Study of Environmental Condition Using Wavelet Decomposition Based on Infrared Image

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Study of Environmental Condition Using Wavelet Decomposition Based on Infrared Image

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***Abstract*—In this paper, we report our experiment about wavelet decomposition for study environmental condition based on infrared images. Infrared images acquired by consumer digital camera, after replacing the infrared stoping filter with filter SRS, and the images captured sequentially every two hours (from 06:00—16:00). The result of this research is the increasing air pollution characterized using wavelet decomposition by increasing index value from 0—3 and amount of white spots about 60% (from 5%—65%). Finally wavelet decomposition was made to estimate the environmental condition, especially air pollution, based on infrared image.**

Keywords—environmental condition, wavelet decomposition, infrared image

I. INTRODUCTION

Air as a component of the environment is important in life needs to be maintained in order to provide support for living things in an optimal. Several researchers have been working on air quality remote monitoring system researches. An Internet and short message-based air quality monitoring was developed in [1], [2]. However, to the authors' knowledge, an air quality remote monitoring system based on thermal imaging of the surrounding environment has not been developed in Indonesia. Therefore, this study proposes an air pollution monitoring system based on infrared images using wavelet decomposition.

II. THE UNDERLYING THEORY

Air pollution is harmful elements that may result in environmental damage, disruption on human health and the quality of the environment. The causes of air pollution caused by motor vehicle exhaust using gasoline and diesel as well as the disposal of the remnants of the industrial plant that could damage the environment.

Worse air environment is estimated to be the causes of fatigue during the trip. Fatigue can lead to motorists and other road users cannot control themselves. In turn, this may reduce alertness and threaten the safety of the trip. However, there is currently no practical tools to tell this condition. So far, the road superintendents (traffic police and CCTV cameras) are only able to tell the extent of traffic levels. In fact, the more dense and the longer traffic congestion, pollution levels in the jammed area also increased. This has implications for accelerated fatigue and concentration of motorists and other road users. CCTV cameras were installed to monitor the level of traffic density and the infrared camera can be used utilized as a means of monitoring air pollution. The resulting infrared image is a picture of a record object or objects in an image is usually a picture. The term image is used to express the intensity of light in a two-dimensional function f (x, y), where (x, y) coordinates of spatial states and the values of f at the point (x, y) expressed levels of brightness (gray level) image at that point [3].

A. *Infrared image*

Infrared image acquired from infrared photography, they have wavelength greater than 700 nm.

Investigation the characteristics of the light-absorbing filter visual and infrared light passed by the effect of variations in light intensity and SRS filter the results obtained [4]; [5] studied the physical phenomena on digital photography which in fact can be improved by using the image of near infrared (NIR), the result of a combination of NIR image with a grayscale image look more powerful than the original RGB image.

Furthermore Fredembach et al. [6] suggested that the near-infrared spectrum contains important information about the imaging light source. It is shown that a simple calculation of the ratio of the NIR and RGB, scene illuminant can be determined accurately.

Have obtained infrared image histogram characteristics are captured using a modified digital camera [7]. Furthermore

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conducted a study and found that moving averages can be applied to spatial filtering towards the object to obtain thermal conditions [8]. Sulistiyanti, et. al. also found that slicing the histogram can be used to obtain information object temperature distribution thermal conditions [9]. Furthermore, by conducting research with Surface (2D) contour fittings obtained for the isothermal calorimetry catches consumer digital camera [10]. Article entitled characterization of Cutting Temperature and Ignition Phenomena of Magnesium Chip using Infrared Imaging [11] indicated that infrared thermography could be use to determine the ignition point of magnesium chips cutting temperature.

B. Wavelet Transform

The wavelet transform is processing for images, used 2-D wavelet transform. The steps of 2-D wavelet transform could be illustration in the Figure 1.

