Halleluyah Aworinde & Segun Adebayo

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LEVERAGING TINYML FOR ACOUSTIC-BASED POULTRY HEALTH MANAGEMENT

Research Talk Presented at the Workshop on widening access to TinyML Network by Establishing Best Practices in Education held at ICTP, Trieste, Italy (July 3 – 7 2023)

This is Bowen University!

- A 22-year-old foremost private University in Nigeria
- Located on a hill
- About 4hours drive from Lagos
- Average population of 5000 students

Some of our Previous activities

- Leveraging Radio Telemetry and Data Analytics to track Fruit Bat Movement Pattern (Data Science Africa Research Grant)
- K'eyemaba: Pest Detection and Prevention using Unmanned Aerial Vehicle on Rice Farmland
- CNN-Based Crop disease detection on Cassava Farm
- Organised TinyML workshop bringing some students from four different Universities together for two days

Our works and challenges are geared towards providing solution to local challenges which can be scaled for global usefulness– ***Glocalization of ideas!***

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The Basis

Increase in consumption of animal products such as meat, milk and eggs in Nigeria but decline in production of these sources of protein

Growing concern of increasing food production by 25% to meet the needs of the growing population

Major source of protein – poultry farms are faced with health challenges which leads to economic loss in poultry farm

Hence, the need for early detection and prevention of poultry related health challenges

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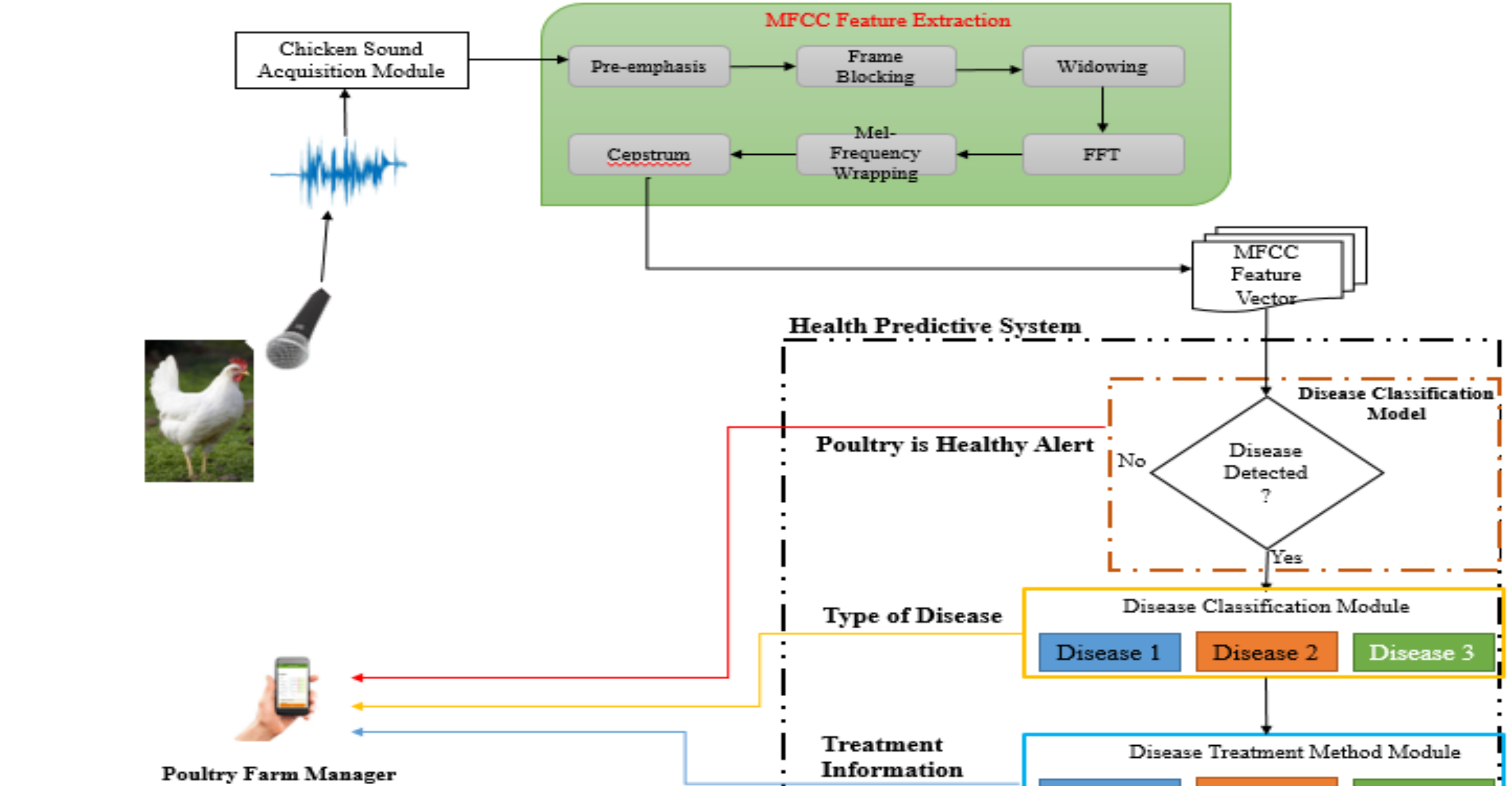
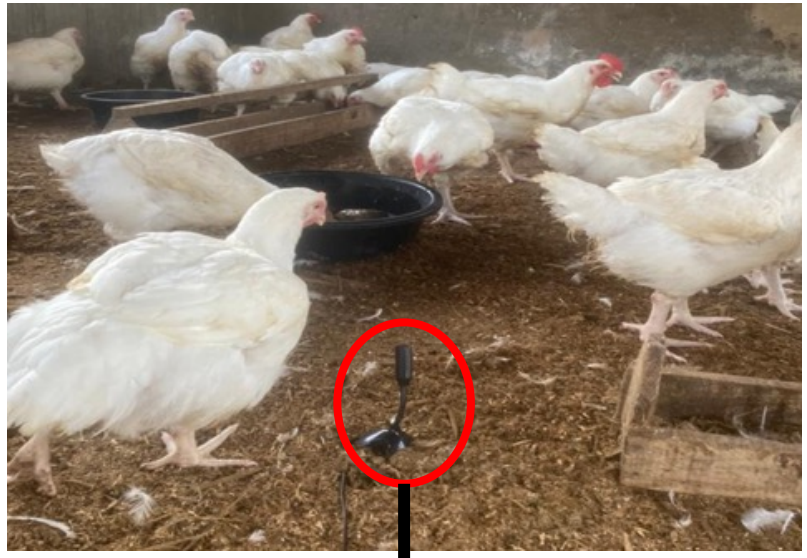
Our Focus

