Two Wheel Vehicle License Plate Detection System with Image Processing

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Abstract: Image processing is a method used to process images into a digital form, which serves to improve and improve the quality of an image. One of its utilization is to detect the license plate of the vehicle that enters the campus area. Currently for the identification of vehicle license plates in the parking area of Politeknik Negeri Batam Campus still use the manual system that is, when the vehicle enters the parking area then the parking attendant only gives the card. Thus, there is no data storage of vehicles coming into the parking area such as vehicle license plate recording. With the license plate detection system using image processing techniques can facilitate the process of checking the license plate of incoming vehicles by mounting the camera to check the license plate number, as well as using the method K-Nearest Neighbor to recognize each character that is on the license plate automatically, this method has an accuracy level of about 84.5% in 80 characters.

1 INTRODUCTION

In this modern era, the development of science and technology that is progressing in all areas has a positive impact on people's lives. With advances in the field of technology, more and more new technologies are emerging. One of the technologies that develop in the field of digital image processing. Image processing is a method for the processing of images (Image) into digital form for a specific purpose that serves to improve and improve the quality of an image to provide information in the form of objects detected on an image (Triyandil, 2014). One of its applications is to identify the license plate number that is entered in an institution such as a parking area campus near a postal park. In general, to recognize the license plate number that enters the campus parking area still use the manual system that is, when the vehicle enters the parking area, the parking attendant gives the card and there is no data storage of incoming vehicles such as vehicle license plate registration. The way is ineffective and will complicate the process of identification of vehicles entering the parking area. The manual parking system will consume a lot of time and energy (Nur Taufiq, 2012).

Meanwhile, Santra et al. (2019) implemented Signal to noise ratio, PSNER and mean square error to computed each capture image after detection. The objective of implementation is to primarily detect moving vehicle. Others researcher Muhammad Tahir Qadri, Muhammad Asif et al. (Qadri, 2009) implemented Automatic Number Plate Recognition (ANPR) as an image processing system to detect the vehicle number (license) plate to identify the vehicle. The system captures the vehicle image and then extraction them using image segmentation. By using optical recognition technique to recognize each character in the license plate.

K Mahesh Babu, M V Raghunadh et al. (Babu, 2016) implemented the template matching method to recognize the characters in vehicle license plate. The researcher conducted four major steps to detect the character as follows: preprocessing of capture image, extracting license number plate region, segmentation and characters recognition.

In this paper, made a system that facilitates the process of checking the license plate of the incoming vehicle, by mounting the camera to detect the license plate of the vehicle. The detection process begins with data retrieval with the camera mounted (Budianto, 2015). This vehicle license plate check, able to recognize the character of letters and numbers found on the license plate that enters the parking area using the image processing method and K-Nearest Neighbor which can be useful as a verification of the

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identity of the vehicle number when entering the parking area of the campus more efficient and simple.

2 BASIC UNDERSTANDING

2.1 Digital Image Processing

Digital image processing is a process of processing and analysis of two-dimensional image imagery that uses computers, aiming to improve the image quality for easy interpretation by humans or machines (computers) (Sari, 2014). A digital image can be represented by a matrix of two dimensions f (x, Y) consisting of M for columns and N for rows, which between the column and row intersection is also called the pixel or the smallest element of an image. There are several types of digital imagery that are often used namely, RGB image, binary image, and grayscale image.

1. RGB Image

RGB image is a color image which consists of three basic colors, namely Red (R), Green (G), and Blue (B). Each basic color has its own intensity with a value range from 0 to 255 (8 bits) (Sari, 2014) as shown in Figure 1 is an example of an RGB image on a vehicle plate.

2. Gray Image Concept

Gray imagery is a digital image processing that takes the value of the different degrees of the sensitivity of each pixel. Where a pixel is represented by a range of values from 0 to 255, a value of 0 represents for the minimum intensity or image condition in a dark state and the 255 value represents for maximum or light intensity. We can see in Figure 2 is the result of the gray image.

Figure 1: RGB image.

Figure 2: Gray image.

3. Image Binarization Concepts

Image Binarization is a process that aims to change the intensity value of an image to 2 values of 0 and 1. Each pixel consists of only a black color of 0 and a white color worth 1 (Kusumanto, 2011). To do this process used threshold can be adjusted value according to the wishes (Setiawan, 2015). The image binarization is often used in research studies using segmentation and morphology processing processes. Figure 3 is the result of an image binarization.

4. Canny Edge Detection

Canny edge detection is a filter process used to detect edges of an image. Canny edge detection was developed by John F. Canny in 1986. The method of canny edge detection is used to look for a contour that is considered a vehicle number plate. Figure 4 is the result of an image binarization.

2.2 Connected Component

Connected components are a collection of pixels of the same value, and that are interconnected with each other through pixel connectivity, i.e. all pixels in the connected component have the same pixel intensity value, in some ways connected. Once all the groups have been specified, each pixel is labeled with a gray or color labeling according to the component set. This method is used in the process of character detection on vehicle number plates, in Connected Component methods. The process of analysis of imagery objects such as calculating the area, height, or width of the object, from the candidate object to be carried out a rule Filtration that represents a license plate. Filtration can be done by doing calculations to determine the area of an object that has been labeled (Ruslianto, 2011).

