Region of interest and color moment method for freshwater fish identification

Gibtha Fitri Laxmi*, Fitrah Satrya Fajar Kusumah
Informatics Engineering Department, Engineering Faculty, Ibn Khaldun University, K.H Sholeh Iskandar Street km 2, Bogor, Indonesia
*Corresponding author, e-mail: gibtha.fitri.laxmi@ft.uika-bogor.ac.id

Abstract

One of the important features in content based image retrieval is color feature. The color feature is the most widely used visual features. Extracting feature image depends on the problem to identify the region or object of interest that is complex in content. This paper presents a methodology to recognize certain freshwater images using region of interest and color feature. In this work, we have considered 7 varieties of freshwater fish, Gourami, Mas/Common carper, Mas Orange, Mas Kancra, Mujair/Java Tilapia, Nila/Nile Tilapia, and Patin. Each variety consists of 20 images. We deployed Color Moment Feature after Region of Interest process to extract the feature. Euclid is used for recognition. Considering only a feature, the classification accuracy of 89% is obtained using color moment. The research technique shows promise for eventually being able to do so, and for the future will help to get important information from the image.

Keywords: color moment, euclid, freshwater fish, identification, region of interest

Copyright © 2019 Universitas Ahmad Dahlan. All rights reserved.

1. Introduction

Indonesia is the largest archipelagic country in the world consisting of 17,504 islands with a long coastline of 95,161 km² and its waters consist of territorial sea, archipelagic waters and inland waters covering 2.7 million km² or 70% of the territory of Indonesia [1]. Indonesia has 1300 species of freshwater fish with a total of 440 species of endemic freshwater fish [2]. Fish are a major source of protein for human body. The presence of freshwater fish species spread throughout Indonesia. Not far from researcher area, many peoples began cultivating the freshwater fish. In process to identify the freshwater, the fisherman needs down to the pool and find one by one which the right fish. Some people have the ability to identify freshwater fish easily, some not. Analyzing the visual input from an image and produces a description to interact, needs technology helps. Technology helps in analyzing the visual input from an image and produces a description to interact with the world. Therefore, to support the people which are utilizing technology for identifying the freshwater fish, we need to develop an identification system that can recognize freshwater fish automatically. This research will become a model base of technology to develop freshwater fish identification.

One of the techniques that can be used to process of identification is image processing. Image of fish that are collected is translated into discrete value and we called it pixels. Pixels value in the image will be processed using Content Based Image Retrieval (CBIR). Content Based Image Retrieval is an image retrieval technique that has similar characteristics or content as well as information contained in images such as colors [3], shapes [4], and textures [5]. Color feature is one that is done to find the information object that is in the image. Color is an important feature that is widely used for image representation [6]. Color is very important because it is invariant in terms of scale, translation, and image rotation. Color space, color quantification, and equality measurement are the main components of color feature extraction.

Considerable research has been done to extract these low level image [7, 8], evaluate distance metrics, and look for efficient searching schemes in image retrieval [9]. From the literature, it is observed that certain work on recognition of freshwater fish characteristics has already been carried out. Problems arise when we don't know the expected area that is containing the important feature. One of the most important things to make sure that the computational pixels aren't spent on unnecessary calculations because color moment has the one dimensional color distribution characterizes with the first three moments [10]. However, no
considerable work is carried out on find region of interest (ROI) from the image. Instead, the entire field image is considered for recognition. In this study, we proposed a method to develop Freshwater Fish identification system using ROI and color moment. This research is important to produce higher accuracy than last research.

2. Research Method

The proposed methodology on implement region of interest and color feature based methodology for classification of freshwater fish is divided into four steps, namely, Image acquisition, Preprocessing, Feature extraction and Classification as shown in Figure 1.