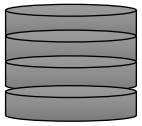
Paucity of Publicly available datasets on Environmental Sound Classification

Most studies so far focus on specific species of chicken with many of these datasets not publicly available in open-source repository such as GitHub, Kaggle, etc.

The work is set out to achieve gathering and annotation of large dataset of poultry vocals and acoustics under varying weather conditions for the purpose of stress detection and prevention to mitigate loss and thereby, maximize profit on poultry farms


Chicken Sound Acquisition Module
MFCC Feature Extraction
Pre-emphasis
Frame Blocking
Widowing
FFT
Mel-Frequency Wrapping
Cepstrum
MFCC Feature Vector
Health Predictive System
Disease Classification Model
Poultry is Healthy Alert
No
Disease Detected ?
Yes
Type of Disease
Disease Classification Module
Disease 1
Disease 2
Disease 3
Treatment Information
Disease Treatment Method Module
Poultry Farm Manager





Preprocessing

Healthy Sound

Unhealthy Sound

Noise Sound

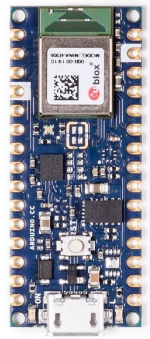
Day Old

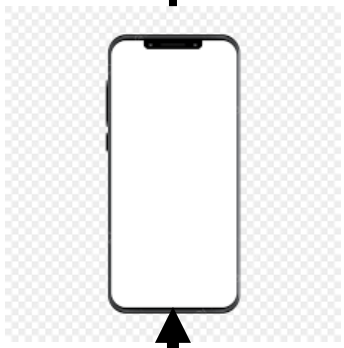
A total of 100 broiler chickens were collected and divided into two groups of 50 each. One of the group were treated for diseases while the other were not.