Figure 3: Image binarization.

Figure 4: Canny edge detection.

2.3 K-Nearest Neighbor

K-Nearest Neighbor is a method that uses a supervised algorithm were the results of a new query are classified based on the majority of categories on the KNN. The function of KNN is to classify the characters of letters and numbers found on the motor plates. KNN sets the class label type on most K-nearest patterns on the data train to be utilized, the similarity of patterns in the data train must be defined first (Tauchid, 2015). K is the number of closest neighbors. The number of neighbors is a core determining factor. The way the KNN works is if P1 is the core, then next performs a label prediction and looks for the closest point K with P1 then classifies the points with the highest number of neighbors in that area. Each class has a value that represents its respective class. Most values will be taken as predictions. For example, K = 4, the closest point in Class A, Class B, Class B, Class B so that the highest value is in class B Then the prediction result of the new data is Class B as shown in Figure 5.

The KNN on the OpenCV function uses a flatten image to be a single row/one column array. Each dataset will be training to see the pattern of each character which will then be used as a comparison for the character recognition of the trial as can be seen in Figure 6.

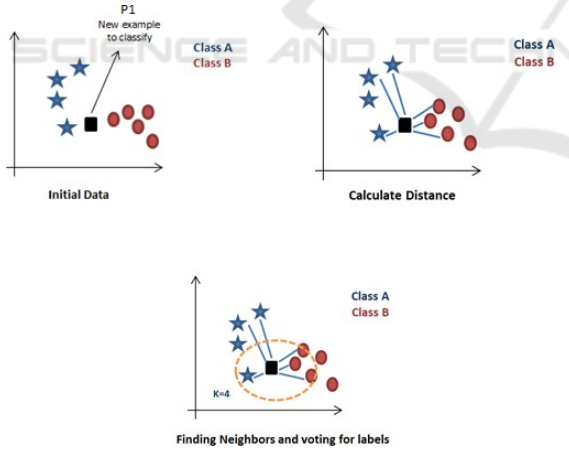


Figure 5: KNN Concept.

3 PROPOSED METHOD

The object to be detected by the camera is a two-wheeled vehicle license plate. Images that are capture by the camera will be processed by the computer using the K-Nearest Neighbor method, then the detection result is displayed on the computer layer. A more detailed process can be seen in Figure 7.

Figure 7 presents the way the overall system works. The system itself is divided from 4 stages, namely pre-processing image, plate detection, character segmentation, character recognition. At pre-

After that, the process to detect the plate part of the motor vehicle by using canny edge detection. Then from an edge image that is already in the get filtered out based on the form contours. The shape of the contours considered a plate is a rectangular shape. When the plate is detected, the next process is to crop the plate containing the character. If the plate is not detected it will be done detection of the character directly from the image that is capture with the webcam.

The third stage is character segmentation, at this stage using the Connected Component method to separate the plates and characters. With the connected component method, each BLOB will be labeled and filtered by area as well as the size of the blob height and width. A blob Area smaller than 150 pixels is not considered a character. Subsequent blob-categorized characters must be eligible where the vertical height is greater than the horizontal width. The height and width ratios should not exceed 0.2 of the height and width of the captured image.

From the results of the already filtered blob will be selected eight BLOB ones whose positions are most parallel. Then the character is sorted into an array shape and will be compared and recognizable one the character.

The next stage uses the K-Nearest Neighbor (KNN) method for character recognition. Each character that has been separated will be matched by this method.

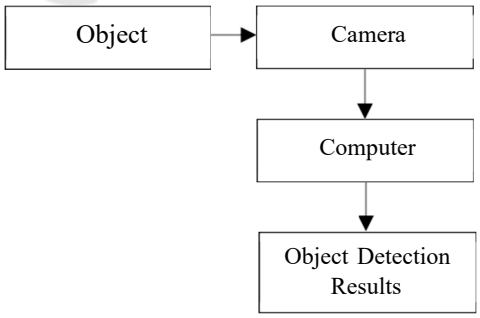


Figure 6: Diagram block system.

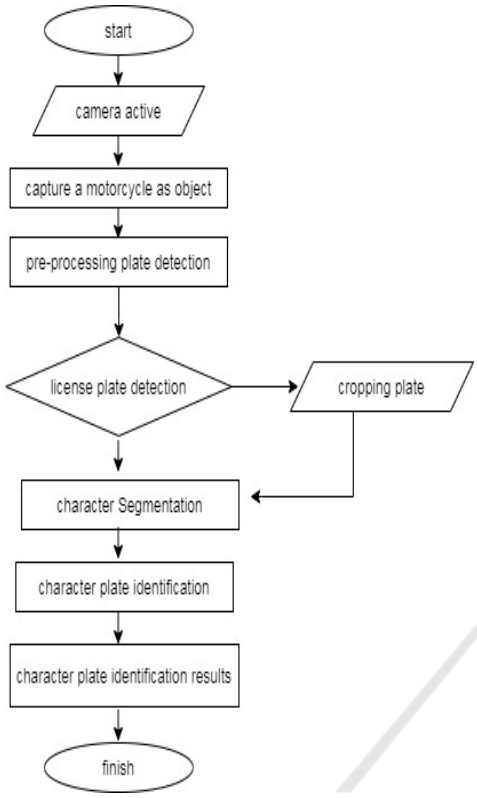


Figure 7: Flowchart system.