![Figure 1. Proposed methodology](image)

2.1. Image Acquisition

The materials used in this research are images of freshwater fish which consists of 7 classes. All types are taken from fish ponds in Ciseeng area, Kabupaten Bogor, West Java, Indonesia. The image of the freshwater fish is taken through the shooting of several fishes alive for each species. The Images consists of 20 images of each class. The digital Canon 60D camera + L series 16-35 f/2.8 mark II lens is used in this activity. The image on white background is saved in jpg format with size of 300x200 pixels. A total of 140 images are considered for the experimental study. Some of the sample Freshwater fish images which represent are as shown in Figure 2.

![Figure 2. Type of freshwater fish images](image)

2.2. Preprocessing Data

The freshwater fish’ images captured are of 4608x3072 pixels. We have cropped and scaled images. The images are scaled to 200x300 pixels. The cropping process is used to make an image smaller and to eliminate unwanted areas to provide the image with a more
focused working area. The scaling process is used to standardize the range of image size. The Preprocessing image is shown in Figure 3.

![Image 3. Preprocessing image](image)

**Figure 3. Preprocessing image**

2.3. Region of Interest (ROI)

Segmentation process is a highly important tool in image processing. In our view, the most critical step in applying method to this problem is the identification of appropriate features. Nevertheless, at this point of research in image retrieval by content, which the better is using or not using segmentation may be asked. They are used to identify the object in the image and segmentation process in this research is used region of interest. The region extraction process consists of three phases: segmenting image regions, merging regions, and extracting features from regions. This process is done by automatically based on different color quantities. Segmentation steps are performed in this research [11]:

- Quantifies the color of pixels. Quantization is useful for reducing the number of colors in the image. Color variations in objects can be classified according to the same color in their appearance. The quantization value of image segmentation used is black, red, green, and blue which can be seen in Table 1.

- The number of color pixel is calculated on the image center which has a size 20x20 pixel. Two colors of quantization with the number of pixels above 70 are taken, except black. All of the pixels with the quantization color become the object of the image and become a main concern.

- Make a binary image. The area of interest in the image is given a value of 1, while the area that is not taken into calculated is given a value of 0.

Color quantization in this segmentation used black, red, green and blue. Different color quantization parameters produce different main object areas as well. The segmentation process in Table 2 aims to get the main object in simple way. A main object is chosen for the entire evaluation. The results is the object-oriented and will, a priori, be dependent on the object complexity.

| Table 1. Color Quantization Value of Segmentation |
|-----------------------------------------------|
| Segmentation | 0 | 0  | 0 |
| Black         | 255 | 0  | 0 |
| Green         | 0  | 255 | 0 |
| Blue          | 0  | 0  | 255 |

| Table 2. Segmentation Process |
|--------------------------------|
| Segmentation image | Black white image | Main object |
| Seg | | |

| Image 4608 x 3072 | Image Cropping 2984 x 2289 | Image Scalling 200 x 300 |
|-------------------|-----------------------------|---------------------------|
| Skala = \( \frac{300}{4608} \) = 0.065 |
| new height = 4608 \times 0.065 = 300 pixels |
| new width = 3072 \times 0.065 = 200 pixels |

2.4. Feature Extraction

Each image can be viewed as a two-dimensional matrix, instead of being first transformed into a vector, and feature extraction is performed on the original image [12-17]. In this research the image can be viewed as feature extraction on the original image. After representing the region of interest of the image, we must extract the feature of regions.
from the original image to improve the quality of the description of the final identification. In the proposed methodology, the research is carried out considering color features.