2 Weeks Old

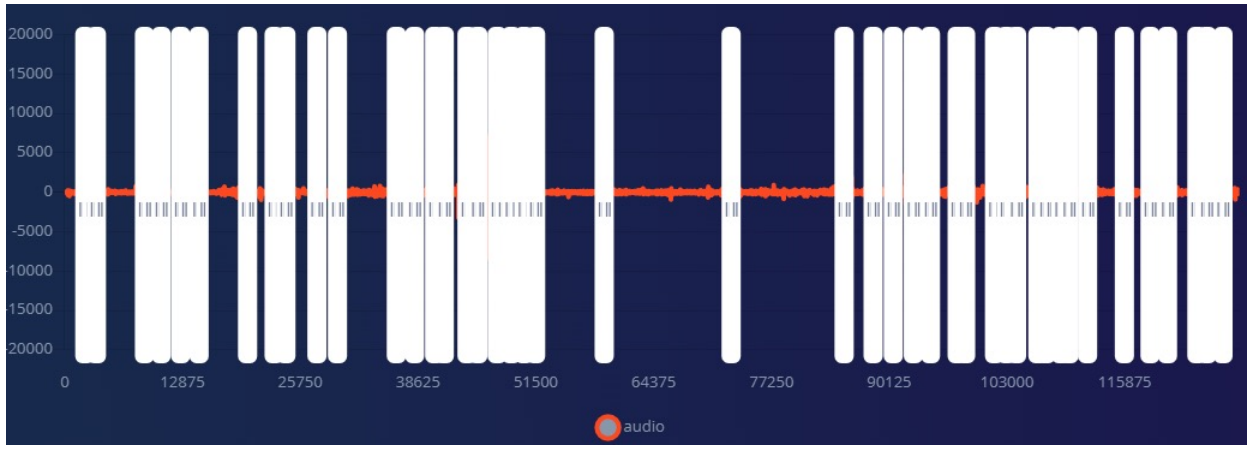
8 Weeks Old

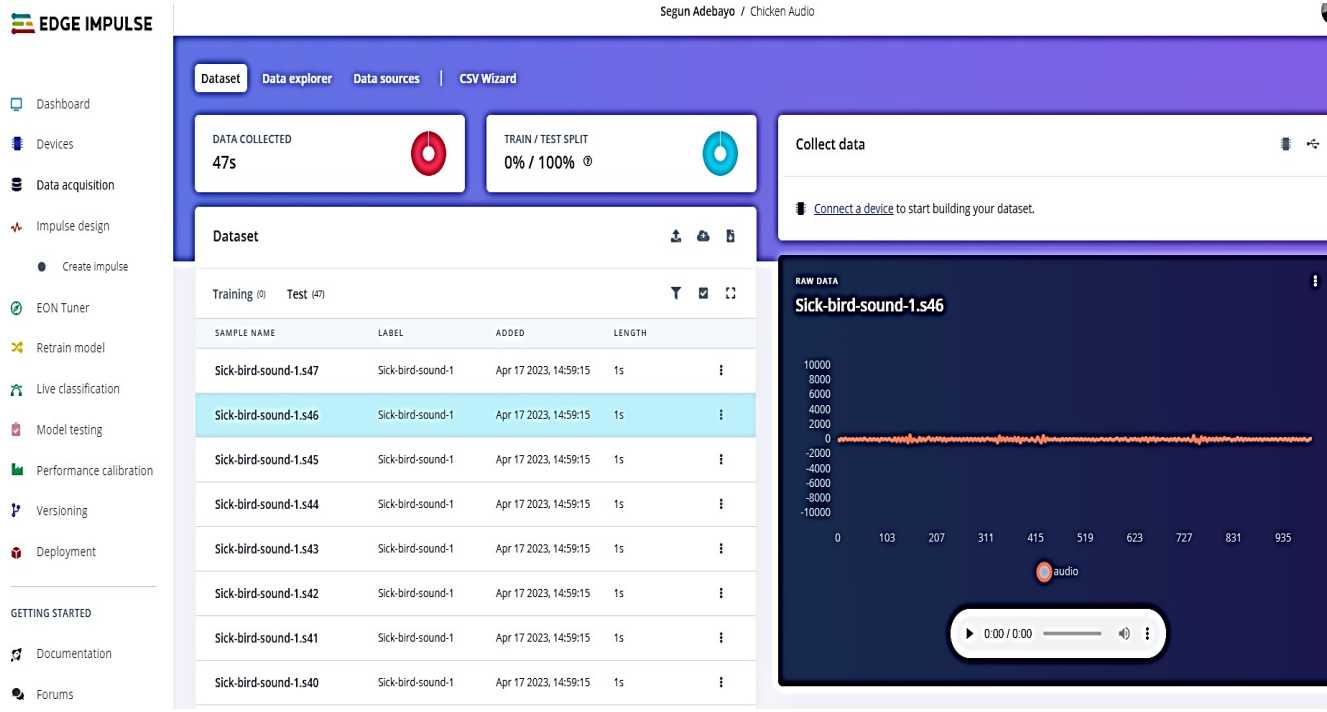
Data Collection with Sensors





EDGE IMPULSE





Dataset Description

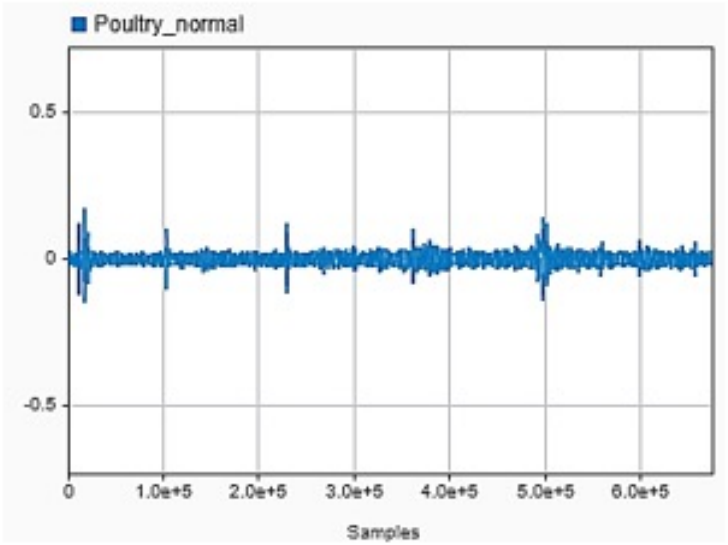
The dataset contains 346 audio signal files and grouped into three folders: healthy, noisy, and unhealthy.

There are 139 audio files in the healthy folder, 86 in the noise folder, and 121 in the unhealthy folder.

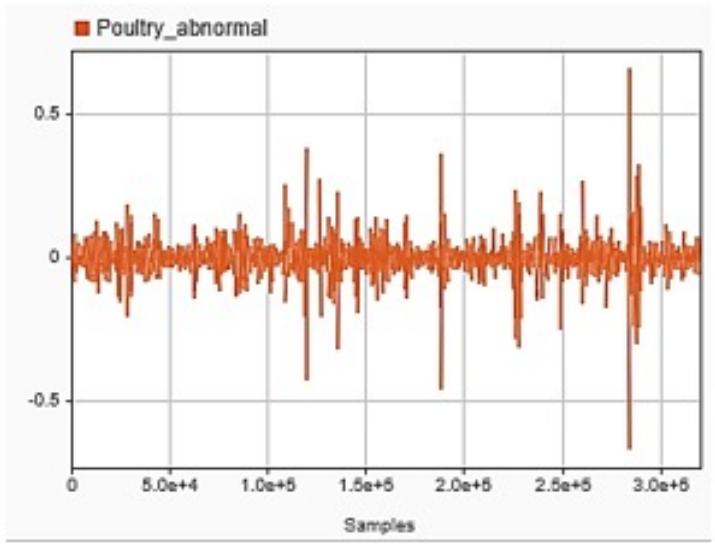
The audio signal file have a range of 5 seconds to 60 seconds length.

The selected sound segments in the unhealthy folder include chicken cough, snore and rale sound.

