimized method and detect the vehicle number plate from a captured image which is being used as an input image. Extraction of number plate will display on a notepad file for authentication purpose. Template matching technique has been used here to recognize the individual character of the number plate. Each character of number plate compares with the character already stored in the database as a template. The real benefit of this template matching technique is that one can easily detect the pattern of character even if it has any designer language, such as cursive format. The work can be helpful for future improvements in the field of image processing, especially in the number plate detection [3][6][12].
3. ALGORITHM

The proposed algorithm executed in various steps such as capturing an image, extraction of Y component, elimination of unwanted signals, dilation, processing of image and extraction of the region of interest. The image of interest mainly consists of two components i.e. Chrominance (C) and Luminance (Y) [1][2]. The gray scale of a pixel is said to be the Luminance (Y) component. Since the Chrominance component is not essential, the knowledge of Luminance component becomes essential while processing this algorithm because the algorithm is independent of that information [2][4][5].

After the noise removal process, the second step of algorithm i.e. dilation process, is executed. In this process, each pixel of the frame is assigned to that value which is equal to the maximum value of neighboring pixel. The prime job of this process is to sharpen the edges and connects the broken line of that image. It ensures the processed image has got a better quality over the captured one. When the quality improvement process of the image is done, the next step is to find the edges by further processing it. Since it is a two dimensional search algorithm, row and column-wise operation is performed to find the edges [2][12][13].

The Histogram, a graphical representation of numerical data, is created by taking the differences of the values of neighboring pixels. It shows the data that is sum of the differences between the pixel value in both row and column wise. In order to get quick and better result, a modified method has been used in this paper. The smoothed histogram is obtained when it is passed through a low pass filter. After the smoothing process, the unnecessary values in the histogram are filtered out by passing it through a Band-pass filter. The average of all histogram values (both row and column value) is called dynamic threshold and it is used as a filter threshold. The Dynamic threshold has advantages that it executed the algorithm irrespective of the light condition and color of the background of the captured image [12][13].

The steps of implementing Number Plate

Fig. 1: Flow chart

In the very first step of the algorithm, capturing of the image is done and after that, Y component which is extracted from that image stored in a two-dimensional array and it is further processed for noise removal. In order to remove the noise, a linear filter is used in this project. In this way, each pixel of that image contains average value of its immediate eight neighboring pixels and hence any spontaneous noise component in the captured frame is spotted and removed easily. Thus it reduces the chances of false processing of the frame [7][8].
Detection algorithm in MATLAB are described below.

3.1 Description of necessary image processing operations

Description given in the introduction shows the necessity of an algorithm which can reduce computation timing and conveys result in an effective manner.

![System block diagram]

**Fig. 2:** System block diagram

To perform this algorithm an input image is required, which is taken by a high-resolution camera and it can be in any format of image i.e. JPG, PNG, EPS, GIF, RAW and so on. In this paper, JPG format has been chosen and High-resolution image is preferred to check the performance of proposed method as bigger is the size of an image more time is taken to run the algorithm, so that one can easily compare this method with existing methods. Original image taken by camera shown below in Fig. 3 is depicted.

![Original image]

**Fig. 3:** Original image

**Gray Image:** Input image in the RGB format which contains three components (color, brightness, and intensity). This image is three-dimensional image but, a two-dimensional image is required for better processing and image of vehicle plate may not contain same or uniform brightness. Hence primarily this input image is converted into a gray image or two-dimensional image[9][13]. The color of the vehicle can affect the image through its reflection in sun light, so the method should be independent of the color of the vehicle. Converted gray image has shown in Fig.4.

![Gray image]

**Fig. 4:** Gray image

**Dilation:** Conversion from RGB to Gray image might lose some important parameter like color difference, object edges of the image turns lighter, hence using Dilation, these losses can be minimized. Dilation improves the quality of the image, fills the holes, makes the image sharper and joins the broken edges[2][3], the gray value of the edge of an objective can adjust to enhance the edge detection it removes some noise as well. Dilated image of Fig.3 is shown in Fig.5.