2.4.1. Color Moment

In this section, this research will define the color moment which will be used for extract color feature. Color moments have been successfully used in content based image retrieval system, it has shown that characterizing one dimensional color distribution with the first three moments is more robust and runs faster than the histogram based methods [18]. Anusha [19] said color moments are calculated to estimate the brightness and the intensity of the images. The algorithm of color moment to extract the images used color basis, there are mean, standard deviation, and skewness. Moments are calculated for each of these channels in an image. An image is characterized by 9 moments there are 3 moments for each 3 color channels. We will define the \( i \)-th color channel at the \( j \)-th image pixel as \( p_{ij} \). The three moments can then be defined as [20]:

a. Moment-1: Mean. Mean can be understood as the average color value in the image.

\[
E_i = \frac{1}{N} \sum_{j=1}^{N} p_{ij}
\]

b. Moment-2: Standard Deviation. The standard deviation is the square root of the variance of the distribution.

\[
\sigma_i = \sqrt{\frac{1}{N} \sum_{j=1}^{N} (p_{ij} - E_i)^2}
\]

c. Moment-3: Skewness. Skewness can be understood as a measure of the degree of asymmetry in the distribution.

\[
S_i = \frac{1}{\sigma_i^3} \sum_{j=1}^{N} (p_{ij} - E_i)^3
\]

The image in this research has three channels: red, green, and blue. RGB channels roughly follow the color receptors in the human eye, and are used in computer display. The freshwater fish image is composed of three images, and the example of channel matrix. There could be shown in Figure 4.

![Gourami Red Green Blue]

150 155 162 164 169
153 159 161 162 167
161 162 160 164 166
160 164 167 164 163
161 163 161 162 163

99 110 101 104 92
94 99 110 120 101
97 99 105 108 107
98 99 103 106 98
106 105 104 104 98

73 72 75 77 74
66 66 64 68 66
72 69 71 82 75
77 78 83 85 88
82 85 80 79 87

Figure 4. Three channels of freshwater fish

Notice how the grey freshwater fish has similar brightness in all channels, the blue and green color in fish image is much brighter than in the red channel. It means that the blue and green channel more dominated than red. The result of mean describes that low number has similar color variance. The example of Freshwater fish color extraction in Gurame Padang is given in Table 3.
2.5. Classification

Image classification is the task of organizing images into semantic categories based on training data, which can largely improve the efficiency of image retrieval [21-23]. In many image classification tasks, each image is often described by a collection of features that form a high-dimensional space [12]. Input in this research is an image, and the output is similar images from the database. The similarity between two images is measured by calculation the distance between the two images. That distance is calculated form feature vectors, and the feature vectors are constructed from the content of the image [24]. To determine if this approach is useful to classify freshwater fish variants based on color feature into the correct families, this research employ Euclidean Distance. The Euclidean Distance computes distance from query q to class p as [25]:

$$d_i = \sqrt{\sum_{j=1}^{n}(q_j - p_{ij})^2}$$  \hspace{1cm} (4)

2.6. Accuracy

Accuracy is a vital parameter for evaluation as it is a direct measurement of the quality and user satisfaction of the image retrieval process [26]. Accuracy of an image retrieval task is defined as the ratio of the number of relevant images retrieved to the total number of images retrieved expressed in percentage. The accuracy is computed using (5) [27, 28]:

$$\text{Accuracy} = \frac{\text{Number of correctly classified images}}{\text{Total number of testing images}} \times 100\%$$  \hspace{1cm} (5)

3. Results and Analysis

This research is divided into two types of data, there are training data and testing data. It has used a total of 140 images is used for experimentations and selected 28 sample images in random to evaluate color feature. Based on Red, Green and Blue color moment mean, standard deviation and skewness are extracted. The Comparison result of color moment using ROI and without ROI can be shown in Table 4.