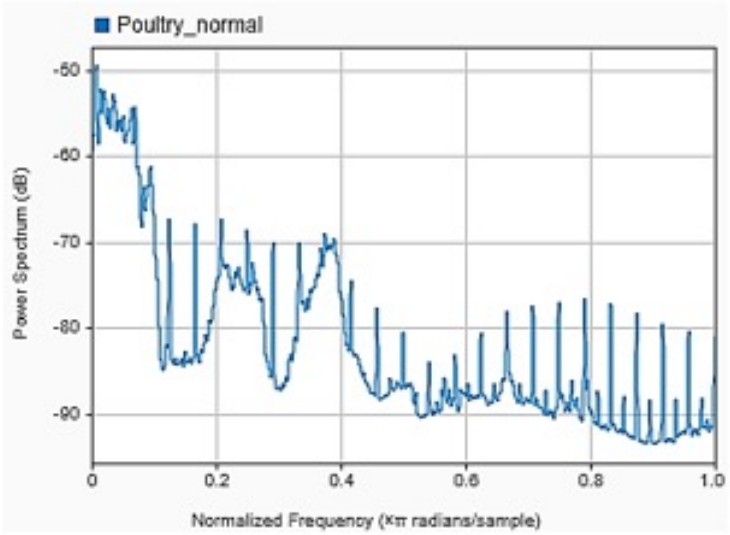
The Noise folder contain sound segments that include background noises (e.g., moving vehicle and human voices) and sound created by poultry bird activities (e.g., feeding, pecking one another).

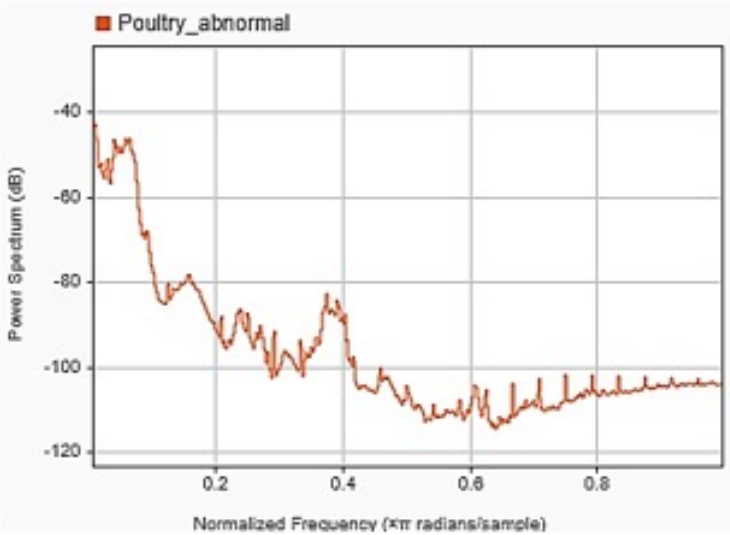


(a)



(b)

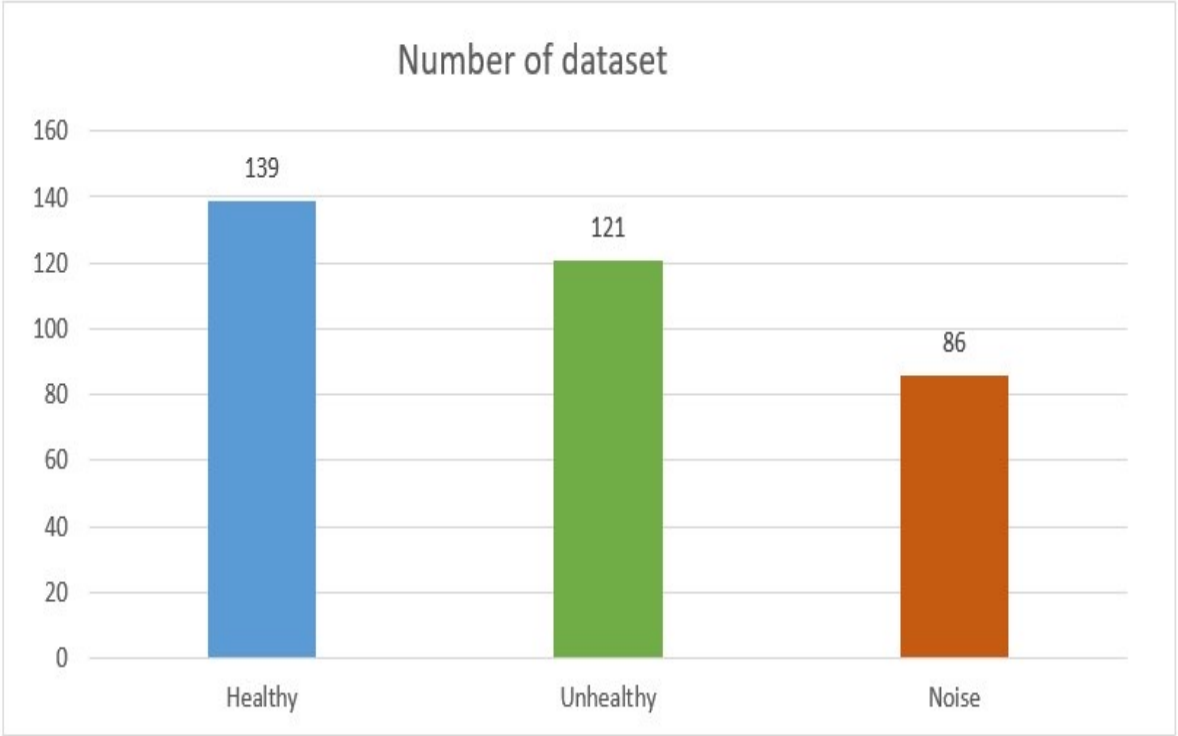




Dataset Description

A total of 346 audio signal files were successfully collected from the poultry farm. This dataset comprises of

