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Segmenting the Character of Plate Vehicle Number Using Connected Component Analysis Method

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ABSTRACT
The introduction of vehicle number plates is one of the important techniques as part of an intelligent transportation system that can be used to identify a vehicle simply by understanding the license plate. The introduction of license plate in Indonesia is usually used in the parking system which is still done manually, namely by recording the number plate character by the parking attendant. The process of character segmentation of vehicle license plate number will be done first before introduction process. The accuracy of character recognition is influenced by the result of the segmentation process. This research performs character segmentation process of vehicle license plate by using method of connected component analysis which is applied as algorithm; which is used to detect the corresponding blob region in a binary image. The data used 52 license plates of vehicles with the shape and type of vehicle number plates in Indonesia. The accuracy of the segmentation process is quite good that is equal to 84.6%.
***Keywords* - S**egmentation, Connected component analysis, Number plate characters

I. INTRODUCTION

The number of vehicles in Indonesia, especially in big cities, continues to increase significantly each year. Based on data from the Indonesian State Police Traffic Corps cited by Kompas newspaper website, in 2013 the number of vehicles in Indonesia reached 104,211.00 units, an increase of 11% compared to the previous year. The large increase in the number of these vehicles also contributes to the emergence of traffic problems such as traffic congestion. Traffic congestion is a condition that occurs when the number of vehicles on the road exceeds the road capacity, and is characterized by decelerations, travel time delays, and long queues [1]. One solution that has been applied in developed countries is the Intelligent Traffic System. This system can be widely used for many purposes, such as urban transport management systems, intelligent parking management, number plate validation, stolen vehicle detection, and traffic statistics [2].

Vehicle Lisence Plate Recognition or abbreviated VLPR is an image processing technology used to identify a vehicle by simply recognizing the license plate. This technology is an important technology as part of the Intelligence Transportation System, much of the research is done in relation to VLPR and most of the research area is divided into three important areas namely License Plate Detection, Character Segmentation and Character Recognition [3].

Detection of vehicle number plates is an important phase in VLPR, this section discusses some works which has been done before the next stage of segmentation. Character Segmentation is the process by which characters on the number plate that have been detected in the previous stage are segmented to get the value per individual character from the set of characters on plate [3]. Character Recognition will classify and then recognize the characters. Classification is based on features that have been extracted. These features are then classified using statistical, syntactic or neural approaches.

The introduction of the license plate is one of the most important technologies in the Intelligent Traffic System [4]. This technology utilizes image processing to identify the vehicle from its license plate image [5]. The introduction of license plate in Indonesia is usually used in the parking system which is still done manually, namely by recording the number plate character by the parking attendant.

Neural network method has been used to recognize the character of vehicle license plate. This method can get good results if the image quality is taken good, but the quality of the image used as input is not entirely good, it can also be affected by conditions such as dust and distortion or due to poor photography environment. The results of the study indicate that with more training data in the dataset, neural networks can produce better classification accuracy. Meanwhile, other problems that arise are

the neural network will have an overfitting problem if the datasets are of large size [6].

The introduction of vehicle number plates has three important areas, namely the detection of the number plate location, the number plate characterization, and the recognition of the number plate characters. The result of the number plate characterization becomes the input data for the feature extraction process and then the introduction process. That is why the accuracy of the character recognition of the vehicle number plate is influenced by the accuracy of the segmentation process.

The purpose of this research is to segment the character of vehicle license plate. The function of this segmentation is to separate the object (character) from the background image and take the character which is the license plate of the vehicle in the form of area code (letter), police number (number), and final serial number / code the first line

II. SYSTEM DESIGN

In this study, the authors did the character segmentation in the vehicle number plate. The character was recognized in the form of alphabet A - Z and numbers 0 - 9. In this research, there were several main processes that were done, that was resizing the image, converting the image, the character of the vehicle license plate. The algorithm stages are shown in Figure 1.

The process began by changing the size of the image of the input in the form of vehicle license plate image size of 300 x 720 pixels. This process aimed to make the image into one size so that it would facilitate the next process. The conversion process was applied by converting the input image of RGB image to grayscale image, according to equation 1.

$$G = (0.2989 \times R) + (0.5870 \times G) + (0.1140 \times B) \quad (1)$$

The next process was to detect or do the character segmentation of vehicle license plate.

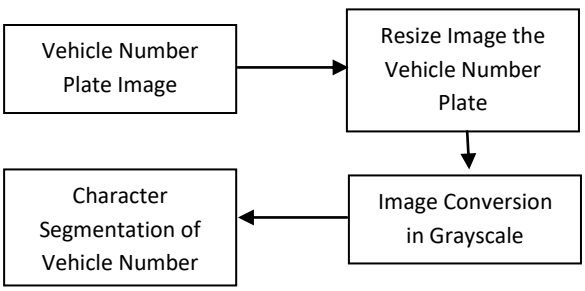


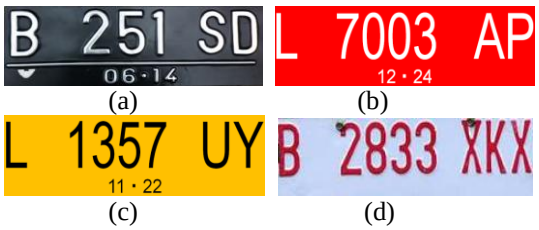
Figure 1. *System Design*

The vehicle number plate segmentation is an important process in plate number recognition systems. This process was crucial to the success of the output of the introduction system.

