Template Matching Algorithm Implementation For Introduction To Indonesian Traditional House

Agus Sujarwadi[a,1], Joseph Carlo K[b,2], Iwan Hartadi TU[c,3], Erik Iman HU[d,4], Suhirman[e,5], A.Djoko Budiyanto[f,6], Suyoto[g,7], Natan Derek[h,8]

[a,c,d,e] Faculty Science and Technology, Universitas Teknologi Yogyakarta, Indonesia,
[b,f,g] Informatics Department, Universitas Atma Jaya Yogyakarta, Indonesia
[h] National Taiwan Normal University, Taiwan

[1]agus.sujarwadi@uty.ac.id*, [2]carlo.kho91@gmail.com; [3]iwan.hartadi@uty.ac.id, [4]erik.iman@uty.ac.id, [5]suhirman@uty.ac.id, [6]djoko.budiyanto@uajy.ac.id, [7]suyoto@uajy.ac.id, [8]derek88@gmail.com

Abstract

Digital image processing is an important way in computer vision to determine the shape of digital image objects. Many image processing applications have been produced, one of which is pattern recognition. Pattern recognition can be interpreted as the process of classifying a number of objects into several categories based on similarities and similarities in characteristics. In this study, the pattern recognition of traditional houses in Indonesia will be carried out. In the pattern recognition process, several stages of image processing (image pre-processing) are needed which aims to make the pattern obtained can be recognized accurately. For the introduction of this traditional house, several stages will be carried out before it can finally be recognized by the system. First, the image will be converted into a gray image, after the gray image is obtained, it will be converted into a binary image using thresholding and then followed by normalizing the image size (resize). After that, the resized image will be recognized using the Template Matching method. The results of this study, using 20 examples of traditional house patterns categorized into 10 types of traditional houses in Indonesia, the system can recognize 16 traditional house patterns correctly with an accuracy percentage of 80%. But this system also still has imperfections. Imperfections occur due to several factors such as taking the angle of the object in the test image that does not match the angle of the object in the target image, and also the presence of additional objects that cover the shape of the traditional house that will be recognized; such as: trees, cars, etc., as well as poor test image conditions.

Keywords: Digital Image Processing, Pattern Recognition, Template Matching Method

I. INTRODUCTION

The topic that often gets special attention in the field of Digital Image Processing is pattern recognition. Pattern recognition systems can be used to recognize various kinds of patterns, one of which is traditional house recognition. Indonesia is a country made up of thousands of islands stretching from Sabang to Merauke. Each region in Indonesia has a different culture. With the existing cultural differences, it also has implications for the form of residence/home of the people who are different. A residence / house with a shape that follows the existing culture, is usually referred to as a traditional house.

Image processing is a technique to determine the shape of an object based on a digital image. In image processing for object recognition must go through several stages of processing. Among them are taking digital images of objects, converting existing object images into grayscale images [1], followed by the threshold process and as the last stage is the template matching process [2].

So that people can easily recognize traditional Indonesian houses, a system is needed to be able to recognize the patterns of traditional Indonesian houses. The recognition of traditional house patterns requires stages of image processing, so that the pattern of the shape of the house obtained can be recognized accurately. One method that can be used to recognize patterns is the Template Matching method. Therefore, using this method a system will be built to identify various types of traditional houses in Indonesia and is expected to obtain a good level of accuracy.

From the explanation above, this research is an attempt to make an application that can assess a digital image of a traditional Indonesian house so that an output is produced stating that the object image is a traditional house from a certain area in Indonesia, and what is the level of accuracy of the system recognition for image of the object being tested.

II. LITERATURE REVIEW

Previous research was conducted by Bhattacharya [3] by using edge detection and template matching to identify motor vehicle plates. The difficulty faced in this study is that there is no standardization of the type of font used by each vehicle plate in India. The method used to identify vehicle plates in this study is to take a digital image of the license plate, then from the image an edge detection process is carried out, character separation and finally a template matching process is carried out. All existing processes are tested using MATLAB, and the thing that has the most influence on this test is the camera used to take pictures. The better the resolution of the camera used, it will produce better test results compared to low resolution cameras.

