

IMPLEMENTATION OF THRESHOLD VALUE IN OTSU METHOD FOR BINARY IMAGE

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ABSTRACT

The uniqueness of facial geometry is one type of biometric that is often used in authentication systems. The segmentation process by producing a binary image or black and white image, known as facial image binarization, is one of the initial processes to determine the geometric characteristics of a face image. The main problem in this process is determining the threshold value because this value greatly affects the results of the segmentation process. In determining the geometric characteristics of the face, such as the shape of the nose, forehead, lips, and chin, it is necessary to perfect the results of the facial image segmentation process. In this study, the Otsu method was used to determine the threshold value for the segmentation process. The image used is a side view of the face. The side view face image is converted to grayscale with a white background. Based on the test, the Otsu method with a threshold value of $T = 250$ can provide a side view face image with a binary image that is better than other limits.

Keywords: Threshold, Segmentation, Binarization, Facial image, Otsu Method

INTRODUCTION

Facial geometry characteristics are one type of biometric characteristics that are widely used for authentication systems, verification systems, or identification systems. The initial process that can be done to make it easier to get the geometric characteristics of the face is segmentation in the form of binarization and edge detection of facial images, in this study used side view face images. In this study, the process carried out was only up to the stage of presenting the binarization process. The segmentation process in the form of binarization will produce a binary image with two gray level values, namely black and white. The basic principle of the binarization method is to separate the non-object area from the object area, which is denoted by the codes 0 and 1. The problem in the binarization process is the process of determining the Threshold value (threshold) for the processed image. This Threshold value is used to divide the grayscale image into two values, namely black and white. Determination of the Threshold value set at a certain value (fixed threshold) is very risky to be applied to facial images because it can produce an imperfect binary image, making it difficult to determine the geometric characteristics of the face image. In this paper, the determination of the threshold value for the binarization process uses the Otsu method.

METHODS

Image as a multimedia component plays a very important role as a form of visual information. The image has characteristics that are not owned by text data, namely the image is rich with

information. The digital image is a representation of the light intensity function in a discrete form on a two-dimensional plane. The image is composed of a set of pixels (picture elements) that have coordinates (a,b) and an amplitude of f(a,b). The coordinates (a,b) indicate the location/position of pixels in an image, while the amplitude f(a,b) indicates the color intensity value of the image. The representation of a digital image and its constituent pixels is shown in Figure 1 below.

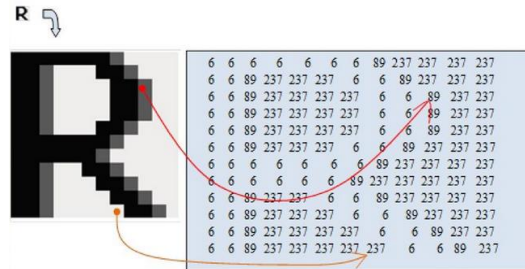


Figure 1. Image and Its Constituent Pixels

Image segmentation with binarization is a process of transforming grayscale images into black and white images using a certain threshold value. In general, the equation for the grayscale image binary process to produce a binary image is as follows where $g(a,b)$ is the binary image of the grayscale image $f(a,b)$ and T represents the threshold value.

$$g(a,b) = \begin{cases} 1 \text{ (white), if } f(a,b) \geq T \\ 0 \text{ (black), if } f(a,b) < T \end{cases} \quad [1]$$

The purpose of the Otsu method is to divide the gray histogram image into two different areas automatically without requiring the user's assistance to enter the Threshold value. The approach taken by the Otsu method is to perform discriminant analysis, which is to determine a variable so that it can distinguish between two or more groups that arise naturally. To separate objects with a background discriminant analysis will maximize these variables.

This algorithm thoroughly looks for the threshold value that minimizes the variance within the class which is defined as the weighted sum of the variances of the two classes.

$$\sigma_{\omega}^2(t) = \omega_0(t)\sigma_0^2(t) + \omega_1(t)\sigma_1^2(t) \quad [2]$$

The work process in this research is by inputting a side view face image, then converting it to a grayscale image, then processing using the Otsu method the image that has been inputted, as shown in Figure 2. The image taken is a side view of the face, the object is taken using a smartphone camera.

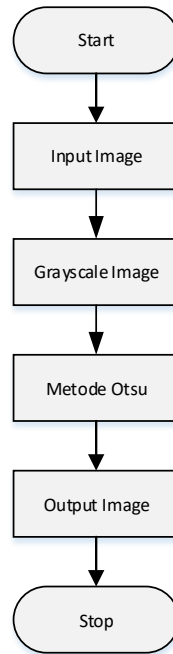


Figure 2. Research Flowchart

RESULTS AND DISCUSSION

In this paper, the test is carried out using a flow diagram schema of the study. The test image is shown in the image below.



Figure 3. Original Image



Figure 4. Grayscale Image



Figure 5. Image of Otsu Method Results

In the image in Figure 5, the image of the threshold results is complemented by the image so that the object is worth one (white color) and the background is zero (black).

The histogram is shown in figure 7 below.

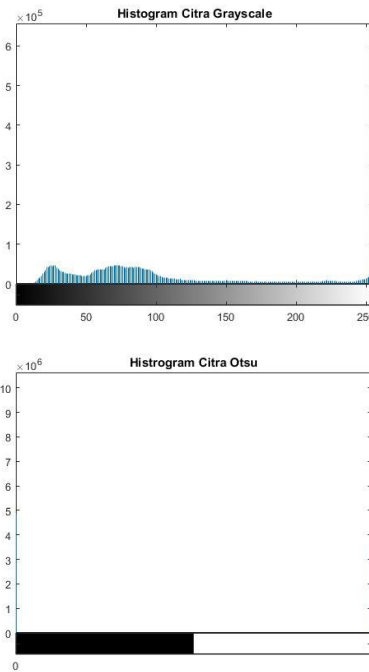


Figure 6. Image Histogram

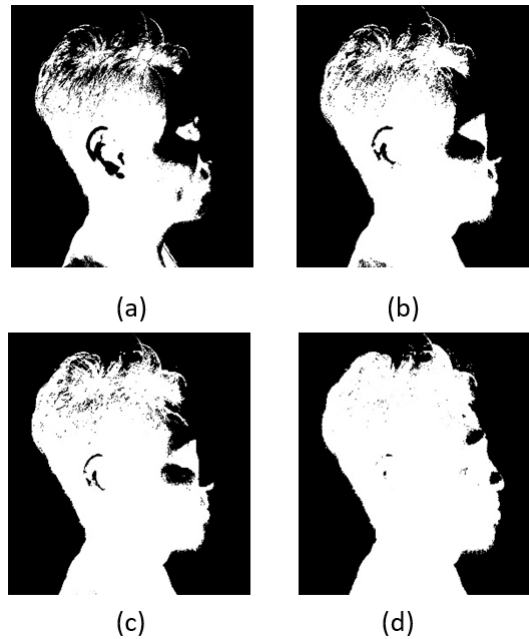


Figure 7. Threshold image with specified value (a) $T=100$; (b) $T=150$; (c) $T=200$; (d) $T=250$

Figure 7 shows the image results with several specified Threshold values, including $T = 100$; $T=150$; $T=200$; $T=250$. In the image of the threshold, the image is complemented so that the object is worth one (white color) and the background is zero (black).

CONCLUSION

Based on the test results with the image used, the Otsu method with the application of the threshold value used can provide satisfactory results in the binarization process. This method produces a better binary face image with the application of a threshold value of $T = 250$. This method produces a clear facial geometry compared to other threshold values.

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