Adaptive Thresholding Algorithms and Morphological to Improve the Quality of Takepan Sasak Image Readability

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Abstract. One of the cultural heritages in West Nusa Tenggara, especially Lombok, is takepan (lontar ancient manuscripts). Takepan written on leaf sheets of Lontar is known as the jejawan script (derived from ancient Javanese). Local adaptive[1] adaptively setting thresholds for each pixel can behave better than the global method in degraded and damaged document images. Adaptive binarasi can also reduce noise when segmenting text from the background. The process of determining the threshold value works on blocks in the image. Images that have contrast and lighting variations that are very difficult to solve as background or background because there are a lot of pixels, this recommends using Local Adaptive Thresholding. From the research that has been done, it can be concluded that adaptive thresholding and morphology with dilation approach help maximize image readability with the highest PSNR value reaching 34.107 dB. In further research can be developed using feature extraction so that it can recognize the character of the letter in takepan.

Keywords: adaptive thresholding, morphology, image processing, takepan sasak.

1. Introduction

One Indonesia has a rich cultural heritage of ancestors who have historical value. This cultural heritage is divided into 2, object inherited and intangible heritage. Cultural products that can be seen and felt with hands and eyes such as artifacts, ancient architecture, etc. are called cultural heritage objects. In contrast, intangible cultural heritage is cannot be seen or felt by hand. Examples are oral traditions and expressions, performance art, ritual celebrations and festivals, skills and knowledge. One of the cultural heritages in West Nusa Tenggara, especially Lombok, is takepan (lontar ancient manuscripts). Takepan written on leaf sheets of Lontar is known as the jejawan script (derived from ancient Javanese). In a long time, the documents usually repair damage such as loss of quality (degraded) updates that seem to fade and others [1]. This happens also in Takepan caused by fungi, termites and scratches associated with writing so that there were stains on the background. There are several studies that have been conducted and developed for the degraded image using thresholding algorithm [2]. Thresholding is one of the popular image segmentation technique in the separation between foreground and background, because the speed of time as well as simple to implement[3]. While Segmentation is the process of dividing the image into its constituent parts or objects[4]–[6]. Research conducted[7]–[11] using thresholding adative useful in the retina, and other tumors that can be utilized in the medical world. According to[12] Binerisasi method there are two methods of global and local adaptive method. Global methods that can be used to solve the problem with a good background, but also images that...
exceed the limit that can produce defective character. In contrast with local adaptive[1] adaptively
determine the threshold for each pixel, which can behave better than the global method in the image of
degraded and damaged documents. Adaptive binarasing can also reduce noise when segmenting text
from the background.
the value of adaptive thresholding is obtained based on the variation in the sensitivity of each local
window[14]. The process of determining the threshold value works on blocks in the image. Images
that have contrast and lighting variations that are very difficult to solve as background or background
because there are a lot of pixels, this recommends using Local Adaptive Thresholding[15]. Therefore,
in this study using adaptive thresholding and morphology for image improvement. So that it can
improve the quality and ability to read on the takepan image.

2. Methods

In this research, several stages were carried out to improve the quality of takepan image readability.
The steps are as follows:

![Figure 1. Stages of the proposed method](image)

2.1 Data acquisition
This is the initial stage to obtain data from analog data into digital data, namely takepan imagery. In
the process of using a scanner with JPG format and obtained 1.5 to 2 Megapixels from each sample. so
for this research, there are 5 takepan images.

2.2 Pre processing
At the pre-processing stage, cropping process needs to be done on the existing takepan image. By
removing unnecessary parts, until the appropriate sample data is obtained and used for the next step.

2.3 Adaptive tresholding
Adaptive Thresholding method is to calculate the local threshold value that has two values in the gray
level. This method is the process of changing the background to white and foreground to black, which
is called binary. In general with the following formula.

\[ G(x,y) = \begin{cases} 1 & \text{if } f(x,y) \geq T \\ 0 & \text{if } f(x,y) < T \end{cases} \]  

(1)

\(-G(x, y)\) represents the binary image of grayscale \(f(x, y)\)
\(-T\) represents the threshold value.

so for the adaptive thresholding formula:

\[ T = \frac{\sum_{(x,y)} \sum_{w} f(x,y)}{Nw} - C \]  

(2)
- W is the block processed,
- NW is the number of pixels in each block W,
- C is a constant that can be determined freely.
if C = 0, the threshold value is equal to the average value of each pixel in the block.

2.4 Morphology
after changing the image into binary the next stage is dilation, which is one of the morphological operations that function for widening or adding pixels an image. In the process of changing the background point (0) with the neighboring point (1) into the object point (1).

2.5 Analysis
To find out the quality and quantity in the proposed method, researchers use Peak Signal-to-Noise Ratio (PSNR). The higher PSNR value means better thresholding results. In PSNR, two images are said to have a low level of similarity if the PSNR value is below 30 dB.

