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Recognition of Indian License Plate Number from a Detected Number Plate

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Abstract - *In general, number plate recognition system includes two main phases: 1). Number plate detection and 2).Character segmentation and Recognition. The work is planned to carry out by applying image processing techniques to character segmentation and recognition of number plate of vehicles automatically. Input of the system is the image of a vehicle captured that is taken in different weather conditions and environment changes. In the stage of character segmentation and recognition, the number plate is segmented into its constituent parts obtaining the characters individually. First image is filtered for enhancing the image, removing the noise and unwanted spots. Apply different operations to the image for separating the characters from each other. If the characters are close to each other then find character region. After finding character region then applying recognition techniques.*

***Key Words*: Horizontal Segmentation, Vertical Segmentation, Character Segmentation**

1. INTRODUCTION

Number Plate Recognition system is an image processing technology used to identify vehicles by their license plates. This technology is gaining popularity in security and traffic monitoring. Now a day's vehicle play major role in transportation. The Number plate recognition system is important for variety of applications like automatic congestion charge system, access control, tracing of stolen cars or identification of dangerous drivers. The number plate recognition plays a major role in automatic monitoring of traffic rules and maintains law enforcement on public roads. The use of vehicles has been increase because of population growth and human needs in recent years. Monitoring legal use of vehicle has become difficult and is big problem. Automatic number plate identification systems are used for effective monitoring of vehicles. The various approaches of number plate recognition system by using optical character recognition system.

Character recognition is a prime requirement of text document image recognition. Character recognition is a two-stage process: the first stage is feature extraction and the second is classification. Feature extraction involves collection of useful data from a given sample. Classification is the categorization of the sample by discriminate function in feature space consisting of feature vectors. Conventional pattern classification is based upon two approaches: non-numeric and numeric methods. The non-numeric approach involves fuzzy theory or knowledgebase for inference, while the numeric approach involves deterministic or statistical methods for inference.

In the pre-processing step, binarization and thresholding techniques remove the noise from the input image. Character segmentation is performed by using vertical projection to determine segmentation locations and horizontal projection to determine the extra space in the segmented character. Character recognition is performed by using template matching.

2. CHARACTER SEGMENTATION

2.1 Assumption

- Input to the system is an image of Indian detected license plate
- Input images are in grayscale image
- Considered only one line of characters in number plate
- Considered different backgrounds
- The threshold is fixed to 30

2.2 Data Set

Number Plate Recognition system requires input sample images. Therefore, it is necessary to collect database with huge number of samples. Input images are collected in various environmental conditions. The data samples for number plate recognition system are captured from the mobile camera or digital camera. The variation in the captured image will be due to difference in number plate size and distance between camera and the car. The actual work considered detected number plate. The detected number plate is in grayscale image.

2.3 Overview of the Model

The system is designed to segment the character and recognize the segmented character from the car number plate. Input to the system is the car number plate detected in the number plate localization phase and the output of the system is the recognized characters in the number plate.

There are five steps in this model. In the pre-processing step binarization and thresholding technique remove the majority of the noise from the input image. Segmentation is performed by using vertical projection to determined segmentation locations and horizontal projection to determine the extra space in the segmented character. Character classification is performed by using template matching.

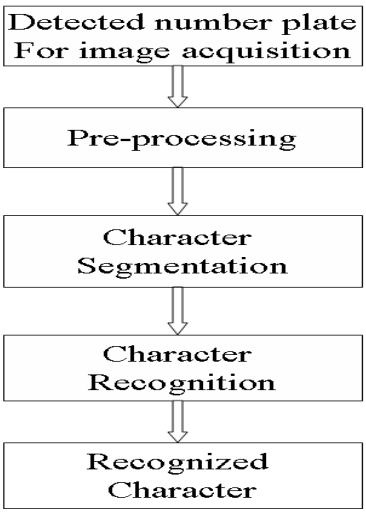

Fig -1: Overview of the model

2.4 Pre-processing

The preprocessing phase is the very important steps. It is necessary to enhance the input image by removing the noise blur as well as sharpening. An image may contain some unwanted information in the background as well as foreground of the image. This unwanted information means noise leads to undesired results in the segmentation and recognition phases. For the good result, an image should be noise free. Hence suitable noise removal methods are applied to the image, so that the anomalies in the further phases can be resolved.

2.5 Horizontal Segmentation

Horizontal projection is computed to separate the individual character from the number plate. For the horizontal segmentation calculate the horizontal projection and vertical projection of intensity. Perform the horizontal projection each character can be separated when the column sum is 0. This is because between each character, there is always a black zone which has the pixel value of 0. The vertical projection is use to remove unwanted area at the top and bottom of the number plate.

In order to locate the right and left edges of number plate from candidate region, the vertical projection after mathematical morphology deal is changed into binary image. The arithmetic for doing this is:

$$f_T(L,i) \begin{cases} 1 & f_I(L,i) \geq T \\ 0 & f_T(L,i) < T \end{cases}$$

Where f_T (L, i) is the vertical projection after mathematical morphology, T is the threshold. Then scan the function of f_T (L, i) and register the potions where values change from 0 to 1 and from 1 to 0 in stack1 and stack2 respectively. So the candidate position of the left and right edge of the number plate is in stack1 (L, i) and stack2 (L, i) respectively, and the candidate's width of the number plate is calculated by:

width (L0, i) =stack2(L, i) - stack1(L, i)

Fig-2: Candidate regions

Algorithm: Horizontal segmentation

Input number plate
m=0, n=0
for t=first column to last column
if pixel(t)=white
then m=m+1
end
if m>threshold
then i is the first column
for c=i to last column
if pixel(c)=white
then n=n+1
end
if n<threshold
then l is the last column
d=image between i and l

2.6 Finding the vertical bounds

For each segmented character follow the same procedure as explained in the horizontal projection to get the vertical bounds. Using local minima of the vertical projection, threshold is calculated. Using this threshold y location for each segmented character is calculated.

