Jurnal Sisfotek Global
ISSN (Online): 2721 - 3161, ISSN (Print): 2088 – 1762
DOI: http://dx.doi.org/10.38101/sisfotek.v13i1.3442
Vol. 13, No. 1, March 2023, pp. 41-45

Recognition of Chicken Species through Sound Using Weierstrass Transform

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ARTICLE HISTORY

Received : February 28th, 2023
Revised : March 28th, 2023
Accepted : March 30th, 2023

KEYWORDS

Voice Recognition
Ornamental Chicken
weiertrass transform

ABSTRACT

Voice recognition is an applied technique in the field of digital signal processing that has been widely used, such as technology in the field of telecommunications which is now able to provide data transmission services not only text but can also serve data transmission using voice. Speech recognition studies to date have only focused on human speech recognition, so it is important to develop research on speech recognition in animals. In this research a speech recognition system will be developed for balenggek, pelung and bekisar ornamental chickens using the Delphi 7 programming language and the weiertrass transform method. The performance evaluation measurement of the speech recognition system in this study uses two parameters, namely the detection rate and the false positive rate. The results showed that the speech recognition system for ornamental chickens using the weierstrass transform method had an average detection rate of 83.00% and an average false positive rate of 16%.

1. Introduction

Technological developments in the field of computer science, especially those that study voice recognition, are currently growing and have a positive impact on human life. In general, voice recognition is used to recognize someone based on their voice [1][2][3]. Speech recognition can help users or humans match previously validated voices and verify the suitability of voices with the original user's voice [4][5]. Research on speech recognition systems has been carried out by several previous researchers, such as [6] in his research testing voice recognition with the output of 7 voice commands. Similar research was also carried out by [7] applying Indonesian speech recognition to support forensic acoustics. Furthermore, it was carried out by [8] applying the MFCC method to speech recognition on basic verbs, but the studies that have been carried out have only focused on human speech recognition. Voice recognition systems can be developed with various applications to facilitate human life [9] one of which is the speech recognition system for ornamental chickens, due to the difficulty in distinguishing the sounds of ornamental chickens of the balenggek, pelung and ranged chicken types, it is important to have a voice recognition system for types of chickens. decoration to make it easier to recognize the authenticity of the sound. Weierstrass transform has been studied by several previous researchers, such as: [10] Discussing solutions to solving the two-dimensional diffusion equation using the weierstrass transform, where the calculation process can simplify differential equations. Similar research was also carried out by [11] in his research using the weierstrass transform to find solutions to partial differential equation problems that have hyperfunction solutions. Furthermore [12] in his research suggested the invariant nature of the roughness index of the Weierstrass transform function when generalized with fractional trigonometry functions is able to simplify the calculation process. Based on this description, in this study the speech recognition system will be built using the Delphi 7 programming language and the weierstrass transform method, the selection of the weierstrass transform method in this study is to reduce the complexity of the speech recognition system and to reduce excessive memory usage on computers so that the computational process is more efficient.

2. Research Method

In this study, the speech recognition system process consisted of collecting data on the voices of balenggek chickens, pelung chickens and ranged chickens consisting of 3 types of sounds with a frequency of 16,000Hz and in WAV format. Voice data collection uses a microphone device and the help

of Adobe Audition 1.5 recording software with a maximum recording duration of 10 seconds. The collected sound is removed by noise reduction which aims to get the original sound without noise. If it is not needed, the voices are prepared for the speech data training stage using the Weiertrass transformation with iterating over the number of sound files so that the voices can be registered or labeled. After the training stage is carried out, the energy value that has been trained is obtained which will be used as a reference pattern, the next step is the sound testing stage where the sound is matched with the Weiertrass transformation stored in the database.

