ISBN 978 – 979-98623-1-0

IMPLEMENTING CONTENT BASED IMAGE RETRIEVAL FOR BATIK USING ROTATED WAVELET TRANSFORM AND CANBERRA DISTANCE

Ricky Eka Putra [1], Nanik Suciati [2], Arya Yudhi Wijaya [3]
Informatics Department, Faculty of Information Technology, Institut Teknologi Adhi Tama Surabaya, Indonesia [1]
Informatics Department, Faculty of Information Technology, Institut Teknologi Sepuluh Nopember, Indonesia [2,3]
rickyeka25@yahoo.com [1], nanik@its-sby.edu [2], arya@if.its.ac.id [3]

Abstract

Batik is a traditional cloth that was one of the nation's cultural richness of Indonesia. Serious attention to the batik needs to be done to prevent the loss of batik as a cultural heritage of Indonesia, which is caused by lack of good information / documentation about batik and / or because of recognition batik as a nation's cultural from the other nations. Therefore, data batik records / inventory is needed. In addition, should also be continuous promotion of introducing batik as a traditional Indonesian fabric to the international world.

In this research will be built Batik Image Retrieval System Based on Motif. Texture feature is an important feature in the image of batik, is extracted using wavelet transform. The wavelet transform which used is a combination of the Discrete Wavelet Transform and Rotated Wavelet Filter. Followed by measuring the distance between image sampled with a set of images in the dataset with Canberra distance. The benefits of this research is produces the software "Batik Image Retrieval System" which have average accuracy 70%.

***Keywords**: content based image retrieval, rotated wavelet transform, canberra distance*

1 INTRODUCTION

1.1 Motivation

Batik is a traditional fabric that became one of the nation's cultural richness of Indonesia. Batik has a long history, which began before the era of Raden Wijaya (1294 - 1309), the first King of Majapahit. During its development, style, motif, and color of batik is also influenced by the culture from outside, such as Hinduism, Islam, Netherlands, China, and Japan. In the book "Spirits of Batik Indonesia" [1] is mentioned more than 181 batik motifs. The amount does not include a variety of local batik motif continues to grow.

Serious attention to the batik needs to be done to prevent the loss of batik as a national heritage of Indonesia, due to lack of information / good documentation about batik and / or because of the recognition of batik as the culture of other nations. Therefore, record / inventory data batik is required. In addition, it should also be continuous promotion of introducing traditional Indonesian batik to the international world.

Efforts to collect image data of batik as an effort to inventory the cultural richness of Indonesia and maintain Indonesia resilience of traditional culture has been carried out by the IACI (Indonesian Archipelago Culture Initiatives), and can be accessed freely at http://www.budaya-indonesia.org/iaci/ Daftar_Motif_Pakaian. Although the number of batik has collected quite a lot, but not all the data of batik in Indonesia inventoried. In such systems, indexing of data is done manually using the keyword area of origin of batik cloth. Users often have difficulty finding batik image data, because users can simply do a search using the keyword area of origin (browse by keyword), such as Central Java, East Java, or Lampung.

In the large image database, the retrifeval of an image data using keyword-based method is inefficient [1,2]. It takes a sophisticated keyword system which contains hundreds of different keywords which can describe a specific image. In addition, the provision of keywords in each image data is done manually by a user are subjective, which may vary from one user to another user. To overcome the shortcomings of the system of keyword-based image retrieval, it takes an image indexing technique automatically based on the visual content of images, such as color, texture, and shape. The new system is known by the system of content-based image retrieval (content-based image retrieval / CBIR), which organize database of images based on visual content of images which are automatically recognized, and which allows the query is done using the example image [2,3,4,5].

The main challenge in content-based retrieval system is to find features that can represent the unique characteristics of the image, so the feature can be used to accurately identify the image. Visual features that can be extracted from an image data is texture, color, and shape [2,4,5]. Associated with the image of batik, texture features is an important feature because the ornaments on batik cloth can be viewed as a composition of several different textures.

