NUMBER PLATE DETECTION

PROJECT REPORT

SIGNALS AND SYSTEM (ECE-1004)

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CERTIFICATE

This is to certify that the project work entitled **"Number Plate Detection"** that is being submitted by

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for Signals And Systems (ECE1004) is a record of bonafide work done under the supervision of **Prof. Lokanath M**. The contents of this project work, in full or in parts, have neither been taken from any other source not have been submitted for any other CAL course.

Place: Vellore

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CONTRIBUTION

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1. **GIRISH** – Code till image dialation.
2. **VARUN** – code for vertical and horizontal edge processing .
3. **SWAROOP** – code from dialation to histogram plotting .
4. **HEMCHARAN** – license plate detection part.
5. **SHIVANAND** – ppt preparation.
6. **VIPUL KUMAR PUROHIT** – Report making and wrote the algorithm for code by studying the code

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ABSTRACT

- Automatic number plate detection (ANPD) is an image processing technology which uses number (license) plate to identify the vehicle. The ANPD system is implemented on the entrance for security control of restricted areas like **"**Military Zones**","** Government offices.**"**
- The developed system first detects the vehicle and captures the vehicle image. Vehicle number plate region is extracted using the **"**Image Segmentation**"** in an image. Optical character recognition technique is used for character recognition.
- The resulting data is then used to compare with the records on a database so as to come up with the specific information like **"**vehicle owner, place of registration, address.**"** The system is implemented and simulated in MATLAB, and it performance is tested on real image. It is observed from the experiment that the developed system successfully detects and recognize the vehicle number plate on real images.

RESEARCH PROBLEM

The main focus in this research project is to experiment deeply with, and find alternative solutions to the **image segmentation** and **character recognition** problems in license plate recognition framework. Blur images, Similarities b/w some characters like O and D, B and E, 5 and 8..etc. Another major issue is Limited coverage area due to which the recognition is not efficient. Each camera added to the ANPD system on a vehicle provides an additional field of view and increases the amount of data and images the processor must analyze.

Keywords—Number plate localization, Morphological operation, Character segmentation, Thresholding, Edge detection.

CONTENTS

1. INTRODUCTION

Vehicle Number Plate Detection (VNPD) is a part of digital image processing which is generally used in vehicle transportation system to categorize the vehicle. Number plate recognition systems are having varieties of application such as traffic maintenances, tracing stolen cars, automatic electronic Toll collection system etc. But the main aim is to control the traffic management system. In India the traffic management system is developing day by day. In India, the number plate containing white background with black foreground color is used for private cars and for the commercial vehicles yellow is used as background and black as foreground color.

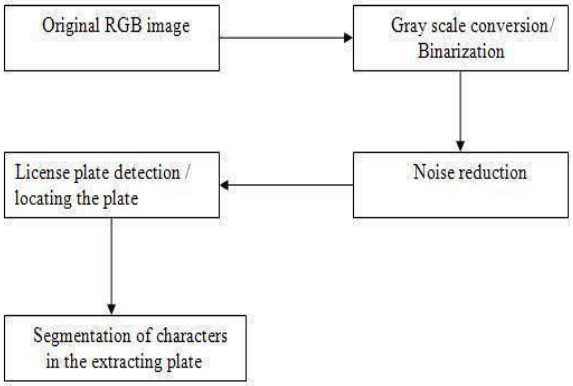
Locating the number plate is very stimulating work in the field of image processing. The whole system mainly consists of two stages. First to identify the position of the number plate from the particular vehicle and second segmentation of all the numbers and letters of the number plate. The identification task is interesting because of the nature of the light. The position error will increase if the color of the number plate is related to the background. Noise on the number plate can sometimes cause error and low accuracy.

2. PROPOSED METHOD

Number plate is a pattern with very high disparities of contrast. If the number plate is very similar to background it's challenging to identify the location. Illumination and contrast is changes as light fall changes to it. The morphological operations are used to eliminate the contrast feature within the plate.

The work is distributed into several parts:

1. Input raw image
2. Image binarization
3. Reduce noise using mid-filtering method
4. Enhance contrast using histogram equalizer
5. Plate localization
6. Character segmentation



3. PLATE DETECTION USING MATLAB

3.1. Input raw image

Input the image that is taken from the car

Figure: 3.1.1- input car image

3.2. Gray scale conversion

From the input RGB image it has to be convert to gray scale and the 8-bit gray value is intended.