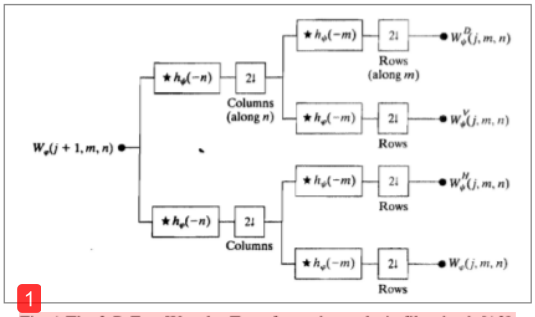


Fig. 1 The 2-D Fast Wavelet Transform, the analysis filter bank [12].

C. Wavelet Decomposition

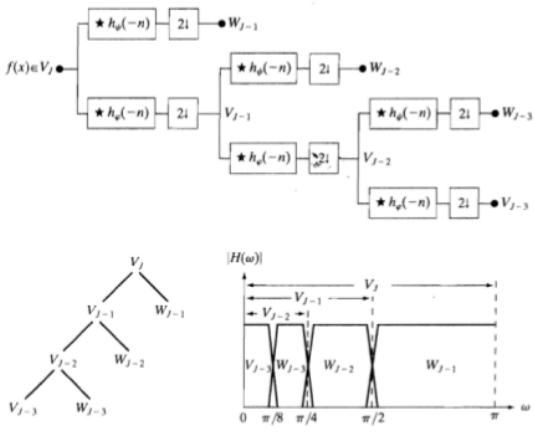


Fig. 2 A three-scale FWT filter bank: a. block diagram; b. decomposition space tree; and c. spectrum splitting characteristic [12].

In [13], demonstrate the advantage of this algorithm over standard soft thresholding (implemented with the same wavelet representation) on images with artificial Gaussian noise. On infrared images of land mines from our data set, this simple technique offers a significant improvement. The background noise is strongly suppressed and the presence of the object of interest is enhanced. One should note that noise suppression is achieved here by a "severe" suppression of all the coefficients that are not located in the vicinity of the edges detected from the low-pass images. This is useful for images where a uniform-intensity object needs to be distinguished from a background, but this method is not as favorable in cases where fine image details need to be preserved.

III. Materials and Methods

The experiment used Fuji Finepix A400 digital camera is given filter infrared SRS, performed around the market Bambu Kuning Bandarlampung. Data obtained starting at 06.00 s.d. 16.00, with a time interval of 2 hours. For infrared images of environmental condition processing, the RGB images converted into gray level images. Conversion to gray level meant to be seen how much noise of the object. After that, the next step is processing using wavelet transformation and wavelet decomposition method, to compare the result of them. Wavelet and wavelet decomposition process aims to evaluate concerning this for characterize air pollutant.

IV. Results of The Research

Figure 3 shows one of original infrared environmental image with position of cropping in RGB and grayscale format, local time is 06:00. Position of cropping assumed as air condition unlimited and could be used everywhere. If cropping in the building, the result obtained in the other place must be calibrate with the building. The images, captured every two hours from 06:00 till 16:00, changed be grayscale images. After that, the grayscale images processed use wavelet and wavelet decomposition.

Figure 4 show the result of wavelet processing, they captured every two hours from 06:00 till 16:00. On the left of each image in Figure 4 is a process wavelet, top-left and clockwise are grayscale an image, horizontal process, diagonal process, and vertical process. And on the right of each image in Figure 4 is amount of horizontal, vertical, and diagonal process of wavelet decomposition. In Figure 4, increasingly air pollution depends on the time. In the morning (06:00—08:00) qualitatively resulting images seen 'dark', these mean environmental condition relatively clear, but from 10:00—16:00 seen increasing 'white spots', these mean dirty air in other words increasing pollution air. Index value in these result of wavelet decomposition processing of images also increase from 0—3 (dark or black spots=0 and white spots=3). It could be show in Figure 4. Figure 4 also show the result of wavelet decomposition processing, they captured every two hours from 06:00 until 16:00. Like Figure 3, the left of each image in Figure 4 is a process wavelet decomposition, top-left and clockwise are grayscale an image, horizontal process, diagonal process, and vertical process. And on the right of each image in Figure 4 is amount of horizontal, vertical, and diagonal process of wavelet decomposition.