Another study was conducted by Bhoi [4], in this study the recognition of the condition of open eyes and closed eyes on a person's face was carried out. This is expected to be able to determine the condition of the iris of a vehicle driver whether his condition is sleepy or not. Because if you are sleepy, your eyes will automatically close with the iris that is not visible. The process used in this research is to prepare an image of an open eye that is used as a template. Then a complete face image as a test material, followed by testing using 2D-Correlator as a template matching, which will produce an output value of eye conditions on the face image of the research object. The entire test process in this study was tested using MATLAB 7.

Tinghua [5] built a polygon based on a shape and using the Fourier transform method to calculate the degree of similarity of shapes. The first procedure is to make the vector bounds of the polygon shape as a periodic function, which is then detailed in a series of Fourier descriptors, and then from the process a set of coefficients that describe the shape information is obtained. Through experiments on the comparison of spatial shapes and similarity of shapes, the results showed that the Fourier transform based on shape identification and template matching is consistent with human knowledge.

Based on the findings in previous studies, we see that the process is carried out to compare an image object with a reference object through the template matching method with high accuracy so that the output results are as expected. The research we do is a research that has a different object, namely a traditional house in Indonesia using the Visual Basic 10 programming language.

III. METHODOLOGY

Template matching on images can be done after going through several image processing processes. In this study, the first step that must be done is to take pictures of traditional house objects digitally, then proceed with the grayscale process on the image where the purpose of this process is to make the image obtained into a standard black and white image. This grayscale process can be described by the formula:

$$G = \max(R,G,B) \quad (1)$$

The value used as a reference in the grayscale formula above is the maximum value of each existing color [6]. After converting the RGB image into a grayscale image, the next step is to convert the grayscale image into a binary image.

One way that can be used in the process of converting grayscale images to binary images is thresholding. Thresholding is used to adjust the number of degrees of gray in the image. By using thresholding, the degree of gray can be changed as desired. The essence of the thresholding process is to change the gray level of an image into a black and white (binary) image, so that in the image there will only be a pixel value of 0 for black and a pixel value of 255 for white[7].

The initial thresholding process is to determine a threshold value T that serves as the middle value between 0 and 255. For example, a value of 128 is taken, then the value of each pixel of the image will be compared with the threshold value T. It can be seen in the following example:

1. If the pixel value <= 128, then the pixel value will be converted to 0
2. If the pixel value is >128, the pixel value will be converted to 1

Or it can be written as the following equation:

$$fB(\mathrm{i},\mathrm{j}) = \begin{cases} 0, & f\mathrm{G}\,(\mathrm{i},\mathrm{j}) \le T \\ 1, & f\mathrm{G}\,(\mathrm{i},\mathrm{j}) > T \end{cases} \quad (2)$$

The results of the above equation will convert the grayscale image into a binary image and can separate the object and the existing background. After the binary image is obtained, the next step is to normalize the image size, this aims to equalize the size of the image to be tested with the reference image. After normalizing the image size, then proceed with the pattern recognition process. Pattern recognition is carried out using the Template Matching method, where this method is to measure the similarity of the values of two digital images in the form of the percentage of similarity between the results of the correlation between the pattern image and the test image.

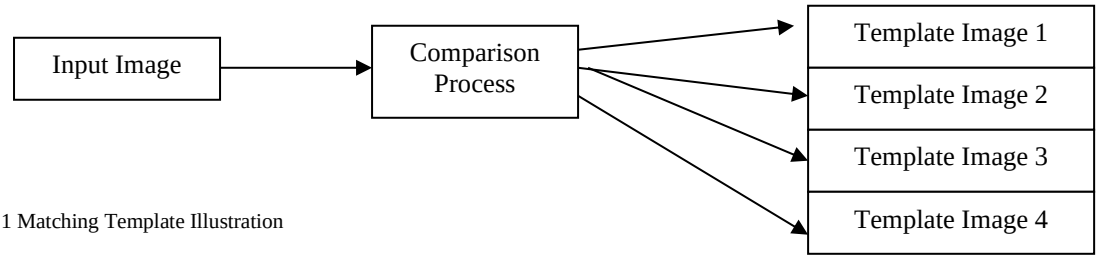

Figure 1 Matching Template Illustration

One way to do Template Matching calculations is to use cross-correlation value calculations. The following formula is used:

