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Java Sparrow Bird Sex Detection Through Texture Analysis and Beak Image Color

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ABSTRACT

Java sparrow is a member of a monomorphic group. Males and females have a physical appearance that looks the same, especially the color of their fur. Limited information regarding the characteristics and behavior of male and female Java sparrows can cause problems regarding sex determination, causing delays in normal mating. Further impact on the crossbreeding efforts of Java sparrow. This study aims to determine the sex detection process of Java sparrow through color and texture analysis of Java sparrow beak image with classification method using ANFIS and determine the level of accuracy. In this study there are 3 stages, namely preprocessing, learning stages and testing stages. The results of the Java sparrow sex detection accuracy through texture and color analysis of beak images using the ANFIS method are 90%. This shows that texture and color can be used to detect the sex of Java sparrow

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INTRODUCTION

Java sparrow (*Lonchura oryzivora*) is endemic to Bali, Java and possibly the island of Madura off East Java, Indonesia. Within its natural range, the species is classified as Endangered, with many populations being wiped out as a result of hunting and trapping (Rosyadi *et al*., 2019).

One of the most popular birds is the java sparrow, due to its contrasting patterned plumage, distinctive white cheeks, and large pink bill (Gregson and Bowkett, 2020) and chirping sweetly (Soma and Mori, 2015). Java sparrow birds are sometimes competed for color and song in various countries including Indonesia. The breeders continue to innovate to produce new colors through crosses. Java sparrow is a member of a monomorphic group, namely males and females have the same appearance, especially the color of their feathers (Suratno *et al*., 2011).

The sex of the Java sparrow is important to know for purposes in the field of breeding, namely determining males and females as brooders, as well as installing males and females in one cage in captivity. The problem is, sex determination is difficult when the Java sparrow has not yet reached maturity. This has caused almost some breeders to fail in their efforts to determine sex.

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Certainty identification of species, individuals and sex is very important in the study of ecology and its application in conservation biology. However, information about gender and its ratio in a population is still very limited. One reason is the difficulty in identifying them. More than half of bird species are monomorphic, between male and female species it is difficult to distinguish directly (based on external morphology). The methods that have been developed to identify the sex of birds are inefficient and some pose a high risk (Cerit and Avanus, 2007).

To determine the sex of monomorphic birds, DNA techniques have been developed. With various methods based on this DNA technique (Liu *et al*., 2011). The technique uses genes located on the sex chromosomes. Female birds have a Z and a W chromosome, while males have two Z chromosomes. Several molecular markers have been used for this technique (Nugraheni *et al*., 2019).

In this study, the technique of detecting sex was tried through image processing of the Java sparrow's beak.

MATERIALS AND METHODS

Physical condition Java sparrow is a member of a monomorphic group, i.e. males and females have the same appearance. For experienced breeders, they detect the sex of the Java sparrow by looking at the color and texture of the beak. This means that the male and female Java sparrow beaks have different colors and textures, although they are difficult to see with the naked eye. This will be more accurate, if through digital image processing in this case using the Matlab tool (Chandankhede, 2012).

The half image in this study is a digital image, which in image processing theory, before the image continues at the image analysis stage, it must be free from interference

or noise, to be free from noise a filter is used, in this study the filter used is the median filter. After the image is free from noise, the image is ready for color and texture analysis to obtain the characteristics of the image.

The characteristics of the beak color obtained from color analysis can describe the state of the beak (quality and quantity), in this study the color image used is the RGB model. Texture analysis is also able to describe the state of the beak (quality and quantity). The texture characteristics of feature extraction using statistical methods include mean, variance, skewness, kurtosis and entropy, where the texture feature value is the value of the beak image pixel analysis that can be used to distinguish between male Java sparrows and female Java sparrows. These characteristics are then used to detect the gender of the Java sparrow.

After obtaining the RGB color image values and texture characteristics of each java sparrow beak image, then proceed with classifying the java sparrow beak image into 2 groups (male and female groups) using Adaptive Neuro Fuzzy Inference System (ANFIS) analysis.

The training data consisted of 30 data consisting of 15 images of male Java Sparrow beaks and 15 images of female Java Sparrow beaks. Test data, 10 data consisting of 5 male Java Sparrow data and 5 female Java Sparrow data.

The following is a Java sparrow gender detection flow chart which consists of database creation and testing process (Fig. 1).

