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Image processing with the thresholding method using MATLAB R2014A.

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Abstract

The development of image processing science has become increasingly popular. With the availability of advanced technology for capturing high-quality images, digital cameras have significantly improved, with higher pixel values generated by the camera. The thresholding algorithm, proposed in this paper, is used to segment digital images, which are then processed as segmented results. The thresholding method involves several steps: converting the RGB image into grayscale, segmenting the image using the thresholding technique, performing complement operations to make objects white (1) and the background black (0), and applying morphological operations to refine the shapes of the objects in the segmented binary image. The morphological operations include hole filling, area opening, and erosion. This study uses MATLAB R2014a to develop the model.

Keywords: Digital image, Thresholding, RGB, Grayscale, MATLAB r2014a.

1. Introduction

The development of image processing science has become increasingly popular. With the availability of advanced technology for capturing high-quality images, digital cameras have significantly improved, with higher pixel values generated by the camera. The thresholding algorithm, proposed in this paper, is used to segment digital images, which are then processed as segmented results. The thresholding method involves several steps: converting the RGB image into grayscale, segmenting the image using the thresholding technique, performing complement operations to make objects white (1) and the background black (0), and applying morphological operations to refine the shapes of the objects in the segmented binary image. The morphological operations include hole filling, area opening, and erosion. This study uses MATLAB R2014a to develop the model.

2. Material and methods

2.1. Thresholding

Thresholding is an image segmentation technique that distinguishes between objects and the background based on the brightness or darkness of the pixels. Darker regions of the image are made darker (black with intensity 0), while lighter regions are made lighter (white with intensity 1). As a result, the output of this segmentation process is a binary image, where pixel intensities are either 0 or 1. After segmenting the image and separating the object from the background, the binary image obtained can be used as a mask to perform cropping, allowing the creation of an image with or without a background that can be modified.

$$F_O(x,y)=\begin{Bmatrix} T1, f1(x,y)\le T1 \\ T3, T1<f1(x,y)\le T2 \\ T2, T2<f1(x,y)\le T3 \end{Bmatrix}$$
$$: Tn, Tn<f1(x,y)\le T1$$

Parameter
$f1(x,y)$: The image obtained after thresholding.
T : Mapping Values

Assuming T1 = 50, T2 = 100, and T3 = 150, all values between 0 and 50 will be replaced with 50, values between 50 and 100 will be replaced with 100, and values between 100 and 150 will be replaced with 150. This mapping will continue accordingly, based on the predefined thresholds. The mapping should be designed to meet specific requirements, such as in a single threshold operation.

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2.2. Single Threshold Operation

A single threshold operation is a division with only one limit, meaning the pixel values are grouped into two categories, as shown in the following formula:

$$f0(x,y)=\frac{0, f0(x,y) \in 128}{225, f1(s,y) S 128}$$

Pixels with intensity values below 128 are changed to black (intensity value = 0), while pixels with intensity values above 128 are changed to white (intensity value = 255). An example calculation can be seen in the following image: for instance, consider a 5x5 pixel grayscale image with 256 colors.

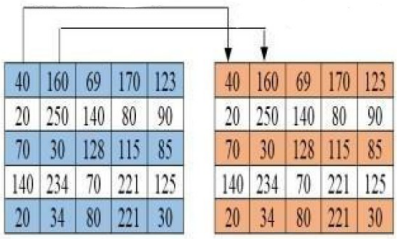

Figure 1. Intensity Pixel

2.3. Methods

The data in this study uses digital image data obtained from Google. Several images were taken to be used in measuring the performance of the thresholding method, which was created using MATLAB r2016a. The system design in this study focuses on a single-user setup, allowing for a personalized and streamlined experience. The application is specifically engineered to capture images through a camera interface, and then automatically process the image to generate relevant information. This process involves various image recognition or analysis techniques, such as object detection, image classification, or feature extraction, depending on the application's requirements. The generated information could include labels, metadata, or other data points related to the content of the image. By integrating image capture with real-time data generation, the system aims to provide efficient, user-friendly functionality for the user to obtain immediate insights from visual inputs.

3. Results and discussion

Thresholding is one of the image segmentation methods that separates objects from the background in an image based on differences in brightness or darkness levels. The regions of the image that are darker will be made darker (perfect black with an intensity value of 0), while the lighter regions will be made brighter (perfect white with an intensity value of 1). Therefore, the output of the segmentation process using the thresholding method is a binary image with pixel intensity values of either 0 or 1. Once the image has been segmented, or the object has been successfully separated from the background, the resulting binary image can be used as a mask to perform cropping, allowing for the creation of an image with or without a background that can be modified.

Below is an example of MATLAB programming for applying the thresholding method to segment digital images. After the object is successfully segmented, the next step is to change the background of the original RGB image. The programming steps are as follows:

- The process of loading and showing the original image.

```
clc; clear; close all;
% Object
Img = imread('ragil.png');
figure, imshow(Img);
```

Figure 2. Original

- The process of convert RGB into GreyScale

```
gray = rgb2gray(Img);
figure, imshow(gray);
```

Figure 3. Greyscale

- The process of Image segmentation using the thresholding method.

```
bw = im2bw(gray,0.5);
figure, imshow(bw);
```

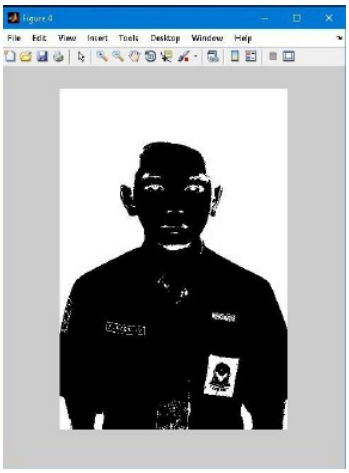

Figure 4. Segmentation

- Performing a complement operation so that the object with a value of 1 (white) and the background with a value of 0 (black).

```
bwi = imcomplement(bw);
figure, imshow(bwi);
```

Figure 5. complement operation

- Performing morphological operations to refine the shape of objects in the binary image resulting from segmentation. The morphological operations performed include filling holes, area opening, and erosion.

```
bwk = imfill(bwi,'holes');
bwj = bwareaopen(bwk,100);
str = strel('disk',5);
bwm = imerode(bwj,str);
figure, imshow(bwm);
```

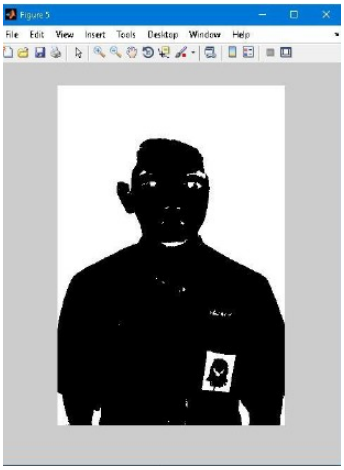

Figure 5. Morfologi

4. Conclusion

Thresholding is a segmentation technique that separates the object from the background based on differences in brightness. The process of thresholding involves several steps: converting the RGB color space of the image to Grayscale, segmenting the image using thresholding, applying a complement operation so that the object becomes 1 (white) and the background becomes 0 (black), and then performing morphological operations to enhance the shape of objects in the binary image obtained after segmentation. The morphological operations used include hole filling, area opening, and erosion

Credit authorship contribution statement

Author Name: Conceptualization, Writing – review & editing. **Author Name**: Supervision, Writing – review & editing. **Author Name**: Conceptualization, Supervision, Writing – review & editing.

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