3.3. Noise reduction

We used median filtering method to reduce the paper and salt noise. We have used 3x 3 masks to get eight neighbors of a pixel and their consistent gray value.

3.4. Contrast enhancement using histogram equalization.

Using histogram equalization method the difference of each image is being enhanced. The function used to improvement that is J=histeq(k); histeq enhances the contrast of the images by converting the values in an intensity image. When image pixel intensity of 8-neibourgh connectivity, we supply a preferred histogram, histeq chooses the grayscale conversion T to minimize

$$\left| \mathbf{c}_1 (T(k)) - c_0 \mathbf{(k)} \right|$$

In below we state the change of histogram from original image and after smearing the contrast enhancement using histogram equalization.

3.5. Plate localization

The basic step in recognition of vehicle number plate is to detect the plate size. In general number plates are rectangular in shape. Hence we have to identify the edges of the rectangular plate. Mathematical morphology will be used to detect that region.Sobel edge detector we used to high light regions with a high edge magnitude and high edge alteration are identified. Depending upon the threshold value edge will be detected from the input image. Figure 2.3 shows the input image before applying Sobel edge detection algorithm and figure 2.4 shows after applying the Sobel edge detection method.

Figure: 3.5.1- Grayscale image after image enhancing.

Figure: 3.5.2-After applying Sobel edge detection method

After edge detection eliminates all connected components that have lower than (eight pixel in our method) pixels.

Thus it will produce another binary image.

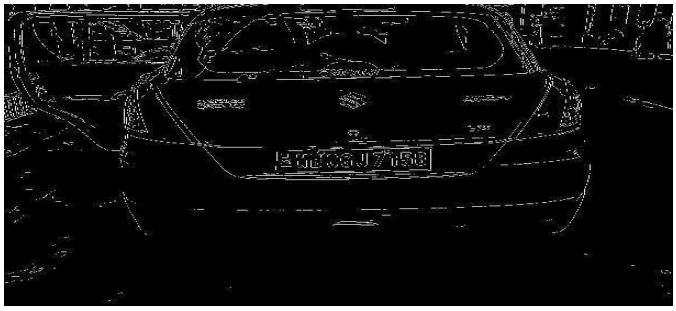


Figure:3.5.3-After removing lower pixels.

Matlab toolbox function deliver a functionimfill(BW,"holes") that fills holes in the binarized image called BW. The set of background pixels are known as hole that cannot be reached by filling the background from the edge of the image.

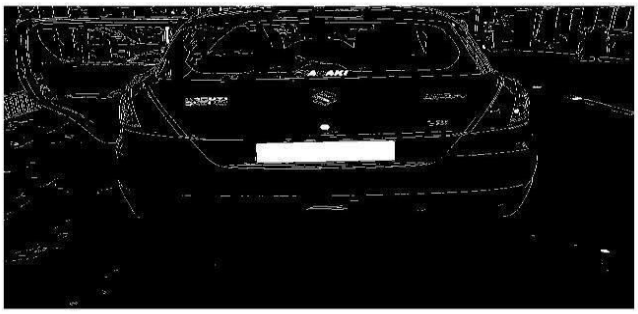


Figure: 3.5.4-After filling the holes

Using flood fill algorithm we fill the hole to trace the plate region. Now neglecting the lower pixel components to gets the actual plate.

Figure:3.5.5-image after removing components with connectivity less than 1000 pixel.

Using Matlab toolbox function bwareaopen() that stipulates the expected connectivity. All components connectivity lower than 1000 pixel are removed to get the actual location of the number plate. We output the four vertexes coordinates of the last selected region after morphological filtering and extract the number plate .

Figure: 3.5.6- License plate before crop

The final positioning of the number plate after cropping.

Figure: 3.5.7- The final number plate after the croping.

3.6. Character Segmentation

Matlab toolbox function delivers a function called regionprops(). It measures a set of properties for each labeled region in the label matrix. We use boundingbox to measure the properties of the image region. After labeling the connecting components, the region will be removing from the input image.

Figure 3.6.1- Segmentation of characters

4. EXPERIMENTAL RESULTS

We have run our proposed method on desktop computer Several vehicle images are taken using 1.3 mega pixel camera as well as 12 mega pixel cameras. In the experiments, we test our proposed method on the different type car image to identify the location exactly.