2.1 Research Stage

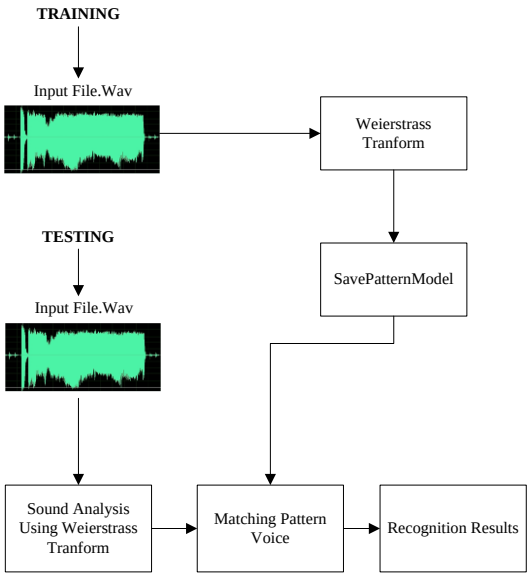

Figure 1. Research Stages [13][14][15]

The overall research steps in this study are shown in Figure 1. At the training stage after the system receives audio.wav input, pre-processing will be carried out with the weierstrass transform. Furthermore, the system will save the pattern model to be used as a reference pattern in the testing process. Whereas in the testing phase after the system receives audio.wav input, an analysis will be carried out using the Weierstrass transform, then the system will match the pattern model with the reference pattern and classify the sound of ornamental chicken species.

2.3 Data Collection

In this study, the sampling data used was audio.wav which was processed through a microphone and recording software Adobe Audition 1.5 with a maximum recording duration of 10 seconds. The data-sharing structure can be seen in table 1

Table 1. Training and test data sharing structure
Chicken sound data

Dataset	Training	Testing	Validation
Chicken Balenggek	20	60	20
Chicken Pelung	20	60	20
Chicken Berkisar			

In table 1 it can be seen the structure of the data sharing carried out in this study. In the Balenggek chicken data, the number of sounds used in training was 20 voices and 60 voices tested and 20 validation data, while in the pelung chicken data the number of voices used in training was 20 voices and 60 voices tested and 20 validation data and in Data on the type of chicken ranged were carried out in this study. In the data on the type of balenggek chicken, the number of sounds used in training is 20 sounds and 60 sounds tested and 20 validation data.

2.4 Performance Evaluation

Confusion Matrix, the metric is explained in advance that TP (True Positive), TN (True Negative), FP (False Positive) and FN (False Negative) according to Table 2 TP stands for because positive data is predicted positive, TN is defined as negative data predicted as negative. Even though FN is the opposite, TP is positive data that is predicted to be negative and FP, the opposite of TN, that is, negative data is predicted to be positive.

Table 2 Confusion Matrix

		Actual class	
		Positive	False Positive
Predictions	Positive	True Positive	False Positive
	Negative	False Negative	True Negative

The study will utilize several evaluation metrics, including Accuracy, Precision, Recall, and F1-score. Accuracy is a straightforward performance measure that calculates the proportion of accurately predicted observations out of the total number of observations. Precision, on the other hand, calculates the ratio of correctly predicted positive observations to the total number of predicted positive observations. Recall calculates the proportion of correctly predicted positive observations from all observations in the actual class. F1-score considers both false positives and false negatives, and is a weighted average of precision and recall.

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad (1)$$

$$Precision = \frac{TP}{TP+FP} \quad (2)$$

$$Recall = \frac{TP}{TP+FN} \quad (3)$$

$$F1 - Score = 2x\frac{Precision\ x\ Recall}{Precision+Recall} \quad (4)$$

3. Results and Discussion

3.1 System Analysis

The results discussed include system training and system testing using the Weierstrass transform method with two parameters detection rate and a false positive rate to see the level of recognition accuracy in decorative chicken sounds. In the process system training, the calculation of the matrix value of the original sound file uses the weierstrass transform method to obtain the energy value of the sound file, then the speech recognition results will be stored in the database to be used as a reference pattern in the testing process. Whereas in the system testing process the steps in the system testing process are the same as the training process where the matrix value of the sound file is processed using the weierstrass transform method to obtain the energy value then the sound energy value will be compared with the energy value in the training process which was previously stored in the database. The approach or similarity in energy values will be a reference for the recognition of decorative chicken sounds, this is also called a statistical approach.

3.2 User Interface

In this program there are two processes, namely the first process for training the sound of decorative balenggek, range and pelung chickens while the second process is for sound recognition testing. The decorative chicken speech recognition program interface can be seen in Figure 2 for training and Figure 3 for testing.