- 139 files that represent healthy audio signals,
- 121 files represent unhealthy audio signals, and
- 86 files are the noise audio signals.



data.mendeley.com

Mendeley Data

Sign In / Register

Poultry Vocalization Signal Dataset for Early Disease Detection

Published: 12 June 2023 | Version 1 | DOI: 10.17632/zp4nf2dxbh.1

Contributors: Halleluyah Aworinde, Segun Adebayo, Akinwale Akinwunmi, Olufemi Alabi, Adebamiji Ayandiji, Olaide Oke, Abel Oyebamiji, Adetoye Adeyemo, Aderonke Sakpere, Kizito Echetama

Description

The aim of generating this dataset is to deliver open, accessible and quality machine learning dataset for Poultry farm management. The dataset contains a total of 346 audio signal files which are divided into three folders: healthy, noise and unhealthy. The healthy folder contains 139 audio files, noise folder has 86, while unhealthy folder has 121 files. The audio files are saved in .wav file format.

Download All 869 MB

Files

Chicken_Audio_Dataset

Steps to reproduce

Bowen University poultry research farm was used as the experimental environment where total number of day-old chicks were acquired and divided into two groups. The first group was treated for respiratory diseases and the other group was not treated for respiratory diseases. The chicks were then placed in a controlled environment, separately from each other, and microphones were positioned at a suitable distance from the birds to avoid background noise and other sounds that may interfere with the analysis. Data was collected at 96 kHz with 24-bit samples. The audio data collection process occurred continuously, three times daily (morning, afternoon and night) for a period of 65days. During this period, food and water are readily available to the birds at all times. After 30 days, the untreated group developed respiratory disease which was evident in their sound. These data were also captured as unhealthy. Audio signals of poultry chickens were collected and stored in MA4 and later converted to WAV format.

Dataset metrics

Usage

Downloads:	693
Views:	22

PLUMX View details >

Latest version

Version 1

Published:	12 Jun 2023
DOI:	10.17632/zp4nf2dxbh.1

Cite this dataset

Aworinde, Halleluyah; Adebayo, Segun; Akinwunmi, Akinwale; Alabi, Olufemi; Ayandiji, Adebamiji; Oke, Olaide; Oyebamiji, Abel; Adeyemo, Adetoye; Sakpere, Aderonke; Echetama, Kizito (2023), "Poultry Vocalization Signal Dataset for Early Disease Detection", Mendeley Data, V1, doi: 10.17632/zp4nf2dxbh.1

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Poultry Vocalization Signal Dataset for Early Disease Detection

Publication Year: 2023

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Usage

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Bibliographic Details

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URL ID: https://data.mendeley.com/datasets/zp4nf2dxbh; http://dx.doi.org/10.17632/zp4nf2dxbh.1; https://dx.doi.org/10.17632/zp4nf2dxbh.1; https://data.mendeley.com/datasets/zp4nf2dxbh/1

AUTHOR(S):
Aworinde, Halleluyah; Adebayo, Segun; Akinwunmi, Akinwale; Alabi, Olufemi; Ayandiji, Adebamiji; Oke, Olaide; Oyebamiji, Abel; Adeyemo, Adet
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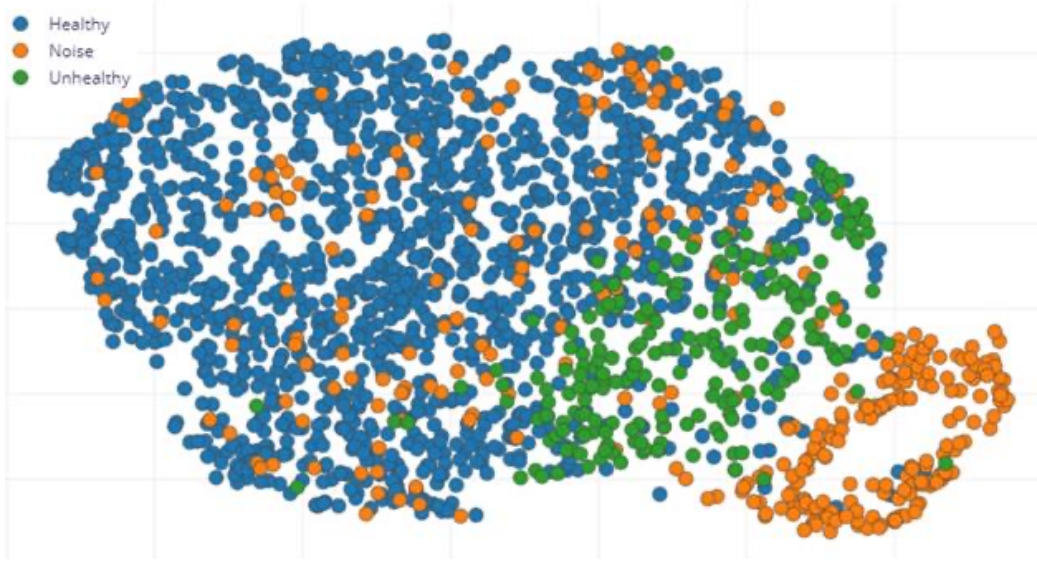
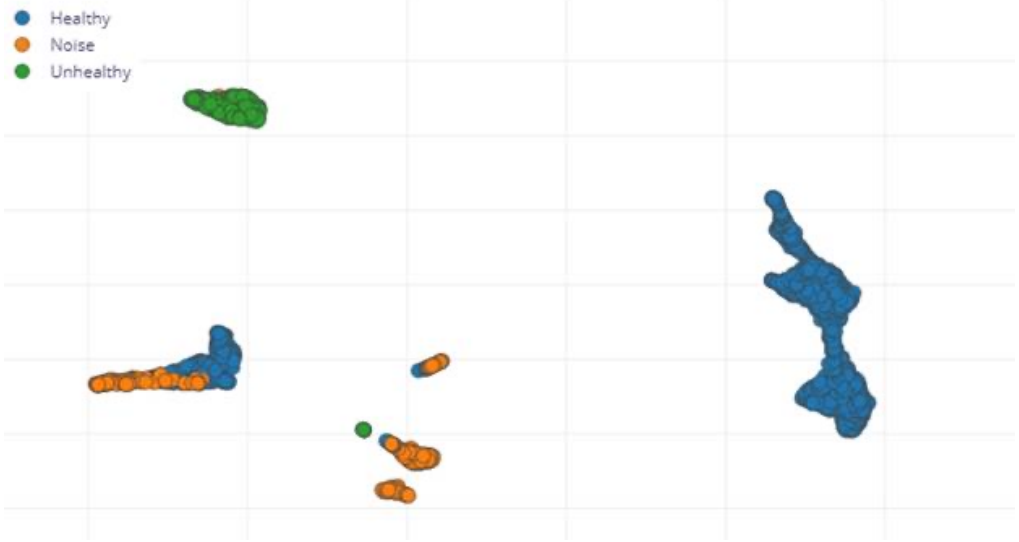
Insights from Dataset Features

