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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*

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1. Introduction

Indonesia is the largest archipelagic country in the world consisting of 17,504 islands with a long coastline of 95,161 km^2 and its waters consist of territorial sea, archipelagic waters and inland waters covering 2.7 million km 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

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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.

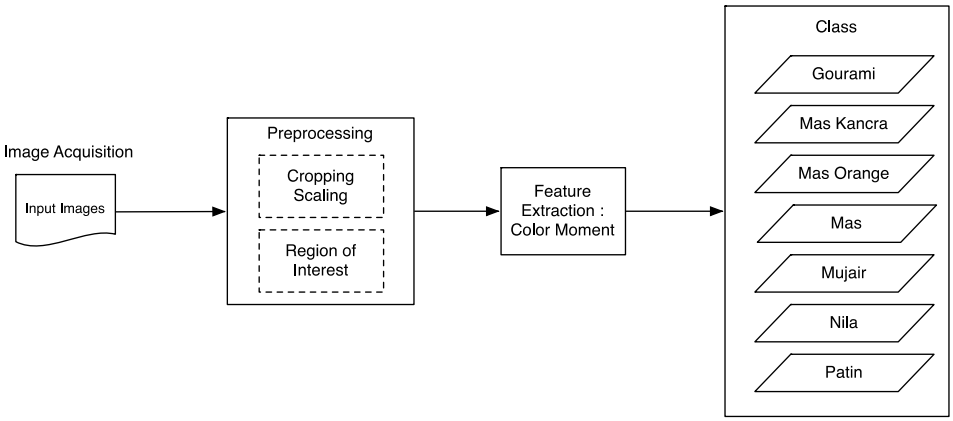


Figure 1. Proposed methodology

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 the Figure 2.

Figure 2. Type of freshwater fish images

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.

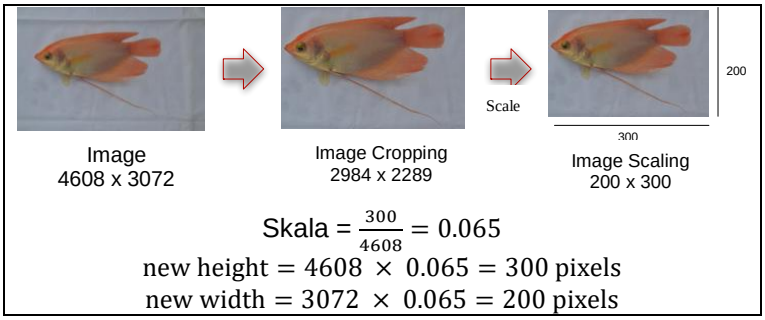


Figure 3. Preprocessing image

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]:

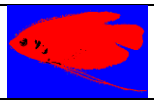
- Quantifies the color of pixels. Quantization is useful for reducing the number of colors in the image. Color variations in objects can be classified according to the same color in their appearance. The quantization value of image segmentation used is black, red, green, and blue which can be seen in 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
255	0	0
0	255	0
0	0	255

Table 2. Segmentation Process

	Segmentation image	Black white image	Main object
Seg			

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.

$$E_i = \sum_{j=1}^{N} \frac{1}{N} p_{ij} \quad (1)$$

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

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

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

$$S_i = \frac{\frac{1}{N} \sum_{j=1}^{N} (P_{ij} - E_i)^3}{\sigma_i^3} \quad (3)$$

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.

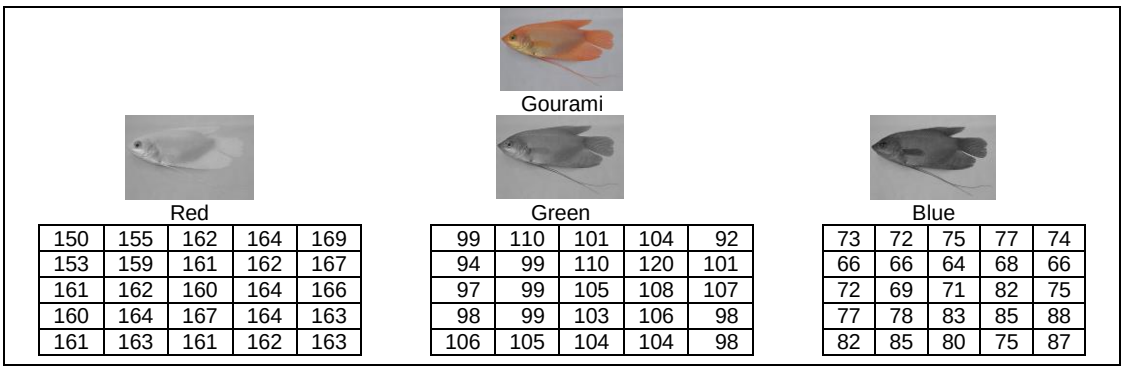


Figure 4. Three channels of freshwater fish

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]:

$$d_i = \sqrt{\sum_{j=1}^{n}(q - p_{ij})^2} \quad (4)$$

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]:

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

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 Tabel 4.

Table 3. Result of Color Feature Extraction

Gourami

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 variance. 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.

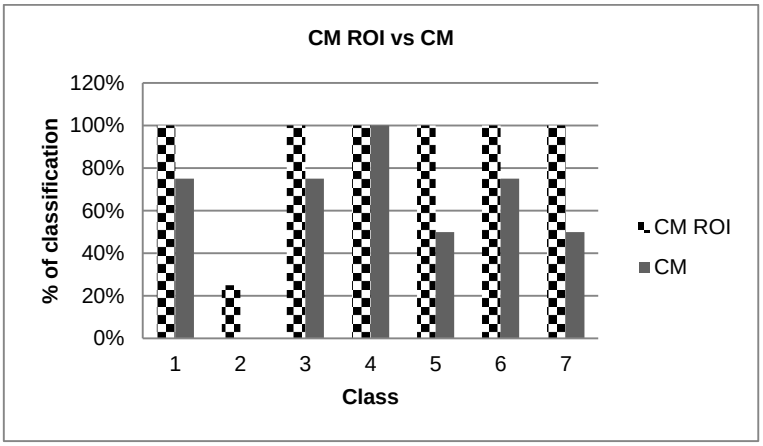


Figure 5. Classification accuracy color moment

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.

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