1.2 Related Work

ISBN 978 – 979-98623-1-0

Recent development in wavelet theory has provided a promising alternative through multichannel filter banks that overcomes these problems. Furthermore, as wavelets form the core technology in the next generation of still image coding standard, JPEG-2000, the choice of wavelet features enables the implementation of the retrieval system that can work directly on the compressed domain.

In the standard wavelet decomposition, HH subband contains diagonal information. It contains directional information in two directions simultaneously both in 45^o and 135^o. In texture retrieval application, characterization of specific directional information of an image improves retrieval performance. That is made possible using nonseparable oriented wavelet transforms, such as the hexagonal wavelet transform.

The hexagonal wavelet representation partitions the orientations into three bands of 60^o covering a frequency domain using a hexagonal sampling system and filters at the expense of implementation difficulty.

Kokare on [1] have present present a new set of 2-D rotated wavelet filters/RWF, which is designed by using Daubechies eight tap coefficients. He have used rotated discrete wavelet filters that are obtained by rotating the standard 2-D DWT filters. Computational complexity associated with the rotated wavelet filters decomposition is same as that of the standard 2-D wavelet filters decomposition, if both are implemented in 2-D frequency domain. In this paper, we implementing RWF and combined by Discrete Wavelet Transform/DWT and also followed by Canberra distance to make a CBIR of batik.

This paper is organized as follows. In Section 2, rotated wavelet filters for CBIR is discussed in brief. Methodology of this paper is given in Section 3. Experimental results and discussions are given in Section 4, which is followed by the conclusions in Section 5.

2 Rotated Wavelet Filter for CBIR

2.1 Content Based Image Retrieval for Batik

Content Based Image Retrieval is also known as Query by Image Content (Qbic). Content Based Image Retrieval (CBIR) system is an image searching application on the basis of a digital image of a large image data using image similarity measure[6]. "Content Based" means search using the contents of the image itself or referred to as the image query, instead of using a text input.

The similarity between the images can be interpreted that the query image and images in the database is exactly the same, can also be interpreted similar approach. Examples of batik images are near similar and not similar can be seen in Figure 1 and Figure 2.

Figure 1 Some batik images are similar

Figure 2 Some batik images are not similar

If the database contains *Q* images, want to look *N* images which most similar with image *query*. Then this could be done by comparing the texture features on the query image with the target image in the image database, and retrieve the image as much as *N*. The symbol *N* indicates the number of images to search.

2.2 Discrete Wavelet Transform

Wavelet is a method that can be used to define a multiresolution space [7]. By using a wavelet, a vector space can be decomposed into a set of nested vector spaces with different resolutions, so it allows for analysis of function in both time domain and frequency domain at the different resolutions. Nowadays, wavelets have been successfully applied in several fields, such as signal analysis, texture analysis, image processing, numerical analysis, computer graphics [8], and others.

Wavelet representation in an image is to use discrete wavelet transform 2-dimensional (2D). Thus, in this case the 1D discrete wavelet transform is applied along the horizontal and vertical directions. By applying the decomposition, it will obtain a wavelet decomposition as shown as Figure 3.

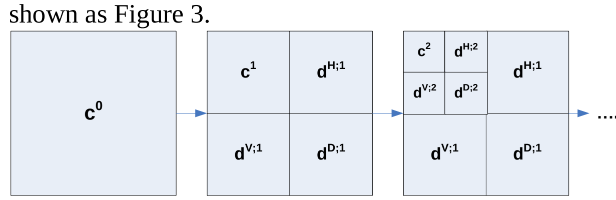

Figure 3 Image Decomposition Process

As seen in Figure 2.3, if an image are processed by two-dimensional discrete wavelet transform with decomposition level one, it will produce four subband, namely:

ISBN 978 – 979-98623-1-0

1. Approximation Coefficient (c1) or also called the LL subband.
2. Horizontal Detail Coefficient ($d^{H;1}$) or also called the HL subband.
3. Vertical Detail Coefficient ($d^{V;1}$) or also called the HL subband.
4. Diagonal Detail Coefficient ($d^{D;1}$) or also called the HH subband.