$$r = \frac{\sum_{i=0}^{N-1}(xi - \bar{x}) \cdot (yi - \bar{y})}{\sqrt{\sum_{i=0}^{N-1}(xi - \bar{x})^2 \cdot \sum_{i=0}^{N-1}(yi - \bar{y})^2}} \quad (3)$$

Where,
x = Pattern image in the form of a gray image
x = The average value of the pattern in the form of a gray image
y = The test image is a gray image
y = The average value of the test image in the form of a gray image
N = Number of pixels in the image
r = value of cross correlation in gray level image

The template matching method will be used to see the comparison of the 1st pixel of the pattern image in the form of a binary image in the database with the 1st pixel of the source character image in the form of a preprocessed binary image, the comparison is carried out on all existing pixels, then see how correlation value that appears. So that the variable description in the correlation value formula can be written as follows:

$$r = \frac{\sum_{i=0}^{N-1}(xi - \bar{x}) \cdot (yi - \bar{y})}{\sqrt{\sum_{i=0}^{N-1}(xi - \bar{x})^2 \cdot \sum_{i=0}^{N-1}(yi - \bar{y})^2}} \quad (4)$$

Where,
x = pixel value in the pattern in the form of a binary image
x = the average value of the pattern in the form of a binary image
y = pixel value in the test image in the form of a binary image
y = the average value of the test image in the form of a binary image
N= Number of pixels in the image
r = Cross correlation value in binary image

If the results obtained are 0, then the two images are different, but if the results obtained are 1 then the two images are similar, whereas if the results obtained are between 0 and 1 then there is a difference in the correlation of the two images.

IV. RESULTS AND DISCUSSION

System testing was carried out using 10 types of traditional houses found in Indonesia, including: traditional houses of the Gadang, Batak, Sasak, Sumba, Tongkongan, Aceh, Honai, Joglo, Banjar traditional houses. Each type of traditional house will have 3 sample patterns, where 1 sample is used as a reference pattern (target), while the other 2 samples are used as test patterns. The following is a picture of a traditional house used as a reference pattern (target) in this study:

House of Gadang

House of Aceh

House of Sasak

House of Batak

House of Sumba

House of Tongkongan

House of Honai

House of Joglo

House of Banjar

House of Panjang

Figure 2 Ten Types of Traditional Houses Found in Indonesia

In making this traditional home recognition system using the VB.Net programming language. VB.Net is a programming language that already supports the Graphical User Interface (GUI) and the availability of libraries that are quite complete for the Windows platform environment.

The process of introducing traditional houses is carried out in several stages, starting from taking pictures of traditional houses. Taking pictures can be done using the camera. When taking pictures, it is expected that the angle position obtained is in accordance with the angular position contained in the reference pattern (target). This aims to increase the accuracy of the system in recognizing the pattern being tested. In this study, the shooting position was carried out from the front of a traditional house

Figure 3 Example of Shooting with a Position from the Front

The next process is to convert the color image into a grayscale image. The method used to convert a color image into a grayscale image is to take the maximum value of the pixels R, G, and B.

Figure 4 Change Color Image to Grayscale Image

The next step is to convert the grayscale image into a binary image. One of the methods used in the process of converting grayscale images to binary images is to use thresholding. In this study, the threshold value of T used is 100, this is because the grayscale image obtained has a high brightness level (more than 100), therefore by using a threshold value of T = 100, the system is able to separate the object from the background contained in it. in the image.