Fig: 4.1-Proper light on cropping

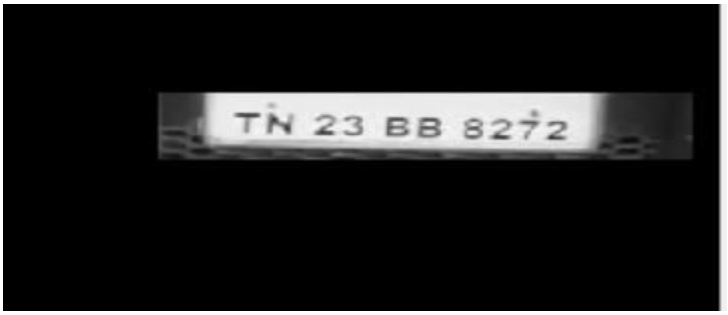


Fig 4.2-Successful number plate.

5.MATLAB CODE

```
clc;
clear all;
close all;
I = imread ('1.jpg');
figure(1);
imshow(I);
Igray = rgb2gray(I); %(Convert an Image to Gray)
[rows cols] = size(Igray);
Idilate = Igray; %% Dilate and Erode Image in order to remove noise
fori = 1:rows
for j = 2:cols-1
temp = max(Igray(i,j-1), Igray(i,j));
Idilate(i,j) = max(temp, Igray(i,j+1));
end
end
I = Idilate; figure(2);
imshow(Igray);
figure(3);
title('Dilated Image')
imshow(Idilate);
difference = 0; sum
= 0; total_sum = 0;
difference = uint32(difference);
%% PROCESS EDGES IN HORIZONTAL DIRECTION
max_horz = 0;
maximum = 0;
fori = 2:cols
sum = 0;
for j = 2:rows
if(I(j, i) > I(j-1, i))
difference = uint32(I(j, i) - I(j-1, i));
else
difference = uint32(I(j-1, i) - I(j, i));
end
if(difference > 20)
sum = sum + difference;
end
end
horz1(i) = sum;
```

```
% Find Peak Value
if(sum > maximum)
max_horz = i;
maximum = sum;
end
total_sum = total_sum + sum;
end
average = total_sum / cols;
figure(4);
% Plot the Histogram for analysis
subplot(3,1,1);
plot (horz1);
title('Horizontal Edge Processing Histogram');
xlabel('Column Number ->');
ylabel('Difference ->');
%% Smoothen the Horizontal Histogram by applying Low Pass Filter
sum = 0;
horz = horz1;
fori = 21:(cols-21)
sum = 0;
for j = (i-20):(i+20)
sum = sum + horz1(j);
end
horz(i) = sum / 41;
end subplot(3,1,2);
plot (horz);
title('Histogram after passing through Low Pass Filter');
xlabel('Column Number ->');
ylabel('Difference ->');
%% Filter out Horizontal Histogram Values by applying Dynamic Threshold
disp('Filter out Horizontal Histogram...');
fori = 1:cols
if(horz(i) < average)
horz(i) = 0;
for j = 1:rows
I(j, i) = 0; end
end end
subplot(3,1,3);
plot (horz);

title('Histogram after Filtering');
xlabel('Column Number ->');
```

```
ylabel('Difference ->');
%% PROCESS EDGES IN VERTICAL DIRECTION
difference = 0;
total_sum = 0;
difference = uint32(difference);
disp('Processing Edges Vertically...');
maximum = 0;
max_vert = 0;
fori = 2:rows
sum = 0;
for j = 2:cols%cols
if(I(i, j) > I(i, j-1))
difference = uint32(I(i, j) - I(i, j-1));
end
if(I(i, j) <= I(i, j-1))
difference = uint32(I(i, j-1) - I(i, j));
end
if(difference > 20)
sum = sum + difference;
end
end
vert1(i) = sum;
%% Find Peak in Vertical Histogram
if(sum > maximum)
max_vert = i;
maximum = sum;
end
total_sum = total_sum + sum;
end
average = total_sum / rows;
figure(5)
subplot(3,1,1);
plot (vert1);
title('Vertical Edge Processing Histogram');
xlabel('Row Number ->');
ylabel('Difference ->');
%% Smoothen the Vertical Histogram by applying Low Pass Filter
disp('Passing Vertical Histogram through Low Pass Filter...'); sum
= 0;
vert = vert1;
fori = 21:(rows-21)
sum = 0;
for j = (i-20):(i+20)
sum = sum + vert1(j);
```

```
end
vert(i) = sum / 41;
end
subplot(3,1,2);
plot (vert);
title('Histogram after passing through Low Pass Filter');
xlabel('Row Number ->');
ylabel('Difference ->');
%% Filter out Vertical Histogram Values by applying Dynamic Threshold
disp('Filter out Vertical Histogram...');
fori = 1:rows
if(vert(i) < average)
vert(i) = 0;
for j = 1:cols
I(i, j) = 0;
end
end end
subplot(3,1,3);
plot (vert);

title('Histogram after Filtering');
xlabel('Row Number ->');
ylabel('Difference ->');
figure(6), imshow(I);
%% Find Probable candidates for Number Plate
j = 1;
fori = 2:cols-2
if(horz(i) ~= 0 &&horz(i-1) == 0 &&horz(i+1) == 0)
column(j) = i;
column(j+1) = i;
j = j + 2;
elseif((horz(i) ~= 0 &&horz(i-1) == 0) || (horz(i) ~= 0 &&horz(i+1) == 0))
column(j) = i;
j = j+1;
end
end
j = 1;
fori = 2:rows-2
if(vert(i) ~= 0 && vert(i-1) == 0 && vert(i+1) == 0)
row(j) = i;
row(j+1) = i;
j = j + 2;
elseif((vert(i) ~= 0 && vert(i-1) == 0) || (vert(i) ~= 0 && vert(i+1) == 0))
row(j) = i;
```

```
j = j+1;
end
end
[temp column_size] = size (column);
if(mod(column_size, 2))
column(column_size+1) = cols;
end
[temp row_size] = size (row);
if(mod(row_size, 2))
row(row_size+1) = rows;
end
%% Region of Interest Extraction
%Check each probable candidate
fori = 1:2:row_size
for j = 1:2:column_size
% If it is not the most probable region remove it from image
if(~((max_horz>= column(j) &&max_horz<= column(j+1)) && (max_vert>=row(i) &&max_vert<=
row(i+1))))
%This loop is only for displaying proper output to User
for m = row(i):row(i+1)
for n = column(j):column(j+1)
I(m, n) = 0;
end
end
end
end
end
figure(7), imshow(I);
imshow(I);
```