![Dilated image]

**Fig. 5:** Dilated image of Fig.3
**Fig. 5:** Dilated image

**Edge Processing:** Edge acknowledgment is the fundamental of picture division and location, which involves a critical position in building capacity. The current calculations of edge recognition don’t have the total favorable circumstances [13][14].

Edge processing is done in order to improve the sharpness of borders or edges to easily distinguish the edges. In edge processing, each pixel value compares with its eight neighborhood pixels and set the value of the pixel at which is higher among these two values.

Edge detection can be done by various methods like sobel edge detection, canny edge detection. In sobel edge detection, vertical and horizontal edge processing happen which give results to compare with the conventional methods of edge processing.

This paper presents a improve sobel edge processing method, to get more accurate and faster results hence four side edge processing proposed here, means processing has done from right & left horizontal and top & lower vertical side edge processing. After performing edge processing step image of vehicle appears shown in Fig.6.

**Fig. 6:** Edge processed image

The shape of a single pixel is to consider square shape, as each pixel has its 8 neighborhood pixel average value of pixels with its neighborhood pixel required to calculate the results of edge processing. So four side comparison is better than two sides [12][13].

3.2 Necessity of passing histograms through a LPF

The histogram is nothing but a graph which represents the value of variable quantity over a given range, so one can easily see the drastic changes of histogram values between consecutive row and columns. These changes show some important information, which can be affected by the further filtering process, so as to prevent the information loss. Therefore, a low pass filter has used to filter unwanted noise and extract the useful component of image matrix [9]. The simplest low-pass filter just calculates the average of a pixel and all of its eight immediate neighbors. The result replaces the original value of the pixel. The process is repeated for every pixel in the image [6][13].

**Fig. 7:** Horizontal edge processing
Fig. 8: Vertical edge processing histogram

Referring to the Fig.7 and Fig.8 shown can observe histogram before passing the low pass filter and after removing noise also. Four sides Edge Processing gives four histograms but only two histograms are sufficient i.e. horizontal edge processing histogram and vertical edge processing histogram and the remaining two has their own particular value with same parameters. Understanding of these histograms based on the variations is depicted graphically.

**Filtration:** The resultant histogram shows the uneven values there are some spikes in value and some values are zero each change shows the change in two consecutive pixel values. Therefore, to identify the region of interest i.e. vehicle number plate. After filtration image contains Sharpe edges, big objects and number plate in which we have interest. In this filtration process, the size of vehicle number plate covers a major area of image hence it is easy to find it for further operations. A filtered image of vehicle has shown in Fig.8.

**Segmentation:** At the end of the procedure, segmentation has been done in which entire image is cut into small pieces, the number plate is one of them hence histogram values helps to find the final image of number plate as the region for histogram gives most uneven values having the highest probability of containing a piece of number plate[15]. The area of interest which is vehicle number plate can be extracted as that is the final image of the number plate of respective vehicle. Command “imcrop” can be used for rectifying the remaining unwanted area that may exist under histogram.

4. **RESULTS**

The success of work carried out is the final result that is a number of the vehicle appears on a notepad screen as it contains both alphabets and numbers, it is better to get a text result rather than an image as the
visibility of character in an image always lags by physical text format of results. The proposed method used in this paper is so optimized that we can see the time taken by this method is very less than others. Snapshot of the result for input image has shown in Fig. 11.

![Image](image.png)

**Fig. 11:** Final output image

5. **CONCLUSION**

The method proposed in this paper is quite user-friendly in the case of localization and recognition of different vehicle number plate under variable environmental and lighting conditions. It facilitates to correctly identify the number plate of a vehicle, even if the image is not so clear and number plate having some minor damages. The high performance of algorithm takes less time and optimizes the results.

6. **FUTURE SCOPE**

The work was carried out towards optimization concept, the detection method and implementation in order to create an algorithm to better fit to the architecture characteristics of this platform and examine their applications on hardware. The algorithm can be used for advance level security purpose, where high-security demand like border security, airport parking security, tolling and much more.

**REFERENCES**