Table 3. Result of Color Feature Extraction

| Moments                | Extraction          |
|------------------------|---------------------|
| Mean Red               | 158.1832            |
| Standard deviation Red | 10.5545             |
| Skewness Red           | -14.683             |
| Mean Green             | 146.6319            |
| Standard deviation Green | 25.6302        |
| Skewness Green         | -0.9304             |
| Mean Blue              | 144.1229            |
| Standard deviation Blue | 41.1607         |
| Skewness Blue          | -0.7988             |

Table 4. Feature Extraction Result

| Moments                | Extraction CM | Extraction CM ROI |
|------------------------|---------------|-------------------|
| Mean Red               | 158.1832      | 157.3090          |
| Standard deviation Red | 10.5545       | 16.6666           |
| Skewness Red           | -14.683       | -0.8621           |
| Mean Green             | 146.6319      | 112.7518          |
| Standard deviation Green | 25.6302      | 14.3786           |
| Skewness Green         | -0.9304       | -0.0463           |
| Mean Blue              | 144.1229      | 87.2491           |
| Standard deviation Blue | 41.1607      | 14.8471           |
| Skewness Blue          | -0.7988       | -0.3076           |

Gourami has a good value of standard deviation and skewness. A Smaller standard deviation of Gourami explains that are very close in value to the mean and the value has not a lot of colors varianc. Another value in this case, is type of skewness. Skewness that has been produced is a negative skew (skewed left) with a long tail to the left (lower values), but if the skewness is substantial and the distribution is far from symmetrical (normal distribution). Skewness value that has been produced from extraction feature using ROI, has a negative value near zero, then it becomes nearly the normal distribution. When the normal distribution is important to represent real-valued whose distributions are not known.
The average classification accuracy on each class of 7 classes for Color Moment Feature using ROI is given in Figure 4, with the smallest accuracy obtained by Mas Kancra. The highest result Color moment using ROI obtained by Gurame Padang, Mas Orange, Mas, Mujair, Nila, and Patin classes with 100% accuracy value. Color Moment method without ROI gave one class with the highest accuracy. The color moment method applied to the Freshwater fish Identification problem gave the results presented in Figure 5. The result using ROI has given good result which has obtained an average accuracy of 89% and without ROI is 61%. Our experimental results demonstrate that the proposed method has higher accuracy than before. The experiment also shows that ROI is important to get the specific main object. Since the image has lot of information, this would confuse the system and made poor accuracy result. ROI the images could reduce the unwanted information of an image. There is a considerable increase in accuracy when color moment using ROI has been implemented.

![CM ROI vs CM](image)

Figure 5. Classification accuracy color moment

4. Conclusion

In this paper, we have proposed an image retrieval method based on color moments and easy to calculate, and they do not add any overhead on the system in the computation. The color feature that we use, it because most of images are dominated with color image, so it is one of the most features that can be taken. To improve the result of identification, we encode amount of information by extracting feature from the main region, called region of interest. Our experimental results demonstrate that the proposed method has higher accuracy than color moments method without region of interest. The improvement of accuracy has reached by 28%. Approach can work successfully on color feature with a specific region and will interest when another feature can be combined. Huge potential research and development of better image retrieval techniques is CBIR system.

Acknowledgement

This paper research was funded by a research grant from Kemenristek DIKTI, and thanks to Ibn Khaldun University, and Engineering Faculty for financial support of the conference and publication.

References

[1] Lasabuda R. Regional Development in Coastal and Ocean in Archipelago Perspective of The Republic of Indonesia. *Jurnal Ilmiah Platax*. 2013; 1:2: 92-101.
[2] Santoso L. Reproductive Biology Fish Belida (Chitala lopis) on the Tulang Bawang River, Lampung. *Berkala Perikanan Terubuk*. 2009; 37(1).
[3] Kodituwakku SR, Selvarajah S. Comparison of Color Features for Image Retrieval. *Indian Journal of Computer Science and Engineering*. 2010; 1(3): 207-211.

Region of interest and color moment method for freshwater fish... (Gibtha Fitri Laxmi)
Thibaut Beghin, James S Cope, Paolo Remagnino, Sarah Barman. Shape and Texture Based Plant Leaf Classification. International Conference on Advanced Concepts for Intelligent Vision Systems (ACVIS). Sydney, 2010; 345-353.

Kusmana Y, Herdiyeni Y. Fusion of Local Binary Patterns Features for Tropical Medicinal Plant. International Conference on Advanced Computer Science and Information System (ICACISIS). 2013; 353-357.