ALGORITHM FOR MATLAB CODE

Convert a Colored Image into Gray Image:

The algorithm described here is independent of the type of colors in image and relies mainly on the gray level of an image for processing and extracting the required information. Color components like Red, Green and Blue value are not used throughout this algorithm. So, if the input image is a colored image represented by 3-dimensional array in MATLAB, it is converted to a 2-dimensional gray image before further processing.

Dilate an Image:

Dilation is a process of improvising given image by filling holes in an image, sharpen the edges of objects in an image, and join the broken lines and increase the brightness of an image. Using dilation, the noise with-in an image can also be removed. By making the edges sharper, the difference of gray value between neighboring pixels at the edge of an object can be increased. This enhances the edge detection. In Number Plate Detection, the image of a car plate may not always contain the same brightness and shades. Therefore, the given image has to be converted from RGB to gray form. However, during this conversion, certain important parameters like difference in color, lighter edges of object, etc. may get lost. The process of dilation will help to nullify such losses.

Horizontal and Vertical Edge Processing of an Image:

Histogram is a graph representing the values of a variable quantity over a given range. In this Number Plate Detection algorithm, the writer has used horizontal and vertical histogram, which represents the column-wise and row-wise histogram respectively. These histograms represent the sum of differences of gray values between neighboring pixels of an image, column-wise and row-wise. In the above step, first the horizontal histogram is calculated. To find a horizontal histogram, the algorithm traverses through each column of an image. In each column, the algorithm starts with the second pixel from the top. The difference between second and first pixel is calculated. If the difference exceeds certain threshold, it is added to total sum of differences. Then, algorithm will move downwards to calculate the difference between the third and second pixels. So on, it moves until the end of a column and calculate the total sum of differences between neighboring pixels. At the end, an array containing the column-wise sum is created. The same process is carried out to find the vertical histogram. In this case, rows are processed instead of columns.

Passing Histograms through a Low Pass Digital Filter:

Referring to the figures shown below, one can see that the histogram values changes drastically between consecutive columns and rows. Therefore, to prevent loss of important information in upcoming steps, it is advisable to smooth out such drastic changes in values of histogram. For the same, the histogram is passed through a low-pass digital filter. While performing this step, each histogram value is averaged out considering the values on it right-hand side and left-hand side. This step is performed on both the horizontal histogram as well as the vertical histogram. Below are the figures showing the histogram before passing through a low-pass digital filter and after passing through a low-pass digital filter.