3. Result and Discussion
5 takepan sasak images are used as a dataset with the constant value (C) = 0.04 in adaptive thresholding can be seen in figure 2.

| No | Citra (adaptive thresholding+morfologi) | PSNR |
|----|---------------------------------|------|
| 1  | ![Image](image1.png) | 34.107 |
| 2  | ![Image](image2.png) | 32.622 |
| 3  | ![Image](image3.png) | 32.083 |
| 4  | ![Image](image4.png) | 32.269 |
| 5  | ![Image](image5.png) | 31.481 |

Figure 2. Results of the proposed method
according to Table 1 data obtained using adaptive thresholding and Peak Signal-to-Noise Ratio (PSNR) morphology for each takepan image obtained values above 30 dB. For image no. 1 has a PSNR value of 34,107 higher than 4 other images.

4. Conclusion

From the research that has been done, it can be concluded that adaptive thresholding and morphology with dilation approach help maximize image readability with the highest PSNR value reaching 34,107 dB. In further research can be developed using feature extraction so that it can recognize the character of the letter in takepan.

References

[1] J. Banerjee, A. M. Namboodiri, and C. V Jawahar, “Contextual Restoration of Severely Degraded Document Images,” IEEE, 2009.
[2] Y. Pai, Y. Chang, and S. R. A, “Adaptive thresholding algorithm: Efficient computation technique based on intelligent block detection for degraded document images,” Pattern Recognit., vol. 43, no. 9, pp. 3177–3187, 2010, doi: 10.1016/j.patcog.2010.03.014.
[3] R. C. Gonzalez and R. E. Woods, Digital Image Processing Third Edition, 3rd ed. New Jersey: Pearson Education, Inc., 2008.
[4] N. M. Zaitoun and M. J. Aqel, “Survey on Image Segmentation Techniques,” Procedia - Process Comput. Sci., vol. 65, no. Iccmit, pp. 797–806, 2015, doi: 10.1016/j.procs.2015.09.027.
[5] P. Kohli, A. Osokin, and S. Jegelka, “A Principled Deep Random Field Model for Image Segmentation Supplementary Material for ‘A Principled Deep Random Field Model for Image Segmentation,’” no. June, pp. 1–4, 2013, doi: 10.1109/CVPR.2013.257.
[6] M. Bhat, “Digital Image Processing,” vol. 3, no. 1, pp. 272–276, 2014.
[7] J. Dash and N. Bhoi, “ScienceDirect A thresholding based technique to extract retinal blood vessels from fundus images,” Futur. Comput. Informatics J., vol. 2, no. 2, pp. 103–109, 2017, doi: 10.1016/j.fcij.2017.10.001.
[8] U. Ilhan and A. Ilhan, “ScienceDirect ScienceDirect Brain tumor segmentation based on a new threshold approach,” Procedia Comput. Sci., vol. 120, pp. 580–587, 2018, doi: 10.1016/j.procs.2017.11.282.
[9] P. V. V Kishore, K. L. Mallika, M. V. D. Prasad, and K. L. Narayana, “Denoising Ultrasound Medical Images with Selective Fusion in Wavelet Domain,” Procedia - Process Comput. Sci., vol. 58, pp. 129–139, 2015, doi: 10.1016/j.procs.2015.08.040.
[10] S. Mukhopadhyay and J. K. Mandal, “Wavelet based Denoising of Medical Images using Subband Adaptive Thresholding through Genetic Algorithm,” Procedia Technol., vol. 10, no. 1, pp. 680–689, 2013, doi: 10.1016/j.protcy.2013.12.410.
[11] R. W. Nur Nafi’iyah, “Perbandingan Otsu Dan Iterative Adaptive Thresholding Dalam,” J. Ilm. Teknol. dan Inf. ASIA, vol. 11, no. 1, pp. 21–28, 2017.
[12] Y. Chen and L. Wang, “Neurocomputing Broken and degraded document images binarization,” Neurocomputing, vol. 237, no. December 2016, pp. 272–280, 2017, doi: 10.1016/j.neucom.2016.12.058.
[13] E. Kavallieratou and E. Stamatatos, “Improving the Quality of Degraded Document Images,” 2006.
[14] J. Anitha, J. D. Peter, and S. I. A. Pandian, “A dual stage adaptive thresholding (DuSAT) for automatic mass detection in mammograms,” Comput. Methods Programs Biomed., vol. 138, pp. 93–104, 2017.
[15] T. Mapayi, S. Viriri, and J.-R. Tapamo, “A new adaptive thresholding technique for retinal vessel segmentation based on local homogeneity information,” in International Conference on Image and Signal Processing, 2014, pp. 558–567.
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