

Content Based Image Retrieval Using Lacunarity and Color Moments of Skin Diseases

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Article Info

Article history:

Received Sep 11, 2017

Revised Nov 27, 2017

Accepted Dec 10, 2017

Keywords:

Color Moments

Content Based Image Retrieval
Image Retrieval

Lacunarity

Skin disease

ABSTRACT

The research conducted contributed in the form of CBIR application which was developed using texture and color feature extraction in searching the contents information of an object of skin disease image. The textured feature is extracted using Lacunarity, while for color feature extraction using Color Moments as well as a combination of both methods. The results of color characteristic extraction test using Color Moments Method yielded images corresponding to 100% similarity percentages and experimentation of texture characteristic extraction using Lacunarity Method yielded images corresponding to a percentage of suitability of 25%, followed by a combined test of both methods and the normalization process produces images corresponding to a percentage of conformity of 60%.

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1. INTRODUCTION

The development of information systems technology in the present time makes the human need for information continues to increase. Such information is not limited to non-visual data (text and voice), but in visual form (image and video). According to research titled "A Review Paper on Content Based Image Retrieval", Image Retrieval is a technique used to search the image of a database that has similar characteristics of the image query. Each image has unique low-level feature information. Examples of low-level features are color, texture, shape, and so on. These features are further compared between the images in the image retrieval system. There are two approaches in image retrieval, namely Image Based Retrieval (TBIR) based on image metadata and Content Based Image Retrieval (CBIR) information based on image content information

The current text-based search technique (TBIR) is not yet fully usable because the name of a file can not present its contents and the image itself has very variable characteristics [1]. Therefore, to know the exact keyword is very influential in this text-based process so that the desired image can be displayed [2]. This can be seen in Google image searching can not find optimal results and does not respond to what is expected because the search technique is only based on the filename and resulted in a messy search. Seeing the problem of text-based techniques is needed alternative approach with another image retrieval method that is Content Based Image Retrieval (CBIR) which aims to avoid the use of textual description [3]. CBIR is a methodology for image data recall based on the content information of an image, such as color, texture, and shape [4].

Based on the above description, the basic framework underlying the design of this CBIR application is to choose the most effective feature to represent the contents of the image [5]. Among the most popular content and image are the color and texture features [6]. Color feature is the most frequently used feature in CBIR because it has a strong correlation with the basic object of an image. The Color Moments method can be used to extract color features. Image can be recognized by the regularity of pixel-shaped patterns by utilizing texture features. The Lacunarity method is included in the method used for the calculation of the distribution of vacancy degrees (lacunas) in the image and it is closely related to the texture image analysis [7].

The retrieval process in the CBIR application design developed in this paper, combines color and texture features as color and texture capture different aspects. Combinations are made up of two types, both serial and parallel. The serial combination is a feature extraction process based on the calculation of the similarity of one feature extraction while the combination in parallel, the combination of color and texture feature extraction, is expected to improve the image retrieval performance in the calculation phase of similarity between the two feature extractions with the query image.

2. RESEARCH METHOD

Lacunarity works in two methods named Differential Box-Counting (DBC) and Gliding Box [3]. Gliding Box is a method used to calculate binary images in Lacunarity. Calculation of Gliding Box begins by calculating a box with size of r side and all processed image will be searched its Lacunarity value by logging the mass of box, S [8]. Gliding-Box method stage begins by placing box or square box with $r \times r$ size in corner Left over the image, then the box will check every pixel that contains 1 or 0 until finally the entire pixel is passed by the box. This box moves from the top left corner of the image through the pixels per pixel of the image until all the pixels in the image are identified. When this box is in a certain pixel, the program will calculate every pixel value passed by which it is considered an object in the image [7]. The frequency of the distribution of pixel content obtained in each box is denoted by $n(M, r)$ which will then be used to determine $Q(M, r)$ as the probability distribution of each value in the box obtained from the distribution of distribution per pixel by the maximum total number of The course of the box is denoted by $N(r)$. Furthermore, these two distributions will be processed by the following formula:

$$\Lambda = \frac{\sum_M M^2 Q(M, r) - [\sum_M M Q(M, r)]^2}{[\sum_M M Q(M, r)]^2} \quad (1)$$

With:

$\Lambda(r)$: Lacunarity with box size r .

M : The mass of each pixel that the box passes.

$Q(m, r)$: probability of M in r -square.