Labeling of components was performed when more than one object was analyzed. This process was done by looking for components connected in an image. The connected component was the part that represents an object in an image that has more than one object. Checking connectivity from a collection of pixels could indicate that this set of pixels is a single or non-specified object that could be determined from connecting or not to other pixel sets in binary imagery.

In Indonesia the background color and the number plate characters vary. Figure 2 shows the applicable shape and type of vehicle license plate in Indonesia which was used in this study. There are types of private vehicle number plates, government-owned vehicles, public transport, and dealer vehicles.

Figure 3 shows the detail of the process of character segmentation of vehicle license plates which was carried out in this study. There have been several studies on character segmentation that have been performed using several methods by the researchers [7] [8] [9] [10].



(a) (b) (c) (d)

Figure 2: Vehicle number plate in Indonesia. (a) private vehicle number plate, (b) government license plate number, (c) license plate of public vehicle, and (d) number plate of dealer vehicle

Since the type of vehicle license plate which have different background color and number plate characters, this study creates a new approach by utilizing the area and image ratio. This approach was made after analyzing the character of the vehicle number plate.

The data input which was used in this segmentation process was the grayscale image of the previous process. Step - step process of character segmentation of vehicle license plate number are as follows:

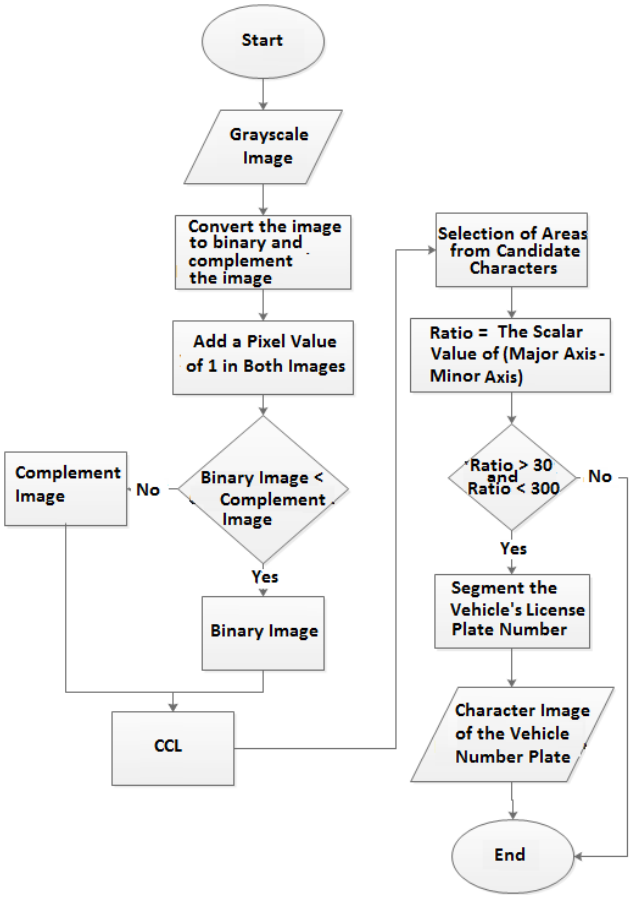


Figure 3. The process of detecting the character of the license plate of the vehicle

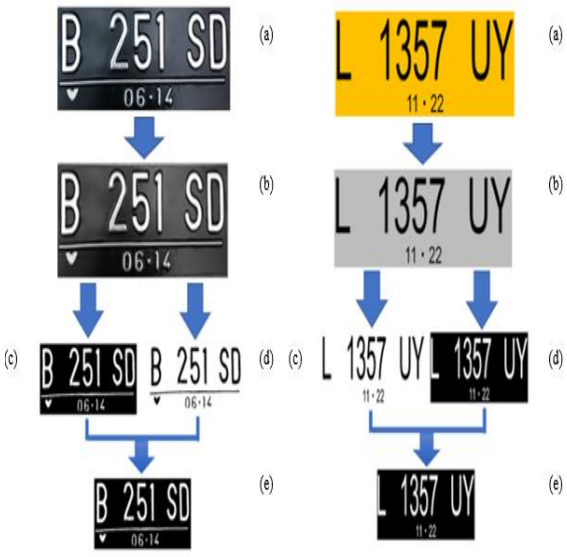


Figure 4. The process of detecting the character of the license plate of the vehicle

