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Traffic Control using Smart Toll booth

Audrin Mary[1], Minna Elizabeth Prince[1], Beethu Baby[1], Vimal V.V[1], Reeju Elisa Baby[1]

Department of Electronics and Communications, Amal Jyothi College of Engineering, Kanjirappally, Kerala[1]

Abstract: Traffic control using smart Toll Booth is a solution to many traffic related problems prevailing nowadays. This paper proposes a smart toll booth wherein license plate recognition and image processing are the key phenomenon. An algorithm has been established that extracts the license plate and segmentation of the characters is done. In this we used template matching to recognize the plate. Once the license plate is recognized, the toll pay is deduced from the car owner's account.

Keywords: License plate recognition, character segmentation, template matching.

I. INTRODUCTION

A Smart Toll Booth seems to play major role in automatic monitoring of the traffic signals and maintains road lanes. License plate is a unique feature and identification of the vehicle. Recognition of the license plate is essential part of the smart toll booth. With the help of digital image processing and pattern recognition we can recognize the license plate. The input is given as an image captured by a camera. The image is stored in the database of the computer system. The captured image is stored. It is then preprocessed to remove noise. The main problem of LPR (License plate recognition) is its boundary detection and noise removal in this paper we propose efficient algorithm that removes the noise and extract the boundary exactly.
The first section of this paper deals with preprocessing. Next we explain character segmentation and template matching. Finally we discuss the recognition of the license plate. As soon as the license plate is recognized the toll pay is deduced from the owner. This can be done by account linking with the help of authorized bank. But in this paper we show it with the help of a virtual account.

MATLAB is used as a platform to write the code. Image processing can be done easily on MATLAB. The images captured by the camera are stored on the system as database. We captured about five images and stored them. These images were loaded into the program and were preprocessed. After segmentation and template matching the license plate was recognized. Immediately the money has to be deduced. In order to show that we used a virtual account i.e. a counter. The counter was set to a higher value initially and then it was down counted.

II. LICENSE PLATE LOCATION

The license plate location is done easily with the help of MATLAB. The plate is located from a binary image. Since the images were captured from a camera we need to do preprocessing techniques. Preprocessing is a process of removing noise from the image. The image consists of noise. Since we need only the license plate portion, we need to remove the remaining portion. Firstly we need to resize the image. We used a resolution of 300*500. The picture is now RGB. The RGB picture is shown in Figure 1. Later we converted the image into Gray scale image. We set a threshold value for the gray scale image. The image is then converted to a black and white image.

License plate occupies almost 1/5 of the total image area [1]. The remaining area has to be removed. The unwanted portions are removed by taking the difference of the figure 4 and figure 2 as shown.
When the image is taken only the license plate is required to be preprocessed. So we cut from the original image the required part as shown in the figure 3. This image is now RGB and has a larger size. Therefore it is resized and converted to gray scale. The gray scale image is then converted to a black and white image. The black and white image is shown in Figure 4.The only image portion we require is the license number. Therefore the remaining portion is removed by difference operation on MATLAB. For that we have to differentiate the area of the images. The number on the plate lies under the area 3500 approximately. The remaining portion comes under around 30. We take the difference by using area. The difference of Figure 4 and Figure 2 is taken to remove the noise. The result of the difference is Figure 3.

Figure 1

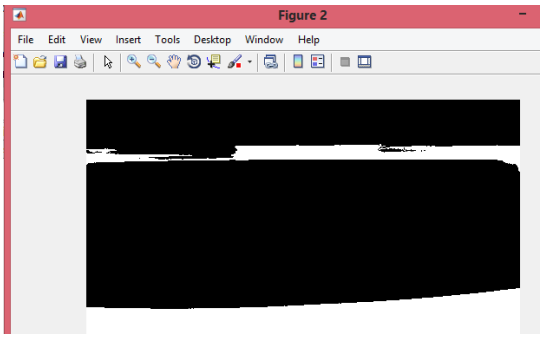

Figure 2

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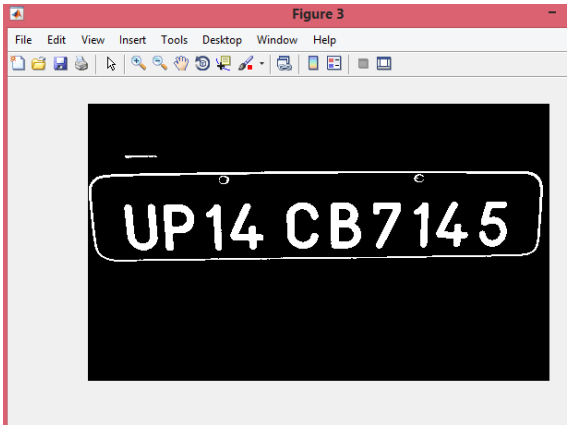

Figure 3

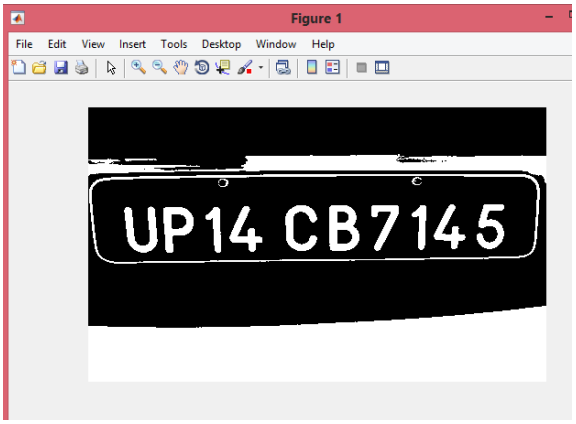

Figure 4

III. CHARACTER SEGMENTATION

Character segmentation is the process of segmenting each character in a license plate. License plate consists of 10 characters including numbers and alphabets. The edge cutting is an important procedure. We must erase the edges before we segment the characters.