DBC method that was developed based on the previous method of Lacunarity is Gliding Box method, commonly used to calculate the value of Lacunarity in binary image. The DBC method was first introduced by Dong on the proposed estimated fractal dimensions of Sarkar and Chaudhuri. In general, Lacunarity calculation using DBC method is done on several window and box sizes [9]. A cube with $r \times r \times r$ size ($r = 3, 5, 7, \dots$) is placed above the top left corner of the image window with the size $W \times W$. For each $r \times r$ -sized Box, the minimum and maximum values of pixels in the box will be Value of u and v . Furthermore from the data will be obtained the relative length of the column, as follows:

$$n_r(i, j) = v - u - 1 \quad (2)$$

Where i and j are image coordinates.

$$M_r = \sum_{i,j} n_r(i, j) \quad (3)$$

With:

M_r : Mass from grayscale image.

$n_r(i, j)$: Relative height of the column with the coordinates i, j .

Color Moments is a method used to distinguish images based on their color features. The basis of this method is the assumption that the color distribution in an image can be expressed as a probability distribution. Therefore, the resulting accuracy is constant even though the image size changes [10]. Color Moments are called compact because they can compress color image information into multiple values. This color extractor does not require quantization in pre-process stages because Color Moments only stores the dominant feature of color distribution in the database. This method uses three main moments of color image distribution, ie mean, standard deviation, and skewness, so this method yields three values for each color component [11]. These three moments can be defined as follows:

$$E = \frac{1}{N} \sum_{j=1}^N P_{ij} \tag{4}$$

$$\sigma_i = \sqrt{\frac{1}{N} \sum_{j=1}^N (P_{ij} - E_i)^2} \tag{5}$$

$$S_i = \sqrt[3]{\frac{1}{N} \sum_{j=1}^N (P_{ij} - E_i)^3} \tag{6}$$

With:

- E : Mean.
- σ : Standard deviation.
- S : Skewness.
- N : Number of pixels.
- i : Current component color index (example: 1 = H, 2 = S, 3 = V).
- j : The order of pixels.
- P_ij : Defines the i-th value of the color component on j-th image pixels.

Data similarity is the relationship of the similarity or proximity of the distance measurement between two data objects. The degree of similarity in the form of a value (score) and based on the value of two data objects will be said to be similar or not. The value of the measurement data similarity will be greater if the compared objects more similar or similar. While data dissimilarity is the level of inequality of measurement between two data objects. The value of data dissimilarity measurement will be lower if the compared object is more similar . The distance used in this research is ecludien distance [12].

$$d_{ij} = \sqrt{\sum_{k=1}^n (x_{ik} - c_{jk})^2} \tag{7}$$

Similar images of the process are analyzed for accuracy using precision. Example: AS (Image retrieved) = 3, AU (image retrieved relevant)= 10.

$$\text{Precision} = \frac{AU}{AS} \times 100\% = \frac{3}{10} \times 100\% = 30\% \tag{9}$$

3. RESULTS AND ANALYSIS

Image processing process is divided into two data insertion and query processing process. There is a knowledge base on the CBIR system that is a training data consisting of a set of vectors characteristic of textures and colors that have been defined.

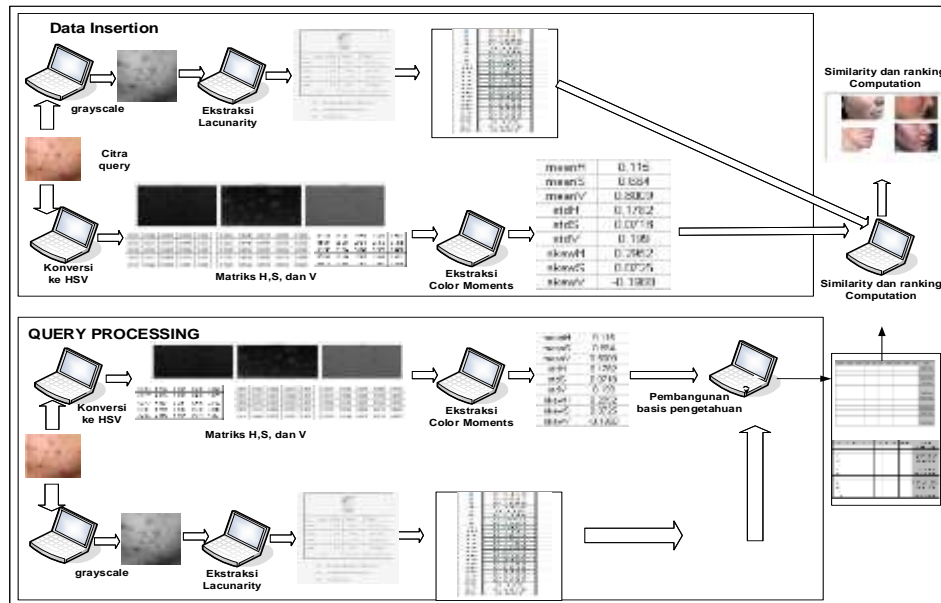


Figure 2. System workflow

The test was conducted to determine the effect of combination of color and texture features in image retrieval performance. Each test performed, calculated its precision value (can be called the value of accuracy). The precision value used is the average precision value of all the images tested in a class. The test results are shown in Table 1.