Algorithm: Vertical segmentation

Input f
r=0
for i=1 to last row
if pixel(i)=white
then r=r+1
end
if r>threshold
then i is the first row
s=0

```
for l=i to last row
if pixel(l)=white
then s=s+1
end
if s<threshold
then l is the row

f=image between i and l
```

3. CHARACTER RECOGNITION

3.1 Normalization

Segmented plate characters need to be normalized to the same size as the templates in the database. Calling the imresize procedure, each segmented character is isolated to a smaller image window where no white spaces exist around the character. This is done by finding the most extreme pixels on all four sides of the character and removing the white area after these points. The character image is then normalized to 20*10 using the command imresize (char, [20 10]).

After each character is segmented from the number plate, a template matching method is used for character recognition. Here, the template matching procedure consists of two important steps, training and recognition.

3.2 Training

The program is first trained with a set of sample images for each of the characters to extract the important features based on which the recognition operation would be performed. In order to create the template for each character the following operation is performed. For every white pixel, insert the value 1 and for every black pixel 0. Repeat this for all the training samples for each character and calculate the weights to get the template. Using the samples create the templates for character recognition.

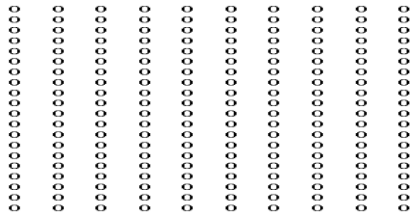

Fig -3: Empty template

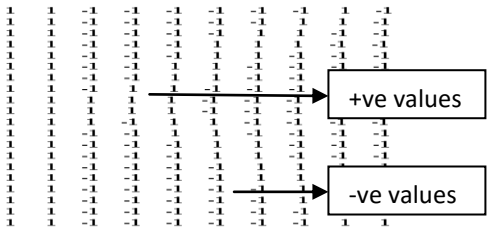

Fig- 4: Template for character K

3.3 Recognition

Calculate the matching score of the segmented character from the templates of the characters stored by the following algorithm.

Compare the pixel values of the matrix of segmented character and the template matrix, and for every match add 1 to the matching score and for every mis-match decrement 1. This is done for all pixels. The match score is generated for every template and the one which gives the highest score is taken to be the recognized character.

4. EXPERIMENTAL ANALYSIS

A database containing 100 number plate images has been used to test the proposed system. Experiments have been implemented to test the efficiency of the proposed vehicle number plate recognition system to recognize vehicle number plate in input gray level image. The test images which include both blurred plates, fragmented characters and ambiguous character such as “O”, “D” and “0”, “C”, “G”, and “6”, “8”, and “B”, “I”, and “1”, “5” and “S” taken under varying illumination condition.

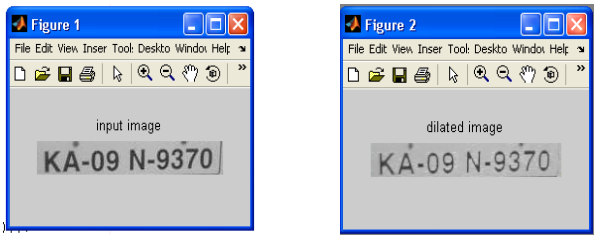

Fig -5: Input image & Dilated image

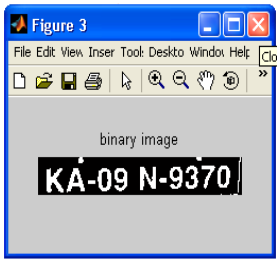

Fig -6: Binary image

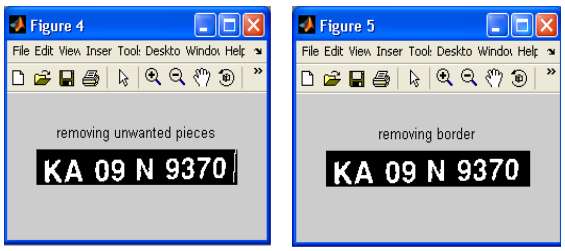

Fig -7: Removing unwanted pieces and border

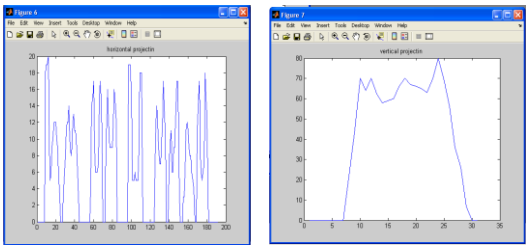

Fig -8: Horizontal and Vertical projection

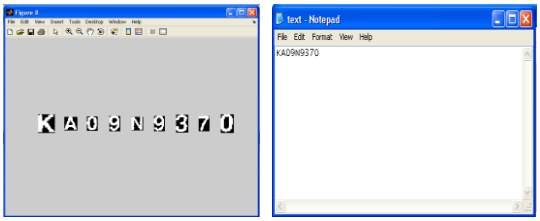

Fig -9: Character segmentation & Character recognition

5. CONCLUSIONS

For number plate character segmentation horizontal projection and vertical projection methods have been used. The horizontal projection and vertical projection gives the good result for the character segmentation.

Template matching is used for the character recognition and it gives the good result for the character recognition. From this, we can conclude that, Template matching technique is a suitable for the recognition of single-font, not-rotated, and fixed-size characters. Although this method is preferably used in binary images and built templates properly and obtained very good results for gray-level images.

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