Seen in Figure 5, increasingly air pollution depends on the time. In the morning (06:00—08:00) qualitatively resulting images seen 'dark', these mean environmental condition

relatively clear, but from 10:00—16:00 seen increasing 'white spots', these mean dirty air in other words increasing pollution air. Index value in these result of wavelet decomposition processing of images also increase from 0—3 (dark or black spots=0 and white spots=3) and amount of white spots increase about 60% (from 5% become 65%), it could be show in Figure 5.

The result of this research shows that wavelet transform could be used to see environmental condition but it is less clear than wavelet decomposition. This is as seen in Figure 4 and Figure 5.

RGB level b. Grayscale level

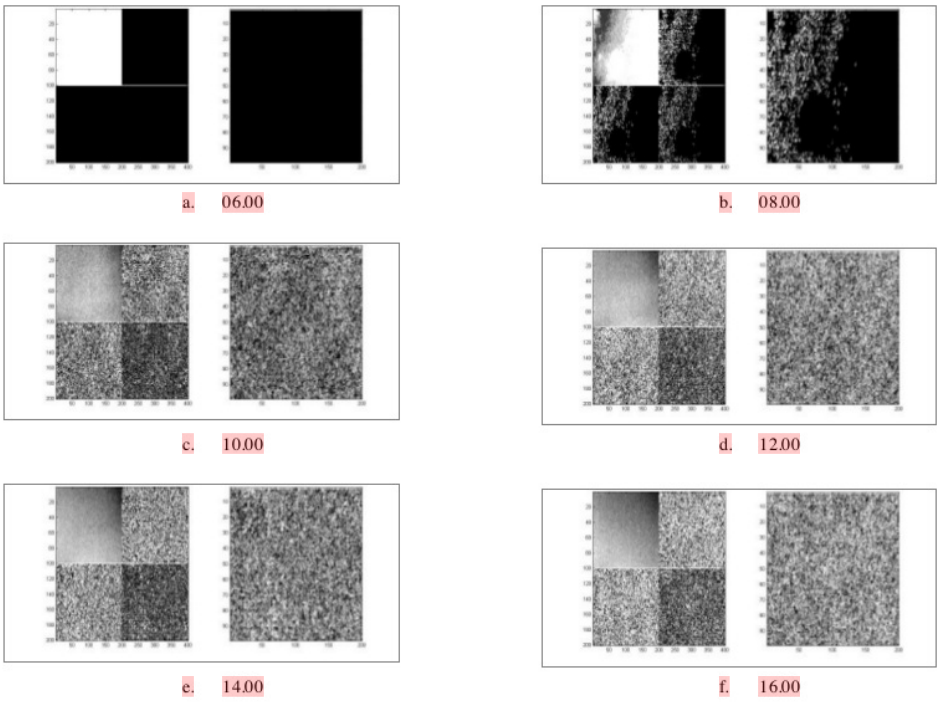
Fig. 3 One of original image

a. 06.00 b. 08.00

c. 10.00 d. 12.00

e. 14.00 f. 16.00

Fig. 4 Wavelet transform of infrared environmental condition images



a. 06.00 b. 08.00 c. 10.00 d. 12.00 e. 14.00 f. 16.00

Fig. 5 Wavelet decomposition of infrared environmental condition images

V. Conclusions and Suggestion

A. Conclusions

- The increasing air pollution characterized using wavelet decomposition by increasing index value from 1 (black)—3 (white) and amount of white spots about 60% (from 5% become 65%).
- Wavelet decomposition could be use to monitoring environmental condition, especially air pollution.

B. Suggestion

This research could be continuing with further research to get characteristic of air pollutant and monitoring air pollution.

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