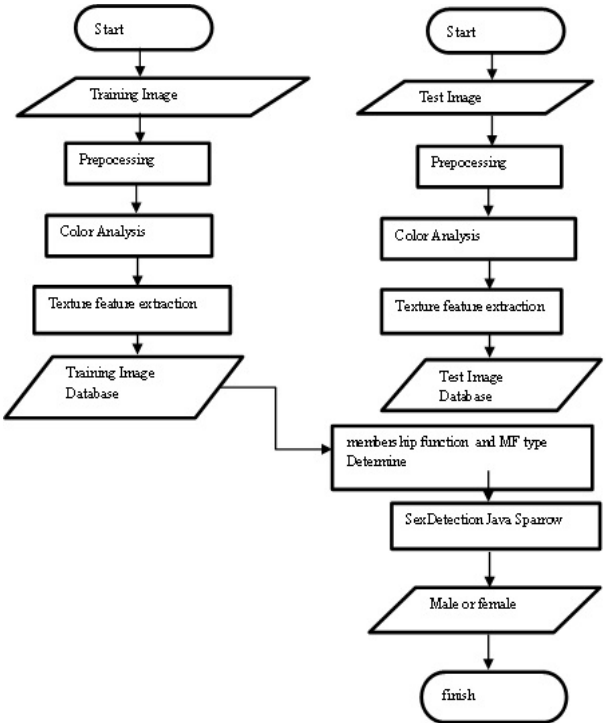

Fig. 1. Flowchart of database creation and sample test.

RESULTS

Java sparrow bird beak image preprocessing

Preprocessing is a step that is carried out before conducting color and texture analysis (statistical feature extraction) namely filtering and cropping image (Fig. 2)

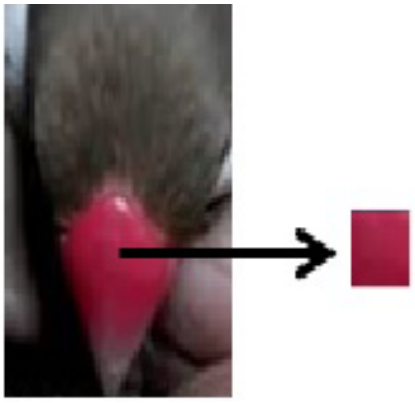

Fig. 2. Beak image of java sparrow.

Color analysis and statistical feature extraction

This color analysis uses the RGB color model. The RGB level bit pattern is composed of these three colors and each color has 28 or 256 (0-255). RGB color model that can be expressed in the form of an RGB color index by normalizing each color component with the following equation (Sanda *et al*., 2016):

$$r = \frac{R}{R+G+B} \quad \ldots(1)$$

$$g = \frac{G}{R+G+B} \quad \ldots(2)$$

$$b = \frac{B}{R+G+B} \quad \ldots(3)$$

Texture feature extraction is a feature observation method based on the histogram characteristics of the image. The histogram shows the probability of occurrence of the gray level value of pixels in an image (Dixit and Hegde, 2013). From the values in the resulting histogram, several first-order characteristic parameters can be calculated, including the mean, skewness variance, kurtosis, and entropy (Bataineh *et al*., 2012).

Mean (μ)

Shows the size of the dispersion of an image

$$\mu = \sum_{n} f_n \, p(f_n) \quad \ldots(4)$$

Where fn is a gray intensity value, and p(fn) shows the histogram value (probability of intensity occurrence in the image).

Variance (σ2)

Shows variations in the histogram elements of an image.

$$\sigma^2 = \sum_n (f_n - \mu)^2 \; p(f_n) \quad \ldots (5)$$

Skewness (α3)

Shows the level of relative inclination of the histogram curve of an image.

$$\alpha_3 = \frac{1}{\alpha^3} \sum_n (f_n - \mu)^3 \; p(f_n) \quad \ldots (6)$$

Kurtosis (α4)

Shows the relative sharpness of the histogram curve of an image.

$$\alpha_4 = \frac{1}{\alpha^4} \sum_n (f_n - \mu)^3 \; p(f_n) - 3 \quad \ldots (7)$$

Entropy

Shows the size of the irregular shape of an image.

$$H = - \sum_n p(f_n). \quad ^2\log p(f_n) \quad \ldots (8)$$

Color analysis and statistical feature extraction

The extracted images for the training trait database were 25 male and female Java sparrow beak images, while the extracted images for testing were 10 male and female Java sparrow beak images. The texture features were extracted by statistical feature extraction method. Table I shows a color analysis covering the average red, green, and blue values.

The beak image also extracted its statistical characteristics, namely the mean, variance, skewness, kurtosis and entropy values (Table II).

Table I. Color analysis table.

Color analysis	Java sparrow beak image	
	Female	Male
Red	194,342	192,076
Green	74,716	86,847
Blue	67,820	78,016

Table II. Statistical feature extraction.

Texture analysis	Java sparrow beak image	
	Female	Male
Mean	102,896	116,408
Variance	15,245	16,151
Skewness	-12,225	-13,142
Kurtosis	485,173	494,923
Entropy	3,035	3,297

Test results using the neuro fuzzy inference system (ANFIS)

In Table III, it shows that out of 10 test data, 9 data is right on target and one data is not on target.

Table III. ANFIS test results.

data to	Java sparrow beak image	
	Target	Introductory results
1	Male	Male
2	Male	Male
3	Male	Male
4	Female	Female
5	Female	Female
6	Female	Female
7	Female	Female
8	Male	Female
9	Male	Male
10	Female	Female

DISCUSSION

Differences in Java sparrow beak image can be analyzed using color analysis and texture analysis. Based on the research results, is known that the most dominant factor influencing the difference between male and female Java sparrows is the average green and blue values. This shows that the brightness and contrast levels of the Java sparrow beak image between males and females are found in the green and blue components. Meanwhile, the brightness and contrast levels of the red components tend to be the same, because the Java sparrow's beak color is close to red.