MFCC Features



Spectrogram Features



MFE Features

Insights from Model Training

Effect of Data Argumentation of Trained Model

Add noise	None	Low	High	Low	High	High	High
Mask time bands	None	None	None	Low	High	High	Low
Mask frequency bands	None	None	None	Low	High	None	None
Accuracy	96.4%	87.8%	80.2%	72.8%	39.0%	60.1%	57.8%
F1-score	96.3%	87.3%	79.6%	70%	28.3%	58%	55.3%
Loss	0.14	0.36	0.46	0.69	1.27	0.87	0.89

Performance of Neural Network Training using MFCC Features

Last training performance (validation set)

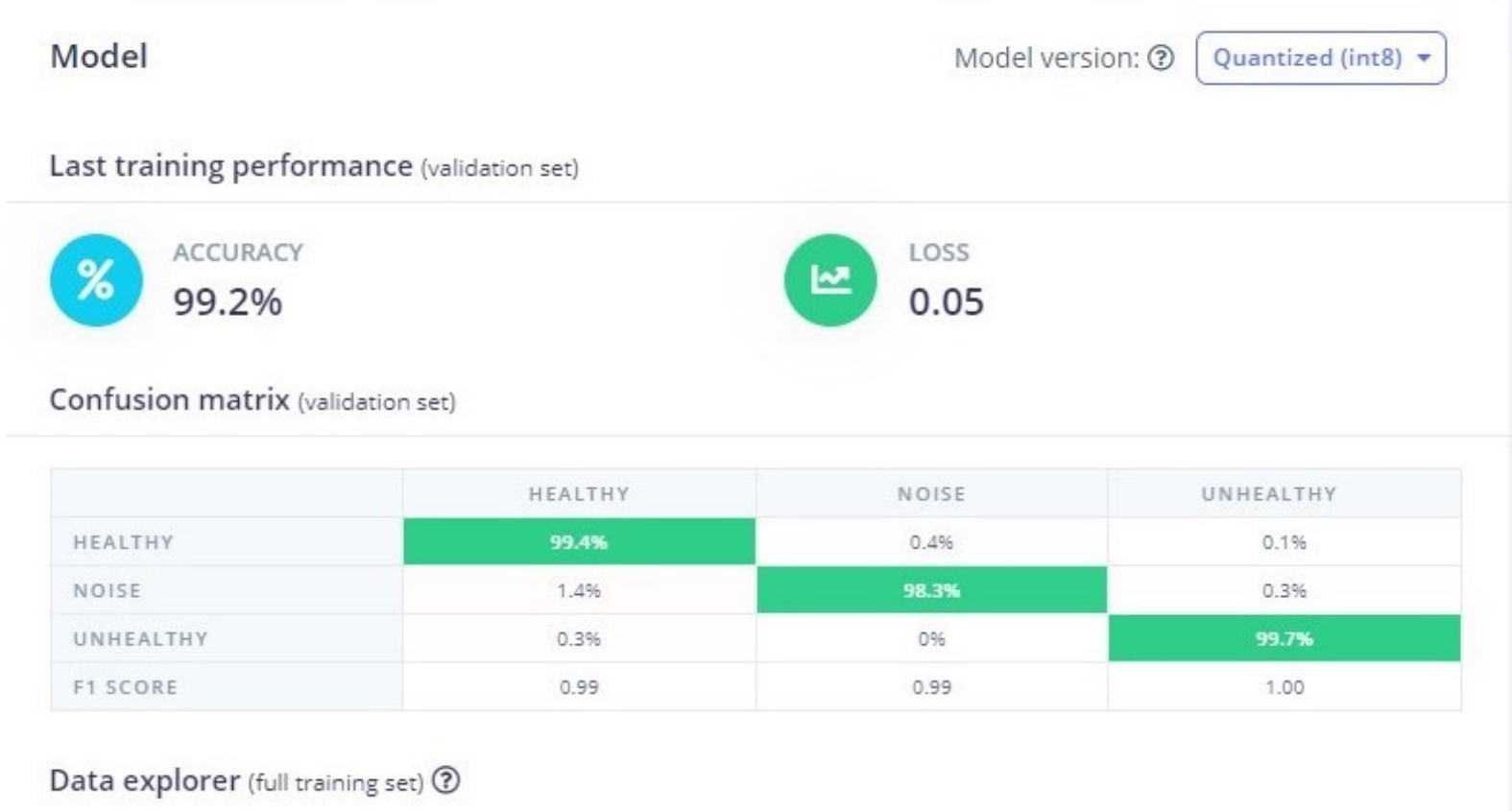
ACCURACY
85.6%

LOSS
0.38

Confusion matrix (validation set)

