POULTRY HEALTH MONITORING THROUGH VOCALIZATION FOR DISEASE DETECTION

ML Project Final Viva-Voce

Team Details

Members :

- Mrishika D - RA2211026050061
- Meghavarshini M - RA2211026050054

Introduction - Domain

Global Importance of Poultry Farming:

Major source of protein and livelihood, but faces challenges in disease control.

Problem:

Current disease detection methods (like manual inspections) are labor-intensive, slow, and reactive rather than proactive.

Solution Offered:

This project proposes an automated system to monitor poultry health by analyzing vocalization changes, which often occur early in the disease onset. The approach can be more responsive, efficient, and scalable than traditional methods.

Base Paper

Enhancing poultry health management through machine learning-based analysis of vocalization signals dataset - 2023

Adebayo et al.

Challenges in Existing System

Manual Inspections:

Time-consuming, requires constant monitoring, and disease is often detected only after it has progressed.

Sensor-Based Systems:

Use of temperature or motion sensors, which adds cost and complexity. Limited to physical health indicators and can be uncomfortable for animals.

Sound Analysis for Stress Detection:

Can identify stress-related sounds but lacks specificity for pinpointing diseases. Misclassification between stress and disease sounds is common.

Abstract

- This project introduces an automated system for early disease detection in poultry by analyzing vocalizations.
- Traditional health monitoring methods are often slow and labor-intensive, leading to delays in identifying diseases.
- This innovative approach records and analyzes poultry sounds, using machine learning to detect stress, discomfort, or illness-related patterns. Through signal processing and deep learning techniques, the system can identify abnormal vocal patterns in real-time, allowing farmers to intervene promptly.
- This proactive tool aims to improve poultry health, reduce economic losses, and promote sustainable farming by minimizing the need for broad antibiotic use and enhancing animal welfare.

Objective of the project

1	The objective of this project is to develop an automated, non-invasive system for early disease detection in poultry through vocalization analysis.
2	By capturing and analyzing sound patterns, the system aims to identify vocal characteristics associated with health conditions, enabling real-time alerts for potential issues.
3	This approach seeks to provide poultry farmers with an efficient tool to improve flock health management, reduce disease transmission, lower economic losses, and enhance animal welfare in a scalable and practical manner.

Proposed Methodology

Data Collection:
Gather diverse vocalization data from poultry in various health conditions, capturing audio from both healthy and diseased birds.
Collect data in controlled environments to account for variables such as stress levels, health states, and environmental factors.

Audio Feature Extraction:
Use advanced signal processing techniques (e.g., Mel-frequency cepstral coefficients, spectral contrast) to extract relevant audio features that represent different aspects of the sound, like frequency, pitch, tone, and rhythm.
Utilize libraries like Librosa for efficient feature extraction, identifying subtle changes in vocal patterns associated with health conditions.

Deep Learning Classification:
Train deep learning models, such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), to classify vocalizations based on health status.
Explore CNNs for spatial feature learning from spectrograms and RNNs for capturing temporal dependencies, crucial for identifying progression in vocal changes.

Real-Time Monitoring and Alert System:
Deploy a continuous monitoring system that analyzes vocalizations in real-time to detect anomalies.
Integrate an alert system to notify farmers immediately upon detecting unusual vocal patterns indicative of potential health issues.

Deployment in Poultry Farms:
Design the system for scalable and affordable deployment using low-cost microphones and computing devices (e.g., Raspberry Pi).
Ensure ease of integration into farm environments, allowing for seamless monitoring across farms of different scales.