From the texture analysis that has been carried out, namely statistical feature extraction, it is known that the value of statistical feature texture analysis that most distinguishes between male and female Java sparrows is the mean value and kurtosis value. The mean value and kurtosis of male Java sparrow beak images are greater than that of female Java sparrows. This indicates that the dispersion measure of the gray intensity of the male Java sparrow image is quantitatively higher than that of the female Java sparrow and the relative sharpness of the histogram curve produces a clear value between the male and female groups. While the variation of elements in the histogram, the relative slope of the histogram curve, and the regularity of the image shape has similarities to the male and female Java sparrow beak images.

Table I shows the average red, green, and blue values for the Java sparrow half image, from these data average red value of female Java sparrow beak image=194,342,

while the average red value of the Java sparrow half image males=192,076 the difference between the two is about 2,266. Then the average green value of the female Java sparrow beak image=74,716, male=86,847 so the difference between the two=12,131. Furthermore, the average blue value of female Java sparrow beak images=6,820, males=78,016 the difference is about 10,196. The results of these calculations show that the most dominant factor that differs from male and female Java sparrows is the average value of green and blue. This indicates that the brightness and contrast levels of the Java sparrow beak image between males and females are found in the green and blue components. Meanwhile, the brightness and contrast levels of the red components tend to be the same, because the beak color of Java sparrow is close to red.

Congested Table II shows the average values of mean, variance, skewness, kurtosis, and entropy of male and female Java sparrow beak images. Judging from the table, the mean value of the image of the female Java sparrow beak=102,896 males=116,408 the difference is around 13,512. The average value of the variance of the female Java sparrow beak image=15,245 males=16,151 the difference is only 0,906. The average value of the skewness of the female Java sparrow beak image=12,225, the male=13,142 the difference is 0.917. The average value of female Java sparrow beak image kurtosis=485,173, male=494,923 the difference=9,75. The average value of the image entropy of the female Java sparrow beak=3,035, male=3,297 the difference is 0,262. From the calculation results, it is known that the most different texture values between male and female Java sparrows are the mean value, and the kurtosis value. The mean value and kurtosis of male Java sparrow beak images are greater than that of female Java sparrows. This indicates that the dispersion measure of the gray intensity of the male Java sparrow image is quantitatively higher than that of the female Java sparrow and the relative sharpness of the histogram curve produces a clear value between the male and female groups. Meanwhile, the variation of elements in the histogram, the relative slope of the histogram curve, and the regularity of the image shape are similar to the male and female Java sparrow beak images. The more similar they are, the harder it is to tell them apart. This indicates that the dispersion measure of the gray intensity of the male Java sparrow image is quantitatively higher than that of the female Java sparrow and the relative sharpness of the histogram curve produces a clear value between the male and female groups. While the variation of elements in the histogram, the relative slope of the histogram curve, and the regularity of the image shape have similarities to the male and female Java sparrow beak images. The more similar they are, the harder it is to tell them apart. This indicates that the dispersion measure of the gray intensity of the male Java sparrow image is quantitatively higher than that of the female Java sparrow and the relative sharpness of the histogram curve produces a clear value between the male and female groups. Meanwhile, the variation of elements in the histogram, the relative slope of the histogram curve, and the regularity of the image shape are similar to the male and female Java sparrow beak images. The more similar they are, the harder it is to tell them apart.

The use of image texture analysis is increasingly being used for various purposes. Texture analysis study for quail sex detection, the results are very good (Mehdizadeh *et al*., 2014). Texture analysis and ANFIS have also been carried out to determine the type of rice (Pazoki *et al*., 2014; Mandal, 2019). Texture Analysis for wheat type detection (Sabanci *et al*., 2017). Using ANFIS to locate tumors (Sharma and Mukharjee, 2013), for blood cell classification (Rawat *et al*., 2018). For the detection of abnormalities in brain MRI images (Shankar *et al*., 2020) and so forth.

This study shows that the color and texture features of the beak image can be used to detect the sex of the java sparrow.

CONCLUSION

Based on the research that has been done, it can be concluded that color analysis parameters that have the potential to be used in gender detection for Java sparrow are the average green value, and the average blue value. These values describe the contrast and brightness levels of the Java sparrow half image. The statistical feature extraction parameters that have the potential to be used to detect the sex of java sparrow are the mean value and kurtosis. Mean shows the size of the dispersion of an image. The larger the mean value, the larger the size of the dispersion. Kurtosis shows the tapering of the histogram. The two parameters have a large enough difference so that it can detect the gender of the Java sparrow. The results of the Java sparrow gender detection program accuracy through texture and color analysis of beak images using the ANFIS method are 90%.

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Statement of conflict of interest

The authors have declared no conflict of interest.

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