	HEALTHY	NOISE	UNHEALTHY
HEALTHY	**91.3%**	4.9%	3.8%
NOISE	23.3%	**72.2%**	4.5%
UNHEALTHY	8.5%	1.7%	**89.8%**
F1 SCORE	0.86	0.79	0.90

Performance of Neural Network Training using Spectrogram Features



Model

Model version: Quantized (int8)

Last training performance (validation set)

ACCURACY
99.2%

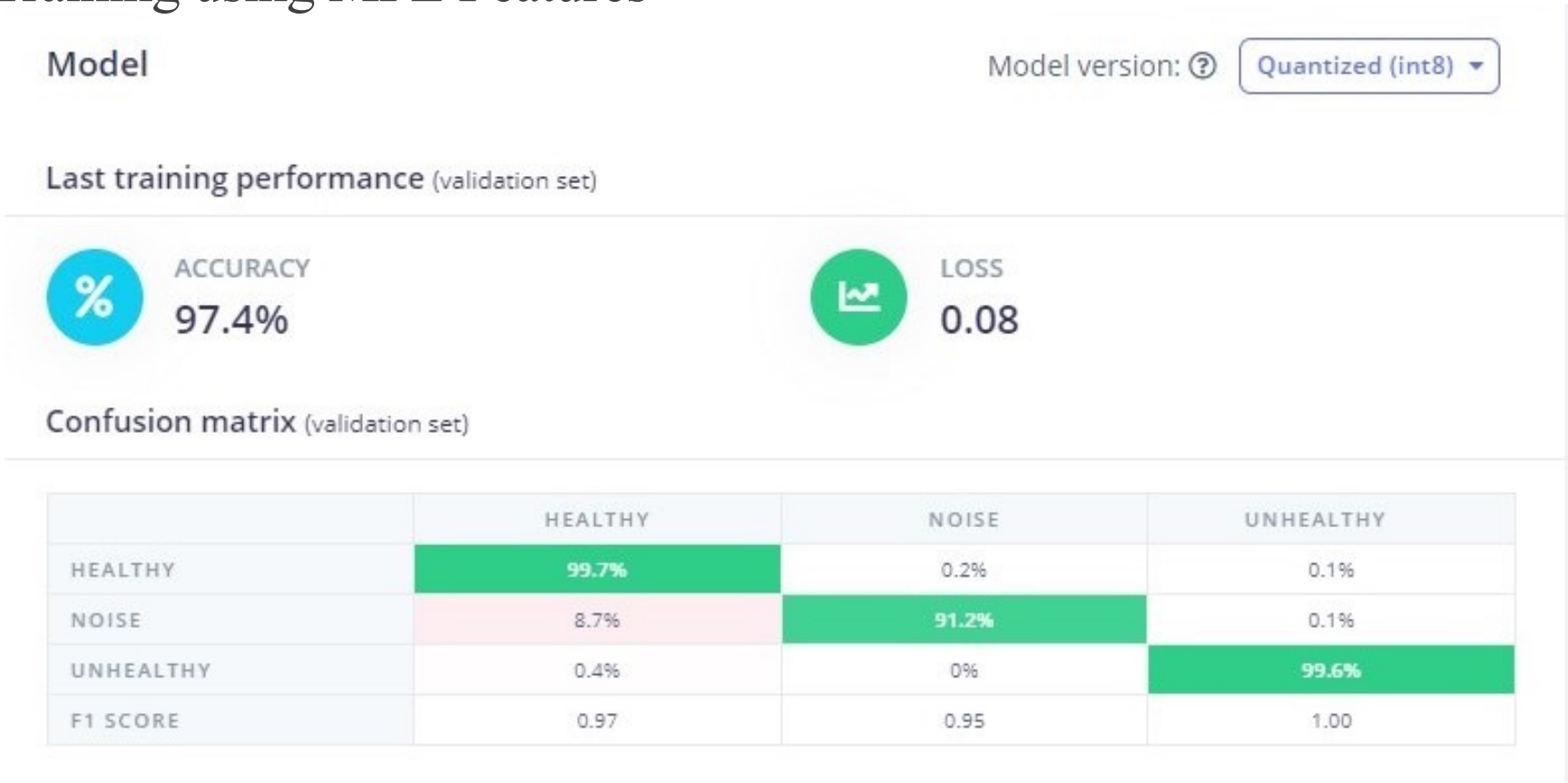
LOSS
0.05

Confusion matrix (validation set)

	HEALTHY	NOISE	UNHEALTHY
HEALTHY	99.4%	0.4%	0.1%
NOISE	1.4%	98.3%	0.3%
UNHEALTHY	0.3%	0%	99.7%
F1 SCORE	0.99	0.99	1.00

Data explorer (full training set)

Performance of Neural Network Training using MFE Features



Model

Model version: Quantized (int8)