Tests on the combination of the Color Moments methods Table 1, it is known that the precision values that have been averaged in each class of 10 classes, with the smallest accuracy results showed 35% acne grade and the highest results obtained nummmular, urticaria and vittiligo grades with an accuracy of 100 %. Urticaria and vittiligo classes have the highest precision values between the other image classes because the images in the nummmular, urticaria and vittiligo classes have almost equal color variations of both object and background color. While the acne class has a complex background that affects the results of the extraction process.

Table 1. Test results of Color Moments

No	Class	Precision
1	Acne	35%
2	Acropustulosis	53%
3	Alopecia	70%
4	Dermatitis	88%
5	Hemangioma	53%
6	Ichthyosis	90%
7	Molluscum	50%
8	Nummular	100%
9	Urticaria	100%
10	Vittiligo	100%

Table 2. Test results of Lacunarity

No	Class	Precision
1	Acne	10%
2	Acropustulosis	15%
3	Alopecia	15%
4	Dermatitis	25%
5	Hemangioma	23%
6	Ichthyosis	13%
7	Molluscum	10%
8	Nummular	25%
9	Urticaria	13%
10	Vittiligo	25%

Tests on the Lacunarity method Table 2, with the smallest accuracy result showed 10% acne and molluscum class and the highest result was obtained dermatitis, nummular and vitiligo class with 25% accuracy. This is because the image's similarity to the texture is affected by the decomposition level of an image.

Table 3. Test results Combination of Lacunarity and Color Moments

No	Class	Precision
1	Acne	18%
2	Acropustulosis	25%
3	Alopecia	60%
4	Dermatitis	55%
5	Hemangioma	23%
6	Ichthyosis	53%
7	Molluscum	28%
8	Nummular	15%
9	Urticaria	25%
10	Vitiligo	20%

In Table 3, a two-feature combination test yielded the smallest accuracy in the 15% nummular class and the highest result obtained by the alopecia class with an accuracy of 60%.

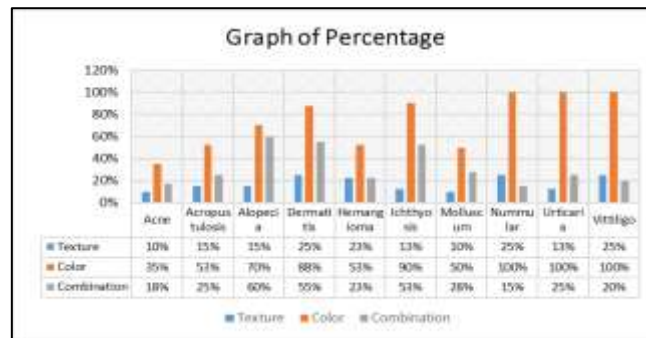


Figure 2. Graph of Percentage

Figure 2 is the percentage graph of the Color Moments, Lacunarity and Combination Methods, showing the precision values that have been averaged on each class of 10 classes, with the smallest precision value of 35% acne grade and the highest result obtained by nummmular, urticaria and vitiligo classes with 100% precision value. The percentage difference is obtained because the images in the nummmular, urticaria and vitiligo classes have almost the same color variations as object color and background color while the acne class has a complex background that affects the extraction process. Lacunarity method, with the smallest accuracy of acne and molluscum 10% and the highest results obtained class dermatitis, nummular and vitiligo with 25% precision value. The difference is caused by the similarity of the image to the texture is affected by the decomposition level of an image. The second combination of combinations of Lacunarity and Color Moments Methods is the smallest precision result in the acne and molluscum classes of 18% and the highest yield in the class of dermatitis, nummular and vitiligo with a precision value of 60%.

4. CONCLUSION

The CBIR technique applied to the developed application is to search for images that have similarities with the specific image criteria of a set of images by performing a comparison between the query image and the image present in the database based on the image content information. Image retrieval using 100 training data and 4 skin disease skin test data with Lacunarity and Color Moments Method for its feature extraction. Based on the results of experiments and analysis of research on the application of both methods in the CBIR application can be drawn conclusion that is, the application performance results are very good if using Color Moments Method to reach 100% accuracy and decreased application performance in Lacunarity Method with the highest accuracy percentage of 25% . Performance when both methods are combined that is the result of

accuracy of 60%. Combination of similarity extraction calculation Methods Color Moments and Lacunarity have better application accuracy compared to texture feature extraction only.

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