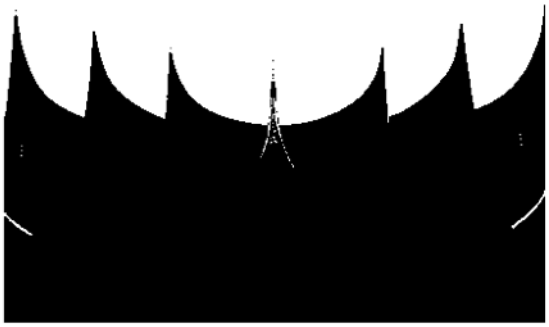

Figure 5 Change Grayscale Image to Binary Image

The next process is to normalize the image size, it aims to equalize the size of the image to be tested with the reference image. After normalizing the image size, then proceed with the pattern recognition process using the template matching method.

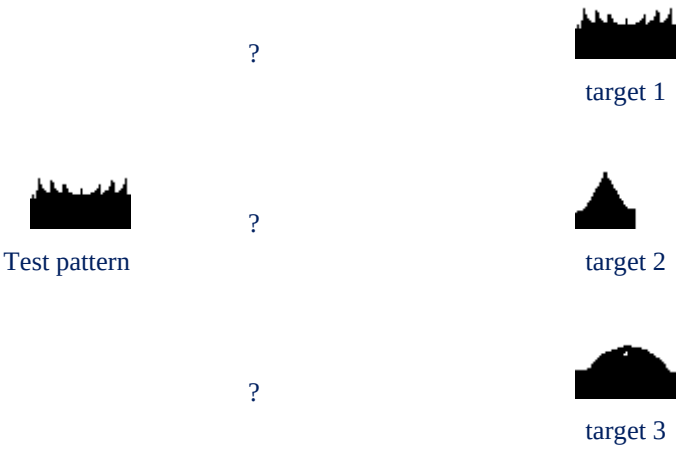

Figure 6 Illustration of Pattern Recognition Using Template Matching

The system analysis result stage is the stage to analyze the results of the introduction of traditional houses. The analysis was carried out using 10 types of traditional houses, each of which has 2 samples of test patterns so that the total pattern tested is 20 patterns. Table 1 shows the results of the introduction of traditional houses.

TABLE 1 TRADITIONAL HOUSE INTRODUCTION RESULTS

NO.	Housename Traditional	Number of Patterns	Correctly Recognized Patterns	Recognized Characters Incorrectly	PresentedTruth
1	Gadang	2	2	0	100%
2	Batak	2	2	0	100%
3	Sasak	2	2	0	100%
4	Sumba	2	1	1	50%
5	Tongkongan	2	2	0	100%
6	Aceh	2	1	1	50%
7	Honai	2	1	1	50%
8	Joglo	2	2	0	100%
9	Banjar	2	2	0	100%
10	Panjang	2	1	1	50%
Total		**20**	**16**	**4**	**80%**

Based on Table 1, the total patterns tested were 20 patterns. The pattern that is correctly recognized is 16 patterns, and the pattern that is recognized incorrectly is 4 patterns, so it can be said that the percentage of the system's success in recognizing patterns is 80%.

V. CONCLUSION

System testing was carried out using 10 types of traditional houses or 29.4% of traditional houses from 37 provinces in Indonesia. Where each type is represented by 2 test sample images so that it becomes 20 pictures of houses, the system is able to correctly recognize 16 traditional house patterns so that the percentage of system accuracy can be said to be 80%.

However, this system also has many shortcomings. Deficiencies or imperfections occur due to many factors such as taking the angle of the object in the test image that does not match the angle of the object in the target image, and also the presence of additional objects that cover the shape of the traditional house that will be recognized, such as: trees, cars, etc., as well as the condition of the test image is not good.

In the future, it is necessary to develop a pattern recognition system, one of which is by adding the number of output target classifications, such as taking pictures of objects from a side angle, so as to increase the success of the system in recognizing patterns.

In addition, this research process also shows that for traditional house image segmentation, it is enough to do with thresholding and not use edge detection because the shape of traditional house buildings is quite recognizable from the edge of the existing building image and is a determinant of the shape of the building. edge detection is used, many image details are not very useful in determining the shape of traditional house buildings.

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