

Recognition of Vehicle Plates using Template Matching Method

Sriyanto Sriyanto¹, Phong Thanh Nguyen^{2*}, Benedikta Anna Haulian Siboro³, Iswanto Iswanto⁴, Robbi Rahim⁵

¹Universitas Muhammadiyah Purwokerto, Purwokerto, Indonesia. Email: sriyanto1907@ump.ac.id

²Department of Project Management, Ho Chi Minh City Open University, Vietnam. Email: phong.nt@ou.edu.vn

³Institut Teknologi Del, Indonesia

⁴Department of Engineer Profession Program, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia

⁵Sekolah Tinggi Ilmu Manajemen Sukma, Medan, Indonesia. Email: usurobbi85@zoho.com

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Abstract:

A vehicle is a means of transportation tool that can deliver someone to a destination. Each vehicle has a license plate to provide a vehicle registration number. This license plate shows the ownership as well as motor vehicle tax payments. However, in reality, many vehicle users are negligent in making tax payments. Besides, motor vehicles are often used for crime. A technique is needed to know the owner of the vehicle. It can be known through the license plate number. Image processing technology can recognize it based on camera catches. The template matching method is one method that can be used to carry out the vehicle plate recognition process. Template matching works by converting pixels into data based on an existing plate number database. By applying this method, the owner of the vehicle can be known using only the photo on the license plate.

Key Words: recognition, image, processing, template, matching, pattern,

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INTRODUCTION

The vehicle is a type of carrier that can deliver someone to move from a location to a specific location. The function of this vehicle is in high demand by various groups. However, a vehicle requires legal legality. Vehicle ownership is an important thing to protect. The ownership sign on a vehicle is marked with a letter and shown through the vehicle plate. Each vehicle plate has a different registration number. It is useful if there are things that are not desirable. Not all of these vehicles are used for good and right purposes. Sometimes, these vehicles are used for unlawful acts. As a result of this, we need a technique that can find out who is breaking the law [1].

The vehicle has a license plate that can be detected by the user or owner of the license plate. Pictures taken through a camera that is prepared to capture images of vehicles will be processed with a computer algorithm to produce a person's name and registration number [2]. However, to do this requires an appropriate technique and algorithm. The template matching method is an image recognition pattern algorithm so that it can be matched to data that has been stored in a database. This algorithm works by matching the pattern of captured images from the camera. Preprocessing is done to extract feature values from the image. The captured image is reduced or cropped so that it only produces a plate number only. The preprocessing process results in the feature value [3]. These values will be processed using the template matching algorithm. It is hoped that by using this method, vehicle plate images can be linked to vehicle owner data.

THEORIES

2.1 Computer Vision

Computer vision is the study of computer intelligence through physical vision. These images are obtained using a camera or sensor. The function of computer vision is to provide meaning or symptoms based on the images studied. Usually, this technique is used to read the value of a situation. In the application of computer vision, we need techniques or algorithms that can process the image. There are two stages carried out in computer vision, namely preprocessing and extraction. Image or sensor results must be converted into digital data so that it can be extracted into tangible results [4].

2.2 Image Processing

Digital Image Processing is a field of study that studies how to modify operations on an image. It also studies how an image is created, processed, and modified. It aims to provide data that can be used for further processing. Images can be categorized into two types, such as digital images and analogue images. Both of these images have significant differences. Digital images are generated based on discrete signals, while analogue images are formulated from continuous signals [5].

Image processing does not only move in the field of images, but images can be formed from the extraction of frames from moving video. The function of image processing is to get the value of features that are useful for further analysis. The result of this extraction is a learning process to recognize the properties of the image. For example, image processing is often used in medicine to identify diseases that are being experienced by patients. X-ray results in the form of images can then be processed with a computer to produce symptoms or illness that is being suffered by patients.

The image can be in two dimensions or the result of a three-dimensional projection. Image processing is often also used in looking at the state of the baby in the womb (USG). The results of the image are often used to see the baby's sex, fetal size, and time of delivery. Image processing is a process of image processing and analysis that involves a lot of camera capture. The process is called data feature extraction. It results in digital data and defined as two-dimensional image processing.

Analogue imagery are continuous images, such as images on television monitors, X-ray, printing, paintings, MRI and images recorded media. It cannot be represented on a computer and has not digital values. It needs conversion to produce digital data. Digital imagery is representative of images taken by devices such as a camera, webcam, or sensor. It produces values saved in a computer. The pattern is known as sampling. It states the size of the image arranged in rows and columns. It also states the pixel and colour value expressed in grayscale or RGB according to the number of binary bits used by the camera [6].