3.1 Testing

This test is conducted to find out if the tool can detect the plates and characters on the license plate of the vehicle that is tested on the daytime conditions with a range of Lux value 1000-7000 using the Lux meter. The data retrieval process on this test is done as follows:

a. Vehicles made for testing are motors.
b. Maximum image capture distance of 1meter.
c. Sampling Place: Outdoor (Campus Park)
d. Taken with a webcam.

4 RESULTS AND DISCUSSION

This research is conducted with several testing stages i.e. sample image capture testing based on daytime conditions and distance of retrievals, vehicle plate detection testing, character segmentation testing, and plate character recognition testing.

Figure 8: Sampling object.

4.1 Image Sampling Testing

At sampling testing was conducted by taking an image with daylight conditions using a webcam with a resolution of 1600 x 896 pixels and the test distance performed on this sampling is a maximum of 1 meter.

4.2 Vehicle Plate Detection Test Result

On the plate, detection testing conducted trials with 5 different vehicles as presented in Table 1. The results of the number plate detection test that successfully detected the platform precisely from 5 samples in Table I are as many as 4 samples. In the detected plate will appear as a green rectangle on the sample image.

License plates can be detected if the plate has an unbroken outline and has a rectangular contour that is clear as Figure 11. As for the sample that failed to be caused by the discovery of the contour that connects and rectangular shape in the image, as shown in Figure 12.

Figure 9: Plate sample 1.

Figure 10: Plate sample 2.

Table 1: Character recognition results.

no	Sample Image	Plate Detection	Number Plate
1		detected	
2		detected	
3		no detected	
4		detected	
5		detected	

Figure 11: Detectable plates.

Figure 12: Undetectable plates.

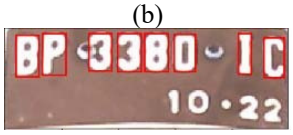
4.3 Character Segmentation Testing Results

Segmentation is done with 2 cases. First, if the plate is detected, the character will be detected using crop plate results as input in the character detection function. For the first case, the results are obtained as can be seen in Figure 13-15/

second case is if not detected plate or plate detected has no character inside of it as shown in Figure 14. In this case, the character segmentation will appear using the original image.

(a)

(b)



(c)

Figure 13: (a), (b), (c) Detectable plates.

Figure 14: Undetectable plates.

Figure 15: Character segmentation.

4.4 Character Recognition Testing results

In the testing of the character recognition test with some samples such as Table 2. The test result of Table 2 obtained an accuracy rate of 87.5% from 64 characters. For characters that fail to be detected due to several factors such as joining the Blob of the character with another object blob, the detected letters are too bold compared to the trained dataset.

Table 2: Character Recognition Results

Number Plate	Characters Plate	Character detected	Number of errors characters
	BP 4919 JE	BP 4919 JE ['B', 'P', '4', '9', '1', '9', 'J', 'E']	0
	BP 3607 QR	BP 3607 OR ['B', 'P', '3', '6', '0', '7', 'O', 'R']	1
	BP 2190 GR	BP 2190 OR ['B', 'P', '2', '1', '9', '0', 'O', 'R']	1
	BP 3380 IC	BP 3380 IC ['B', 'P', '3', '3', '8', '0', 'I', 'C']	0
	BP 2252 GH	BP 2252 GN ['B', 'P', '2', '2', '5', '2', 'G', 'N']	1
	BP 2190 GR	BP 2190 GR ['B', 'P', '2', '1', '9', '0', 'G', 'R']	0
	BP 4553 IC	BP 4553 IC ['B', 'P', '4', '5', '5', '3', 'I', 'C']	0
	BP 3459 HQ	BP 3459 HQ ['B', 'P', '3', '4', '5', '9', 'H', 'Q']	1

5 CONCLUSIONS

Based on the test results of the motor plate detection of the success rate depends on the shape of the rectangular contour found, when the plate image has a clear contour line and not cut off, then the number plate will be detected accurately. Also, the light affects the image quality results captured by the camera. The higher the light then the more noise is detected.

The results of the character segmentation trial success level are already quite accurate using the connected component method. With an accurate rate of about 80- 90% in separating part of the character part on the number plate.

For the results of the character recognition trials with the method K-Nearest neighbour level of accuracy in 80 characters is 84.5%. Character recognition using the K- Nearest neighbour method in a proven application can be applied. Although overall the success rate of 10 samples of motors taken with changing light conditions with the assumption of errors that can be tolerated as much as one character.

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