Last training performance (validation set)

ACCURACY
97.4%

LOSS
0.08

Confusion matrix (validation set)

	HEALTHY	NOISE	UNHEALTHY
HEALTHY	99.7%	0.2%	0.1%
NOISE	8.7%	91.2%	0.1%
UNHEALTHY	0.4%	0%	99.6%
F1 SCORE	0.97	0.95	1.00

Performance of Neural Network Training using MFE & MFCC Features

Last training performance (validation set)

ACCURACY
96.8%

LOSS
0.11

Confusion matrix (validation set)

	HEALTHY	NOISE	UNHEALTHY
HEALTHY	**97.4%**	1.9%	0.7%
NOISE	6.1%	**93.2%**	0.7%
UNHEALTHY	0.5%	0.1%	**99.4%**
F1 SCORE	0.97	0.95	0.99

RESULTS

Types of Model	Model Accuracy	F1 Score	Loss
MFCC Features-based	85.6%	85%	0.38
Spectrogram Features-based	99.2%	99.3%	0.05
MFE Features-based	97.4%	97.3%	0.08
MFCC & Spectrogram Features-based	98.4%	98.6%	0.06
MFCC & MFE Features-based	96.8%	97%	0.11

Team Composition

Dr. Halleluyah Aworinde
Machine Intelligence

Dr. Akinwale Akinwunmi
Cloud Computing

Dr. Adebamiji Ayandiji
Agricultural & Rural Extension Specialist

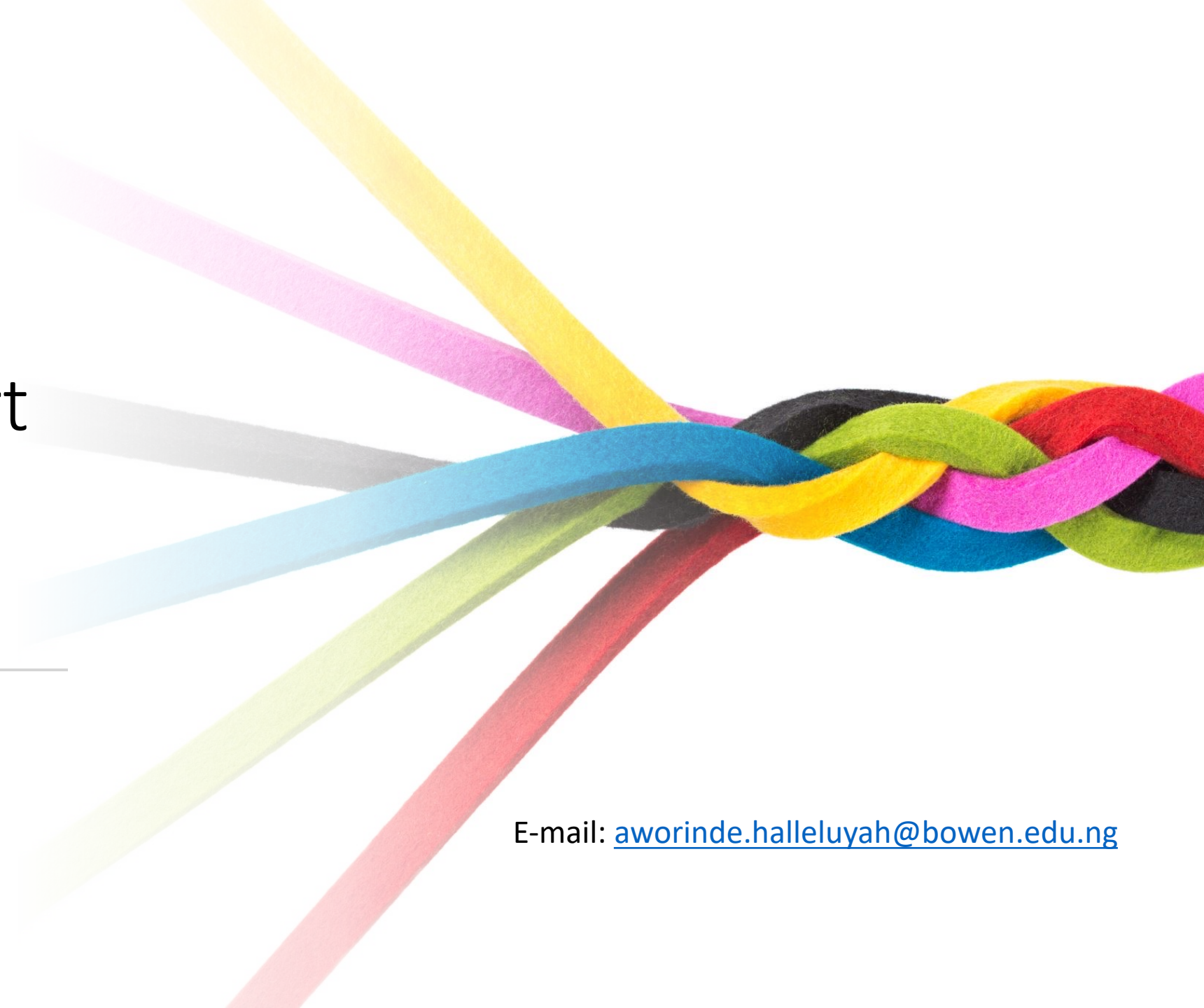
Echetama Kizito Chizitere
Student

OKE OLAIDE FELICIA
Student

Dr. Segun Adebayo
IoT/Hardware

Prof. Olufemi Alabi
Animal Scientist

We are still learning, we open to support and collaboration



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THANK YOU…