While for the partition in the domani frequency of the 2D wavelet decomposition for one level can be seen in Figure 4.

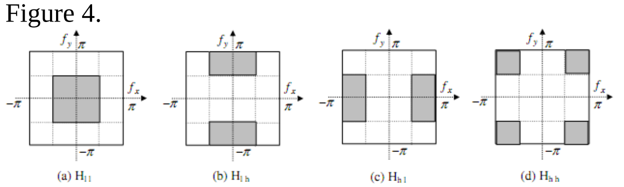

Figure 4 Partitions of frequency domain resulting from one level DWT decomposition.

Let h and g represent the one-dimensional Daubechies eight tap wavelet low pass and high pass filter coefficients respectively.

$$h = \begin{bmatrix} 0.23037781330886 & 0.71484657055254 & 0.63088076792959 & -0.02798376941698 \\ -0.18703481171888 & 0.03084138183599 & 0.03288301166698 & -0.01059740178500 \end{bmatrix}$$

$$g = \begin{bmatrix} 0.01059740178500 & 0.03288301166698 & 0.03084138183599 & -0.18703481171888 \\ 0.02798376941698 & 0.63088076792959 & -0.71484657055254 & 0.23037781330886 \end{bmatrix}$$

The 2-D low–low, low–high, high–low, and high–high filter coefficients are derived from h and g using the following matrix operations.

$$\begin{aligned} H_{LL} &= h^T h \\ H_{LH} &= h^T g \\ H_{HL} &= g^T h \\ H_{HH} &= g^T g \end{aligned} \qquad (1)$$

2.3 Rotated Wavelet Filter

Rotated Wavelet transformation is the development of the Discrete Wavelet Transform (DWT) [2]. HH subband in the DWT decomposition contains diagonal information from the batik image. It is very difficult to distinguish the diagonal information which oriented by angle 45^o and 135^o.

In some cases, characterization of the specific direction information in an image can improve the accuracy of an image retrieval system. To design the rotated wavelet filters or rotated Wavelet Filter (RWF) 2D, needed Daubechies eight tabs filter coefficients.

RWF is obtained by rotating standard 2-D DWT filters by 45^o so that the decomposition is performed along the direction x_d and y_d instead of x_n and y_n directions as illustrated in Figure 5.

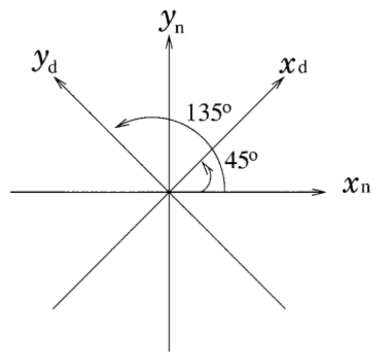

Figure 5 Angle reference used in this paper

The size of a filter is $(2L-1)\times(2L-1)$, where L is the length of the 1-D filter. The computational complexity associated with the RWF decomposition is same as that of DWF transform, if both are implemented in the 2-D frequency domain. The filter characteristics of the rotated 2-D filters are shown in Figure 6.

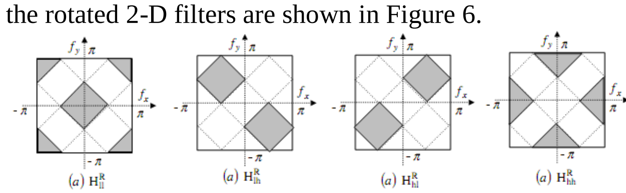

Figure 6 Partitions of frequency domain resulting from one level RWF decomposition.