2.3 Pattern Recognition

The development of new technology will be dominated by systems and machines with artificial intelligence (machine intelligence). Pattern recognition technology is one of the essential components of an intelligent machine or system

that is used both to process data and in decision making. Pattern recognition requires analysis to produce a feature value. Pattern recognition is related to image processing. The data obtained must be converted into digital data in order to determine what patterns are being studied. The pattern is the shape or character of an object that is depicted in the form of numbers and has different shapes. These POs are obtained from the results of tests on objects that are expressed in terms of numbers [7].

2.4 Template Matching

Template matching is a technique for finding patterns in images. There are two parts involved in this method, such as training and test data. Training data is data that is trained as a database. Test data is data that is compared to a database. Between the test data and the training data, an MSE value search is performed. If MSE has a high value, then the test data and training data have no closeness [8]. The lower the MSE value, the closer it is between the test data and the training data. This comparison is made using a template. The difference is made by calculating the colour distance between the two colour data of the object being compared [9]. The following equation is how the template matching calculates the distance between two objects.

$$D(m,n) = \sum_{j=1}^m \sum_{k=1}^n |f(j,k) - T(j,k)|$$

The equation earlier explains that there are two objects involved, T and D. These two objects have pixels that are

projected into the notation m and n. Each pixel will count how the color image difference between objects T and D. If the value is zero, this means there is no pixel difference between objects T and D. But this is very rare because the pixel value in the image cannot have any difference between the images stored in a database with captured images. The following is an equation so that an object T matches object D [10].

$$D(m,n) < LD(m,n)$$

METHODOLOGY

This study uses plate data of motorcycle. The research location is in Medan, Indonesia. The camera is needed in capturing image data. Each picture is then carried out the preprocessing stage. The image will be changed using image processing techniques to eliminate pixels. Merging of pixels occurs in the grayscale process. Each pixel in the image produces 8-bit, forming the colour image. This result will be used in the template matching process.

3.1 Object Data (Original)

Object data is the initial data that has not been done in image processing. This object data is still in the form of an image captured by the camera. This object data in the form of a motorized vehicle plate number by a country's standard rules.



Figure 1. Camera Capture Objects

3.2 Template Data (Reference)

Data template (Reference) is data in image processing using a template matching method. This reference data is alphabetical letters ranging from A to Z and numbers ranging from 0 to 9, which will be used as a comparison with object data, to be able to recognize and match the value of each character of the object data, in order to get maximum results and by the value of each character from the object data. The following is how to get the template data (reference) as follows:

Capturing motor vehicle license plate numbers in accordance with policy standards. The process of adaptation is adjusted to the distance and intensity of light sufficient during the process.

Then the plate number is scanned to be made per-letter and per-digit according to the letters of the alphabet from A to Z and numbers ranging from 0 to 9.



Figure 2. Plate Template

A flowchart is designed that illustrates the workflow process of the system to help the process of designing a vehicle plate recognition application with this template matching algorithm. It starts by displaying the Introduction form, which is the original form that was displayed when the application was first to run. In this form, the user can choose the Plate, Info, and Exit Introduction menu. If the user selects the Introduction menu, the system will wait for the input of the vehicle plate image to be recognized,

then process the image by matching the vehicle plate image template data with the template matching method. The results of the introduction of the vehicle plate image is then displayed as the system output. If the user selects the Info menu, the system will display an Info form that functions to display software designer information. Meanwhile, if the user selects the exit menu, the application will be closed. Figure 3 below is a form of flowchart design of the application designed