Ritendra Datta, Dhiraj Joshi, Jia Li, James Z Wang. Image Retrieval : ideas, influences, and trends of the new age. ACM Computing Surveys. 2008; 40 (2): 1-60.

Eosina P, Laxmi GF, Fatimah F. The Sobel Edge Detection Techniques for Freshwater Fish Image Analysis. The 4th International Seminar on Sciences. Bogor. 2017.

Sukarman LD. Identification of Freshwater Fish with the Color Moment Feature Method. Thesis. Ibn Khalidun University. Bogor. 2018.

Laxmi GF, Herdiyeni Y, Arkeman Y. Optimization of Fuzzy Local Binary Pattern in Threshold and Operator Selection using Multi Objective Genetic Algorithm. International Conference Computer Control Informatics and its Applications (IC3INA). Jakarta. 2017; 29-34.

Singh SM, Hemachandran K. Content-Based Image Retrieval using Color Moment and Gabor Texture Feature. International Journal of Computer Science. 2012; 9(5): 299-309.

Balqis DP. Fuzzy Color Histogram for Flower Images Retrieval. Thesis. Bogor: Mathematics and Science Faculty. Bogor Agricultural University. 2006.

Zhang W, Xue X, Sun Z, Guo YF, Chi M, Lu H. Efficient Feature Extraction for Image Classification. IEEE. 2007.

Yang J, Zhang D, Frangi A, Yang JY. Twodimensional pca: a new approach to appearance-based face representation and recognition. IEEE Trans. on PAMI. 2004; 26(1): 131-137.

Ye J, Janardan R, Li Q. Two-dimensional linear discriminant analysis. In NIPS, Cambridge, MA. 2004.

He X, Cai D, Niyogi P. Tensor subspace analysis. In NIPS, Cambridge, MA. 2005.

Chen HT, Chang HW, Liu TL. Local discriminant embedding and its variants. In CVPR. 2005.

Yan S, Xu D, Zhang B, Zhang HJ, Yang Q, Lin S. Graph embedding and extensions: A general framework for dimensionality reduction. IEEE Trans. on PAMI. 2007; 29(1): 40-51.

M Stricker, Orengo M. Similarity of color images. SPIE Conference on Storage and Retrieval for Image and Video Databases. San Jose. 1995; 2420: 381-392.

Anusha V, Reddy VU, Ramashti T. Content Based Image Retrieval Using Color Moments and Texture. International Journal of Engineering Research & Technology (IJERT). 2014; 3(2): 2812-2815.

Keen N. Color moments. School Of Informatics, University Of Edinburgh. 2005.

Nga W, Doradooc A, Yeunga DS, Pedryczd W, Izquierdoc E. Image classification with the use of radial basis function neural networks and the minimization of the localized generalization error. Pattern Recognition. 2007; 40:19–32.

Chapelle O, Haffner P, Vapnik VN. Support vector machines for histogram-based image classification. IEEE Trans. on Neural Networks. 1999; 10(5):1055–1064.

X Qiu, L Wu. Boosting image classification scheme. ICME. 2004.

Sarker IH. Contect-based Image Retrieval Using Haar Wavelet Transform and Color Moment. Smart Computing Review. 2013; 3(3): 155-165.

Deza E, Michel M. Encyclopedia of Distances. Springer. 2009; 94.

Chadha A, Mallik S, Johar R. Comparative Study and Optimization of Feature-Extraction Techniques for Content base Image Retrieval. International Journal of Computer Applications. 2012; 52(20): 35-42.

Ester Bernado M, Josep MG. Accuracy Based Learning Classifier Systems : Models, Analysis and Applications to Classification Tasks. Evolutionary Computation. 2003; 11(3): 209-238.

Elhariri E, El-Bendary N, Hassanien AE. Plant classification system based on Leaf Features. IEEE. 2014; 271-276.