2.4 Canberra Distance

Distance measurement method commonly used is the Euclidean distance. Euclidean distance is not always the best metric. The fact is that the distances in each dimension are squared before summation, places great emphasis on those features for which the dissimilarity is large. Hence it is necessary to normalize the individual feature components before finding the distance between two images. This has been taken care of in Canberra distance metric, which motivates us to use Canberra distance metric as dissimilarity measure.

The Canberra distance method can be seen in Equation 3. With x and y are two features vector, which this one at d dimension of database image and the other is a query image.

$$Canb(x,y) = \sum_{i=1}^{d} \frac{|x_i - y_i|}{|x_i| + |y_i|} \qquad (3)$$

In Equation 3, the numerator signifies the difference and denominator normalizes the difference. Thus distance value will never exceed one, being equal to one whenever either of the attributes is zero. Thus it appears to be a good similarity measure to be used, which avoids scaling effect.

ISBN 978 – 979-98623-1-0

3 METHODOLOGY

3.1 Feature Extraction

Features obtained from the energy value and standard deviation which are obtained from the image processing based on wavelet decomposition. Extraction of features used in this study combines the results of the decomposition of the DWT and RWF.

The analysis was performed up to fifth level of decomposition. In each set, feature vector is formed using energy and standard deviation of every subband. The Energy and Standard Deviation of wavelet subband are computed as follows.

$$\text{Energy } = \frac{1}{M \times N} \sum_{i=1}^{M} \sum_{j=1}^{N} \left| X_{ij} \right| \quad (4)$$

$$\text{Standard Deviation } = \left[\frac{1}{M \times N} \sum_{i=1}^{M} \sum_{j=1}^{N} \left(X_{ij} - \mu_{ij} \right)^2 \right]^{\frac{1}{2}} \quad (5)$$

Where $M \times N$ is the size of wavelet subband, X_{ij} is wavelet coefficient, and μ_{ij} is the mean value of wavelet coefficient. Length of the feature vector is equal to (No. of subbands $\times$ No. of feature parameters used in combination) elements. So, this research using 80 $\times$ 1 features for each image. Where 40 $\times$ 1 is for wavelet decomposition using DWT and 40 $\times$ 1 is using RWF.

Table 1. Accuracy Results and Time Consumption

No.	Image Name	Accuracy (%)	Time (s)
1	a02 – Parang Grendeh	0.75	0.164
2	b_ron telo	0.75	0.151
3	c15 – Lereng Kawung Seling	0.75	0.152
4	e0_BATIK_MADURA_1	0.50	0.156
5	f06 – Snow White	0.75	0.140
	Average	0.7	0.153

3.2 Filling Feature Database

Feature database contains each feature image from decomposition process. Size of this database is no. images $\times$80. For creation of the feature database, above procedure(feature extraction) is repeated for all the images of the image database and these feature vectors are stored in the feature database. Flowchart about this process is shown in Figure 7.

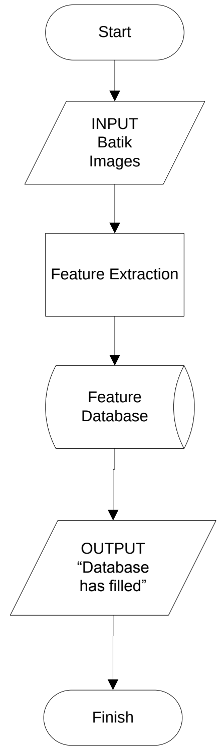

Figure 7 Filling Feature Database Flowchart

3.3 Retrieval

In this fase, resulting some images which have closest distance with query image. So, there is a distance measurement between feature query images with features database. Continued by a rangking process so that just only a few images that are similar with query image will retrieved.

4 RESULTS AND DISCUSSIONS

Retrieved top 4 similar images from the feature database for a sample query image are shown in Figure 9. Images are displayed from top left to right bottom in the increasing order of distance from query image. The results of measurements of 5-image examples can be seen in Table 1.