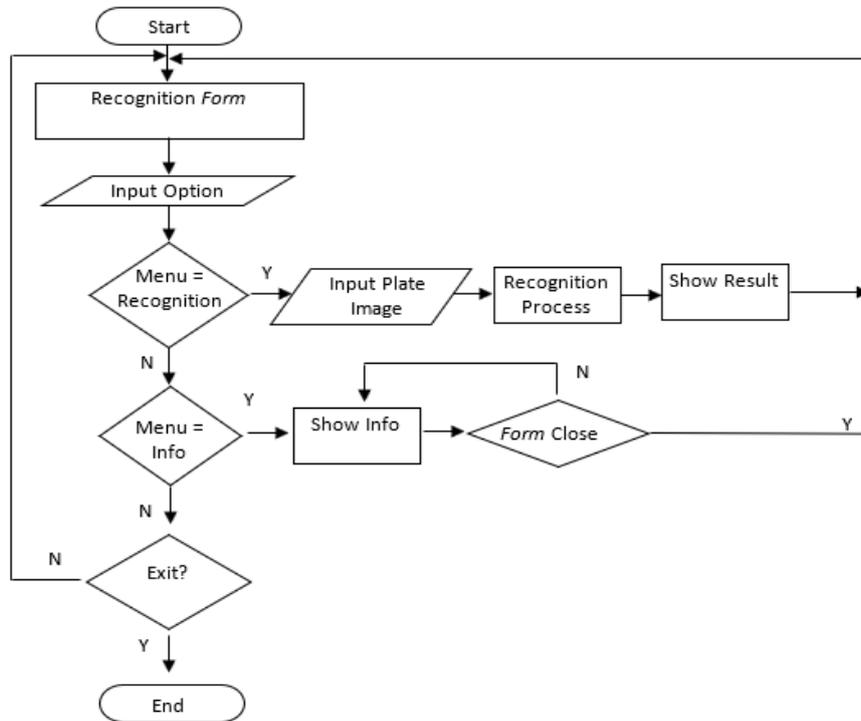


Figure 3. Recognition Process

RESULT AND DISCUSSION

4.1 Block Diagram

The following explanation is the design of software for matching vehicle license plate numbers using the template

matching method. The stages of image processing in the vehicle license plate number are shown in figure 4.

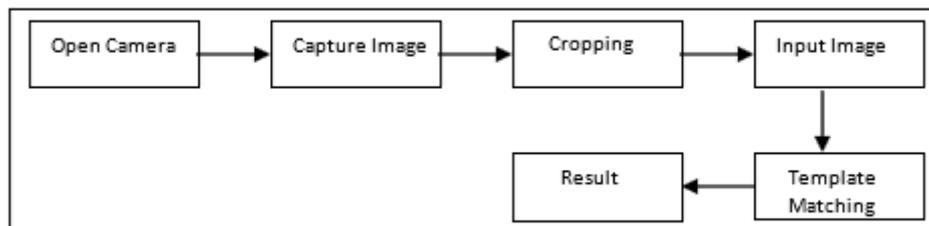


Figure 4. Block diagram of matching plate numbers

Figure 4 is a block diagram of the software to do the pattern matching process of the system used. The pattern matching process is as follows:

- Activate the camera to capture the license plate number.
- The capture of the plate number image is done manually using the camera and then input to the computer.
- After detecting the number plate image on the window display from the camera.
- Then cropping the number plate area. So that only the plate number will be processed.

- After that, the pattern matching process is carried out with the template matching method to match the patterns or characters of the object data with the template data (reference). So that the results obtained by the object data.
- Data from matching vehicle number plate patterns will be in the form of text.

4.2 Cropping

After making the process of taking pictures of motor vehicles, the next process is the process of cropping.

This cropping process is done manually. The process of cropping this image is used to remove parts of the other area than the vehicle plate number. So that only the vehicle license plate number is processed. By using the following formula:

$$x' = x - xL \text{ for } x = xL - xR$$

$$y' = y - yT \text{ for } y = yT - yB$$

The image size becomes:

$$w' = xR - xL$$

$$h' = yB - yT$$

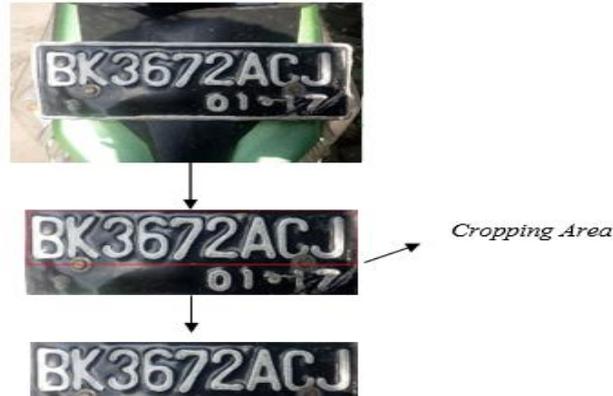


Figure 5. Cropping Result

4.3 Template Matching

In the pattern matching process using the template matching method, to make the pattern matching on the vehicle plate number. Before doing the pattern matching process, first, use a data template (reference). This reference data is alphabetical letters ranging from A to Z and numbers

ranging from 0 to 9, which will be used later in comparison with object data, to be able to recognize and match the value of each character from the object data, in order to get maximum results, and by the value of each character from the object data.



Figure 6. Template Matching Result

Figure 6 is the result of the template matching process. From the research conducted on the number of digits in the license plate number, the average number of vehicle plates consists of 3 to 9 digits. To avoid mistakes in the process, if there are vehicles that have nine digits, then in this matching template process, nine digits are used as a reference for the number of digits, for the difference in each letter and number on the vehicle plate number. After determining the number of digits, then entering the reference data in the form of letters of the alphabet and numbers into each digit, to facilitate the process of comparison between object data with reference data.

CONCLUSION

Template matching is a great algorithm for recognizing patterns. Based on testing conducted in this study, several conclusions can be presented. Lighting, distance, and camera position significantly affect the results of processing by using the Template Matching method. Vehicle plates are easily recognized by processing image data so that it becomes numbers and letters that can be matched against a traffic database.

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