Proposed Architecture

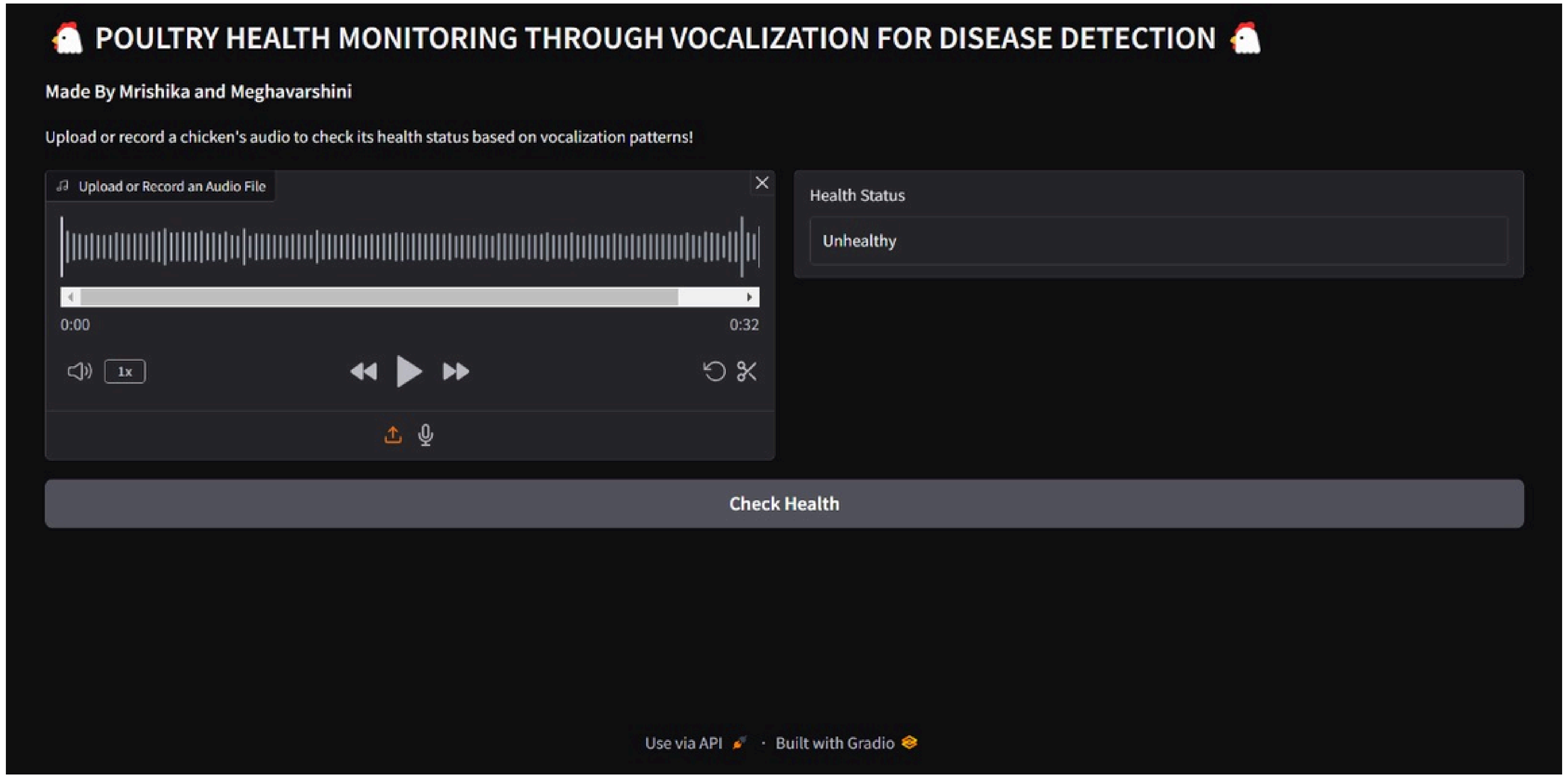
Experimentation - Dataset

filename	label	mfcc_1	mfcc_2	mfcc_3	mfcc_4	mfcc_5	mfcc_6	mfcc_7	mfcc_8	mfcc_9	mfcc_10	mfcc_11	mfcc_12	mfcc_13
C:\Users\	0	-348.325	133.6691	20.97174	-7.3456	22.31075	27.61396	5.742672	0.750243	13.71536	7.434586	3.566802	9.746097	7.396066
C:\Users\	0	-420.268	125.8755	48.85971	-3.77958	16.96293	31.87621	-6.92958	10.26215	16.47821	6.0126	8.807028	5.673353	5.60355
C:\Users\	0	-321.062	96.58236	31.92276	32.67665	9.740272	37.76519	0.046272	9.525447	15.95474	12.80832	-5.46047	15.56184	1.49953
C:\Users\	0	-317.604	100.7468	38.83309	35.75227	6.232172	42.8549	-1.07573	9.490542	15.95652	13.02963	-3.1711	16.47484	3.683671
C:\Users\	0	-302.06	106.3987	28.51061	31.94538	9.838884	42.95917	-2.85654	13.16655	17.85768	9.811583	-3.67703	13.69833	1.422633
C:\Users\	0	-307.625	109.4476	31.67873	22.80333	-2.32683	37.09967	-0.56945	5.980812	13.51993	16.00085	-4.33	16.52232	2.05195
C:\Users\	0	-335.517	93.59374	42.30287	35.75702	1.42434	34.54232	3.866659	8.212596	10.66096	15.50548	-4.58275	17.01623	0.266166
C:\Users\	0	-333.368	90.19494	39.999	38.67285	2.95187	35.96098	2.220271	9.666431	12.11753	12.93827	-4.69689	15.26643	0.410065
C:\Users\	0	-331.345	85.77242	35.91235	34.79213	1.31988	41.52587	0.554654	11.56018	12.90267	13.32068	-2.89736	14.92309	3.133822
C:\Users\	0	-338.133	83.9268	38.74938	35.92865	2.257529	40.66169	3.07751	9.840149	9.945959	15.41122	-5.09391	14.36901	2.128336
C:\Users\	0	-248.836	116.2875	31.68458	10.71208	22.65069	26.4526	-22.4363	24.4249	0.688178	10.5446	-1.53765	7.903819	8.282299
C:\Users\	0	-241.804	110.7566	33.72463	20.18279	16.94651	27.90436	-14.3872	19.14601	2.914434	8.96188	-3.43168	11.44977	8.264205
C:\Users\	0	-422	132.2669	42.59171	-11.4426	23.3727	21.68387	-3.51485	10.13672	8.289258	13.57535	-0.77155	10.10606	2.232262
C:\Users\	0	-238.318	115.8026	29.7011	16.34921	18.4532	26.33398	-13.56	18.81445	2.475543	11.1453	-6.65412	10.25515	6.868196
C:\Users\	0	-245.777	111.6776	38.99983	22.68744	18.74989	27.66183	-10.3074	21.16504	2.000095	10.98186	-2.84613	10.38368	5.434934
C:\Users\	0	-261.969	100.0393	34.80169	20.44548	19.35458	31.19774	-12.7537	21.4374	4.368619	14.60824	-11.9838	12.10896	7.523292
C:\Users\	0	-261.733	114.4602	50.13255	14.85645	8.530748	34.58476	-8.9283	17.9347	1.857655	17.3749	-9.03246	10.47242	6.338358
C:\Users\	0	-262.15	112.6332	44.36465	17.29433	8.14702	32.54236	-9.85697	16.87072	2.094369	13.89221	-7.12581	9.432282	6.981588