1. The conversion process of the grayscale image into binary images and complement images. The purpose of this process is to obtain a white pixel value of 1 in both images because the vehicle number plate has several types shown in Figure 2.
2. Sum the pixel value of 1, in the binary image and the complement image.
3. Compare the number of pixel values in the binary image and the complement image. From the comparison results, there are selected the smallest value. The examples of illustrations of processes 1, 2 and 3 can be seen in Figure 4.
4. The result image of the 3rd step is used as input for the connected component method applied as an algorithm used to detect the corresponding blob region in a binary image.
5. Conduct a selection of candidates which are the number plate characters using the area of the blob. To specify the blob area of a character, a threshold value of 1500 is used. If the blob area is more than 1500 pixels, then the area is detected as a character, corresponding to Equation 2.

$$blob_i = \begin{Bmatrix} Character & area_i \geq 1500 \\ noCharacter & area_i < 1500 \end{Bmatrix} \quad (2)$$

From the selection process using the area of the blob region, it has obtained the candidate character from the license plate.

6. To solve the problem as in Figure 2 (a), where there is a horizontal straight line that is detected as a character due to the value of blob area ≥ 1500, then it is calculated the ratio of the image. The image ratio is obtained from the difference between the scalar value of the major length of the axis and the scalar minor axis value. From the value of the ratio, determining the candidate character is given the conditions on the image ratio value, such as equation 3. This process aims to eliminate objects that are not shaped like the object / character of the vehicle number plate in the form of boxes and oval.

$$rasio = \begin{Bmatrix} ratioCharacter > 30 \,\&\, ratio < 300 \\ noCharacter \quad otherwise \end{Bmatrix} \quad (3)$$

Objects detected as characters will be searched for the value of the area surrounding the rectangular object or the so-called boundingbox.

7. Conduct a cutting process based on the bounding box region that is the area surrounded by the four coordinates of the point

$((x_{min}, y_{min})$, (x_{min}, y_{max}), (x_{max}, y_{min}),

$(x_{max}, y_{max}))$.

An example of a test for the process of character segmentation of vehicle license plate number from step 1 to step 7 can be seen in Figure 5.

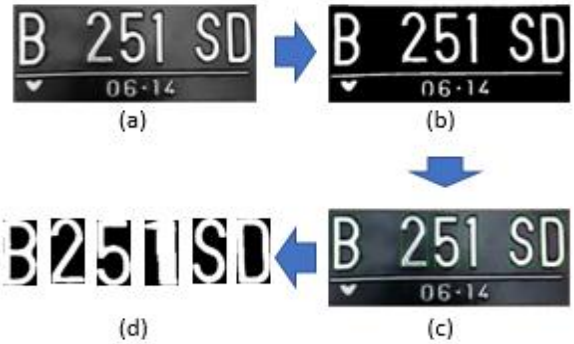


Figure 5. The result of the process of character segmentation of vehicle license plate number (a) Grayscale Image, (b) Selected image, (c) Character segmentation, (d) Character of vehicle number plate.

III. RESULT AND DISCUSSIONS

In this study, trials were conducted using 52 randomly used vehicle license plate data. Several experimental data in this study are shown in Figure 6.

Figure 6. Some testing data

Table 1 shows the results of the segmentation process on the vehicle license plate number. The sample of the results of the trials can be seen in Figure 7.

Table 1. *Calculation process η(r,s)*

Testing Data	Result	Testing Data	Result
Data-1	False	Data-27	True
Data-2	False	Data-28	True
Data-3	True	Data-29	True
Data-4	True	Data-30	True
Data-5	True	Data-31	True
Data-6	True	Data-32	True
Data-7	True	Data-33	True
Data-8	False	Data-34	True
Data-9	True	Data-35	True
Data-10	True	Data-36	False
Data-11	True	Data-37	True
Data-12	True	Data-38	True
Data-13	True	Data-39	True
Data-14	True	Data-40	True
Data-15	True	Data-41	False
Data-16	True	Data-42	True
Data-17	True	Data-43	True
Data-18	True	Data-44	False
Data-19	True	Data-45	True
Data-20	True	Data-46	True
Data-21	True	Data-47	True
Data-22	True	Data-48	True
Data-23	True	Data-49	True
Data-24	True	Data-50	True
Data-25	False	Data-51	True
Data-26	False	Data-52	True
Acuracy			84,6%

Figure 7. Segmentation Result (a) True, (b) False

IV. CONCLUSION

This study aims to create a new approach used for the character segmentation of vehicle license plate. From the research that has been done, the method of character segmentation of vehicle license plate which was used to detect the character is well proven with the result of accuracy reach 84.6%. Error of segmentation result which was caused by vehicle license plate image is too bright lighting. In addition, it is caused by the image used as the experiment with less focus, so that the resulting image is blurred.

The results of this study can be used to recognize the character of vehicle license plate. Combining the appropriate feature extraction and classification methods is expected to produce fairly good recognition accuracy.

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