Character segmentation is done on MATLAB with the help of bounding box. Bounding box comes under the region properties of the image. When we segment the image we get the segments as the binary image. The colour image is a three dimensional array [1]. The three dimensions represent one of the colour values, R, G, and B. Each pixel multiply the empirical value in the two dimensional array.

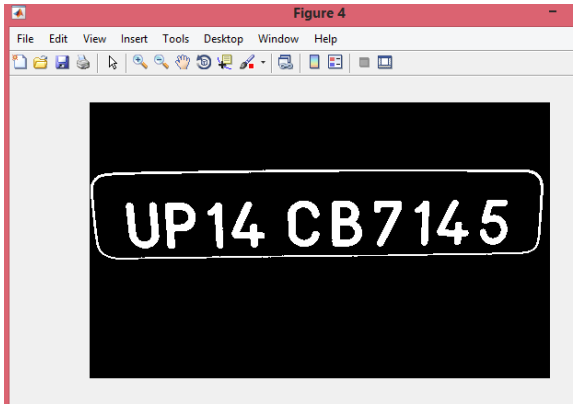

Figure 5

Then we sum the three arrays to get a grayscale image [1]. The edges are identified using bounding box. Bounding box comes under the region properties. For example, we take a bounding box of width 2 units and colour green. The image is also filtered for better results. We take the maximum and minimum of the threshold value defined by the bounding box.

The image is given as a cell in the program code. The maximum and minimum of row and column of the cell of the image is taken in order to identify the edges. We then subtract the license plate portion alone from the rest of the image. It is shown in the Figure 5.

IV. CHARACTER RECOGNITION

Template matching is done to check the license plate number in the database and the incoming input. It is done by correlation function. The count of total letters in the input image is taken. Correlation function is applied. The letters of the input image is checked with the template of the program code.

The method is to resize the character block to the same size with the template. Once the characters are matched, the plate is recognized. We can see the characters being segmented with the help of bounding box as shown in Figure 6.

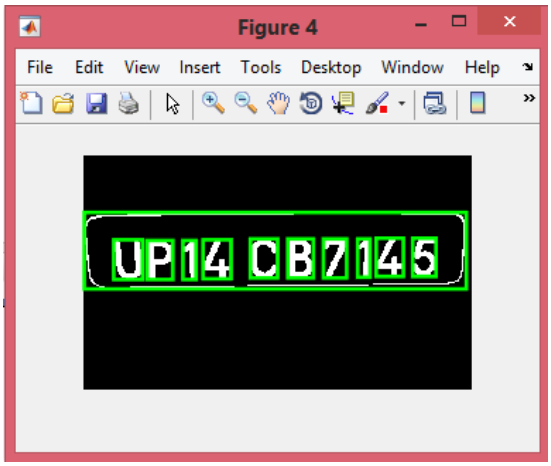

Figure 6

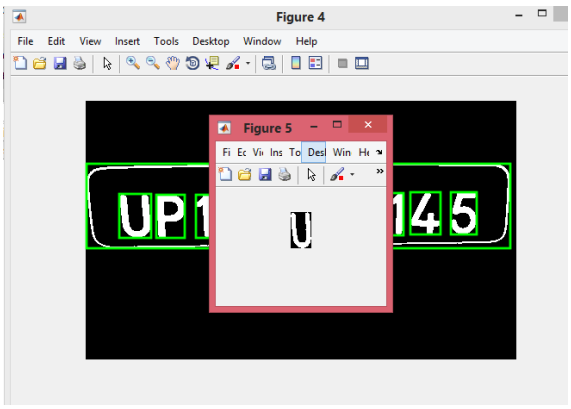

Figure 7

Each of the characters being segmented with the help of the bounding box is shown in Figure 7. The result of the recognition.

V. ACCOUNT LINKING

The main operation of our project is the account linking. This is the difficult part of the project because it requires a tedious work to link all the accounts of the users. Different users have accounts of different banks. Therefore we need to seek the help of Road Transport Corporation of the country and also the banks.

For practical purpose all the users required to be registered in the same banks for uniformity. Then the only task is to collect their details and link the account with license plate. The license plate of each user is stored in the database and the users account number too. Since each user can have only one account in each bank the money can be withdrawn easily. As soon as the toll booth camera detects the image and sends the output, the account is linked and the money is withdrawn. Thus the toll pay is deduced and subsequently the traffic is reduced.

VI. ANALYSIS AND CONCLUSIONS

One feature of our work is that we used image processing for recognition rather than electromagnetic wave detection. But still there are limits to our work.

All the images used should have the same illuminance, at least in the license plate region. Another drawback is that the account linking of all the users cannot be possibly done. Only for a limited number of people is possible. So in that case we need to make it available only for those who want.

We used 30 images of the license plates and a virtual account in the MATLAB. We found our program efficient and successful.

Total accurate location in %	Total accurate segmentation in %	Total accurate recognition in %	Traffic control in %
98	77	70	75

The recognition could be higher if we used a larger library of templates.

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