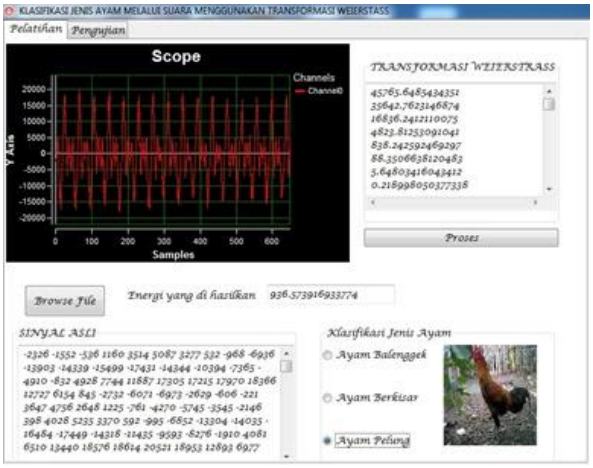

Figure 2. Voice Recognition Training Program Interface

In Figure 2 you can see the interface display of the voice recognition training system in this study. The first step is to browse the file to enter the .wav sound file that has been saved, then calculate the matrix using the Weierstrass transform and select the type of decorative chicken sound to be stored in the database.

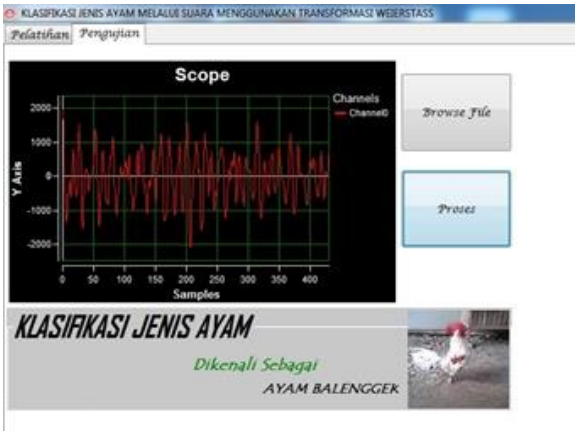

Figure 3. Voice Recognition Testing Program Interface

In Figure 3 you can see the interface of the speech recognition testing system in this study. The first step is to browse the file to enter the .wav sound file that has been saved, then the process uses the Weierstrass transform to get the sound results that are recognized.

3.3 Evaluation Model

In this study, system performance measurement is based on all test data that is correlated with the number of training datasets. The results of measuring system performance can be seen in table 2

Table 2. Performance Results of the Ornamental Chicken Sound Recognition System

	Chicken Balenggek	Chicken Pelung	Chicker Berkisar
Chicken Balenggek	44	5	11
Chicken Pelung	1	57	2
Chicker Berkisar	7	4	49

In table 2 it can be seen the trials that have been carried out in this study. In testing the sound of balenggek chickens where the system can recognize 44 sounds and 16 sounds are not detected, whereas in testing the sound of pelung chickens where the system can recognize 57 sounds and 3 sounds are not detected then in testing chicken sounds it ranges where the system can recognize 49 sounds and 11 sounds not detected.

Tabel 3. Model evaluation results

	Accuracy	Precision	Recall	F1-Score
Chicken Balenggek	0.73333 3333	0.84615 3846	0.733 333	0.785 714
Chicken Pelung	0.95	0.86363 6364	0.95	0.904 762
Chicker Berkisar	0.81666 6667	0.79032 2581	0.816 667	0.803 279
Average Score	0.83333 3333	0.83337 093	0.833 333	0.831 252

Table 3 shows the results of the model evaluation that was carried out in this study using the Weierstrass transform method. In the balenggek chicken sound test, the results were Accuracy: 0.73, Precision: 0.84, Recall: 0.73 and F1-Score: 0.78. Whereas in the pelung chicken sound test, the results were Accuracy: 0.95, Precision: 0.86, Recall: 0.95 and F1-Score: 0.91. Furthermore, in the chicken sound trial, the results ranged from Accuracy: 0.81, Precision: 0.79, Recall: 0.81 and F1-Score: 0.81.

4. Conclusion

The use of the weierstrass transform method in the speech recognition system shows very satisfactory results with an average detection rate of 83.00% and a false positive rate of 16%. The success rate of testing on this system is not only supported by the performance of the sound samples of balenggek, pelung and berkisar chickens but is also influenced by the removal of sound noise when the test is carried out because too much noise will reduce the level of similarity in sound reference patterns that have been stored in the database. The percentage detection rate indicates that this method can be used as an approach to support speech recognition of ornamental chicken species.

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