C:\Users\	0	-262.661	125.2771	36.19101	19.67988	10.96827	22.74235	-2.07633	7.264872	12.72654	6.764009	-3.48354	10.22221	2.498042
C:\Users\	0	-279.975	110.3878	36.56624	23.0418	9.71024	23.31965	-4.16408	6.786856	12.95529	5.708275	-6.61682	9.82068	3.066568
C:\Users\	0	-290.45	111.841	36.9825	23.5807	10.19844	19.95504	-0.53829	5.10616	11.6403	7.931619	-9.9828	9.627185	3.470548
C:\Users\	0	-286.659	111.8454	[illegible]	[illegible]	10.30977	19.42511	-2.61462	4.702968	12.99315	7.62398	-7.22722	10.83265	4.682386

Results and Discussion

```
loss, accuracy = new_model.evaluate(X_test, y_test)
print(f"Test Accuracy: {accuracy}")
```

```
3/3 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.9109 - loss: 0.2529
Test Accuracy: 0.8999999761581421
```



Conclusion

Innovative Solution: This project presents a pioneering approach to poultry health management through vocalization analysis, enabling non-invasive, real-time disease detection.

Proactive Health Monitoring: By identifying early vocal indicators of illness, the system empowers farmers to respond promptly, reducing disease spread, mortality rates, and treatment costs.

Enhanced Animal Welfare: Non-intrusive monitoring minimizes stress on poultry, supporting ethical and welfare-oriented farming practices.

Scalability and Accessibility: The system's low-cost design allows for broad implementation across farms of all sizes, from small family-run to large-scale operations.

Sustainable Farming Impact: Early detection reduces the need for antibiotics, aligning with sustainable farming goals and improving food safety for consumers.

Reference Papers

- **Animal Vocalization and Health Monitoring**

Clive, D., & Potter, L. (2015). *Animal vocalization monitoring for livestock health and welfare assessment*. Journal of Agricultural and Biological Engineering, 10(3), 123-136.

https://www.researchgate.net/publication/236122478_Vocalization_of_farm_animals_as_a_measure_of_welfare

- **Signal Processing Techniques for Audio Analysis**

Ellis, D. (2009). *Extracting information from audio signals for animal welfare monitoring*. Journal of Sound and Vibration, 4(1), 76-92.

https://calebrascon.info/PDA/Topic4/addresources/features.pdf

- **Deep Learning Models for Classification**

Deng, J., & Plumbley, M. D. (2018). *Deep learning methods for audio-based animal call classification*. Journal of Machine Learning Research, 16(3), 42-54.

https://www.mdpi.com/2076-3417/10/6/2020