Filtering out Unwanted Regions in an Image

Once the histograms are passed through a low-pass digital filter, a filter is applied to remove unwanted areas from an image. In this case, the unwanted areas are the rows and columns with low histogram values. A low histogram value indicates that the part of image contains very little variations among neighboring pixels. Since a region with a license plate contains a plain background with alphanumeric characters in it, the difference in the neighboring pixels, especially at the edges of characters and number plate, will be very high. This result in a high histogram value for such part of an image Therefore, a region with probable license plate has a high horizontal and vertical histogram values. Areas with less value are thus not required anymore. Such areas are removed from an image by applying a dynamic threshold. In this algorithm, the dynamic threshold is equal to the average value of a histogram. Both horizontal and vertical histograms are passed through a filter with this dynamic threshold. The output of this process is histogram showing regions having high probability of containing a number plate.

Extraction

The output of segmentation process is all the regions that have maximum probability of containing a license plate. Out of these regions, the one with the maximum histogram value is considered as the most probable candidate for number plate. All the regions are processed row-wise and column-wise to find a common region having maximum horizontal and vertical histogram value. This is the region having highest probability of containing a license plate. The image detected license plate is shown below: This algorithm was verified using several input images having resolution varying from 680 * 480 to 1600 * 1200. The images contained vehicles of different colors and varying intensity of light. With all such images, the algorithm correctly recognized the number plate. This algorithm was also tried on images having number plate aligned at certain angle (approximately 8-10 degree) to horizontal axis. Even with such images, the number plates were detected successfully.

6. APPLICATIONS OF NPD SYSTEM

Parking

One of the main applications of ANPR is parking automation and parking security: ticketless parking fee management, parking access automation, vehicle location guidance, car theft prevention, "lost ticket" fraud, fraud by changing tickets, simplified, partially or fully automated payment process, among many others.

Access Control

Access control in general is a mechanism for limiting access to areas and resources based on users' identities and their membership in various predefined groups. Access to limited zones, however, may also be managed based on the accessing vehicles alone or together with personal identity

Motorway Road Tolling

Road Tolling means, that motorists pay directly for the usage of particular segment of road infrastructures. Tolls are a common way of funding the improvements of highways, motorways, roads and bridges: tolls are fees for services. Efficient road tolling increases the level of related road services by reducing travel time overhead, congestion and improve roadways quality.

Border Control

Border Control is an established state-coordinated effort to achieve operational control of the country's state border with the priority mission of supporting the homeland's security against terrorism, illegal cross border traffic, smuggling and criminal activities.

Law Enforcement

Automatic number plate recognition is an ideal technology to be used for law enforcement purposes. It is able to automatically identify stolen cars based on the up-to date blacklist. Other very common law enforcement applications are red-light enforcement and over speed charging and bus lane control.

7. CONCLUSION AND FUTURE WORKS

An efficient less time consuming vehicle number plate detection method is projected which performed on multifaceted image. By using, Sober edge detection method here detects edges and fills the holes less than 8 pixels only. To removing the license plate we remove connected components less than 1000 pixels. Our anticipated algorithm is mainly based on Indian automobile number plate system. Extraction of number plate accuracy may be increased for low ambient light image.

Some of possible difficulties:

1. Broken number plate.
2. Blurry images.
3. Number plate not within the legal specification.
4. Low resolution of the characters.

Poor maintenance of the vehicle plate. Similarity between certain characters, namely, O and D; 5 and S; 8 and B, E; O and 0, etc

8.REFERENCES

[1] Deniing Jiang, Tulu Muluneh Mekonnen, Tiruneth Embiale, Ashenafi Gebrehiwot "Car Plate Recognition System" in Fifth internation conference on Intelligent Networks and Intelligent Systems, IEEE, 978-0-7695-4855-5/12 2012.

[2] Huili Han, Runping Han "Method of License plate Location Based on Edge Detection and Color Information",

IEEE, 978-1-4577-1701- 7/11, 2011, pp1477-1480.

[3] Ch. Jaya Lakshmi, DrA.Jhansi Rani, Dr. K. Sri Ramakrishna, M.Lantikiran, V.R. Siddhartha,"A novel Approach for Indian License Plate Recognition System", IJAEST, Vol 2 Issue I, 2011, pp 010-014.

[4] ShokriGendy, Clifton L.Smith, Stefan Lachowicz, "Automatic Car registration Plate Using Fast Hough Transform",

IEEE, 0-7803-3913- 4-9/97,1997, pp 209-218