ISBN 978 – 979-98623-1-0

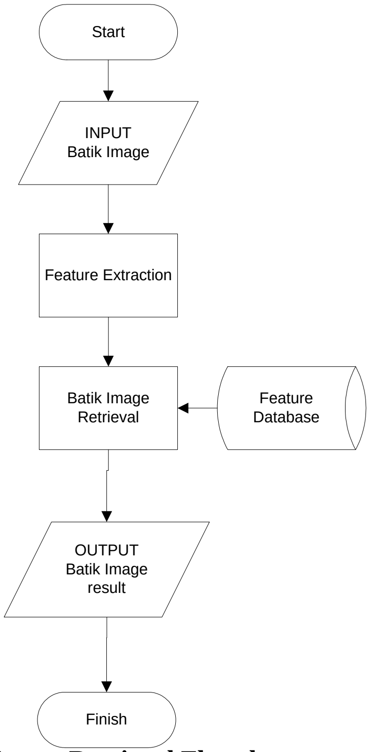

Figure 8 Batik Image Retrieval Flowchart

5 RESULTS AND DISCUSSIONS

Retrieved top 4 similar images from the feature database for a sample query image are shown in Figure 9. Images are displayed from top left to right bottom in the increasing order of distance from query image. The results of measurements of 5-image examples can be seen in Table 1.

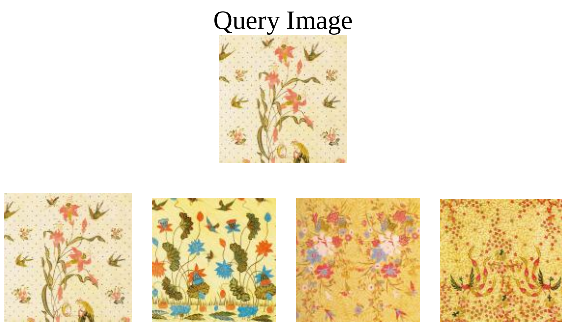

Figure 9 Retrieved top 4 similar Batik Images

6 CONCLUSIONS

From this research can be concluded, among others:

1. Rotated Wavelet Filter and Canberra distance can be implementing at Batik Image Retrieval.
2. Average accuracy from batik image retrieval using RWF and Canberra distance is 70%.

Further research could be adding classification method (MLP, SVM, etc) to obtain more better accuracy than this system.

7 REFERENCES

[1] Achjadi, J., 1999. Batik Spirits of Indonesia. Yayasan Batik Indonesia, PT. Buku Antar Bangsa.

[2] Kokare, M., Biswas, P.K., Chatterji, B.N., 2007. Texture image retrieval using rotated wavelet filters. Pattern Recognition Letter, vol. 28, pp. 1240–1249.

[3] Suciati, N., Herumurti, D., Buliali, J.L., Kusuma, D.W., Saikhu, A., Asano, C.M., Asano, A., 2007. Image Retrieval based on Object Extraction and Kansei Estimation. Proceeding of 2nd Korean-Japan Joint Workshop on Pattern Recognition (KJPR), pp. 191-196.

[4] Jhanwar, N., Chaudhuri, S., Seetharaman, G., Zavidovique, B., 2004. Content based image retrieval using motif cooccurrence matrix. Image and Vision Computing, vol. 22, pp. 1211–1220.

[5] He, Z., You, X., Yuan, Y., 2009. Texture image retrieval based on non-tensor product wavelet filterbanks. Signal Processing, vol. 89, pp 1501–1510.

[6] Suematsu, N., Ishida, Y., Hayashi, A., dan Kanbara, T., 2002. Region-Based Image Retrieval using Wavelet Transform, Faculty of Information Sciences Hiroshima City University.

[7] Gonzalez, Rafael C., Woods, R.E., 2002.Digital Image Processing. New Jersey : Prentice-Hall, Inc., Upper Saddle River.

[8] Suciati, N., Harada, K., 2009. Editing Techniques on Wavelet-based Multiresolution Surface. Current Development in Theory and Applications of Wavelets, vol. 3, no. 3, pp. 205-217.