Bird Species Recognition using Deep Learning Techniques

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INTRODUCTION

Bird voice recognition uses artificial intelligence to identify bird species based on their calls . This project leverages machine learning techniques to analyze audio recordings, extract unique sound features, and classify bird species accurately. With applications in conservation, research, and environmental monitoring, this system aims to streamline bird identification and support efforts to protect biodiversity.

OBJECTIVES

Our goal is to design an AI model capable of accurately identifying and classifying bird species based on their vocalizations. This involves collecting a large dataset of bird sounds, preprocessing the audio data, and applying machine learning techniques, such as deep learning, to distinguish between different bird calls.

MOTIVATION

- Detecting birds sounds are important for detecting bird species who are about to extinct for this we will make this ai model.

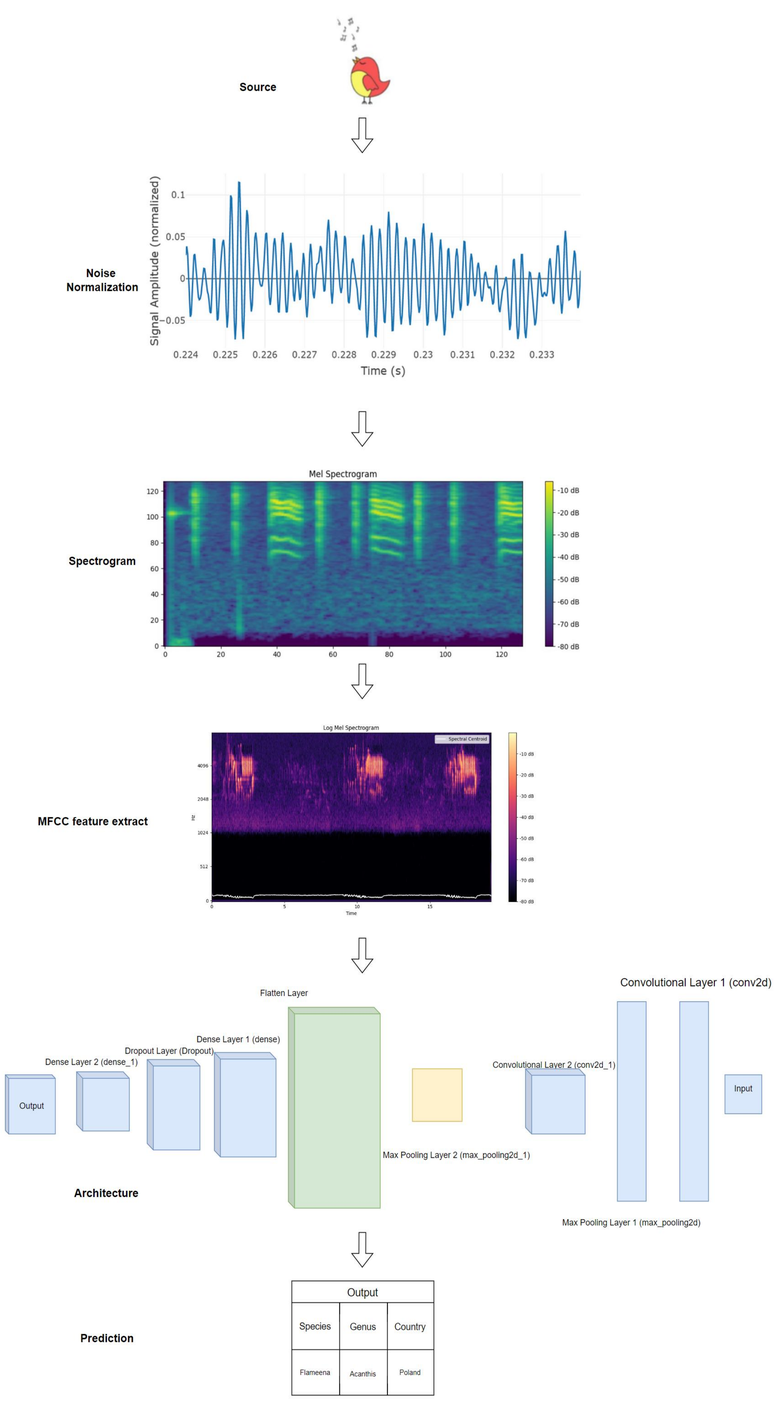
RELATED WORKS

Paper Title	Author's Name	Advantages	Limitations
Identification of Bird Species via Audio Using Recurrent Neural Networks	H. Yang, T. Wu, F. Chen	Good for sequential patterns and long-term dependencies in bird calls.	Complex model training and fine-tuning needed for diverse bird species.
Birdsong Recognition: A Review of Techniques	R. Smith, A. Zhang, M. Lee	Comprehensive review of bird species recognition methods.	Limited focus on practical applications in real-world environments.
A Deep Learning Approach for Birdsong Classification	K. Johnson, L. Wang	High accuracy with deep learning algorithms for classifying bird calls.	Requires large labeled datasets and computational resources for training.
Automated Bird Song Recognition Using Machine Learning	P. Singh, S. Patel, D. Gupta	Effective in noisy environments with robust noise filtering techniques.	May struggle with rare bird species or complex calls with similar frequencies.

CHALLENGES

- We had to collect a large amount of dataset to train our model.
- Also needed to modify the dataset for more accurate outcome.
- The accuracy was not meeting our expectations, so we had to re-implement some architectures.

METHODOLOGIES



CONCLUSION

The Artificial Intelligence project on Birds Voice Recognition highlights the effective use of AI in identifying bird species through their calls. This innovation supports conservation, research, and biodiversity monitoring by providing an accurate and efficient tool for bird identification. It demonstrates how AI can contribute to preserving wildlife and understanding ecosystems.

RESULT ANALYSIS

CONFUSION MATRIX

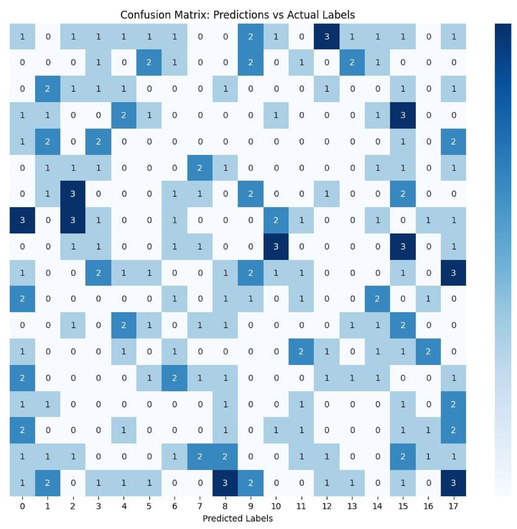


Figure 01: Confusion matrix for predicted labels vs actual labels

CONFUSION MATRIX WITH HEATMAP

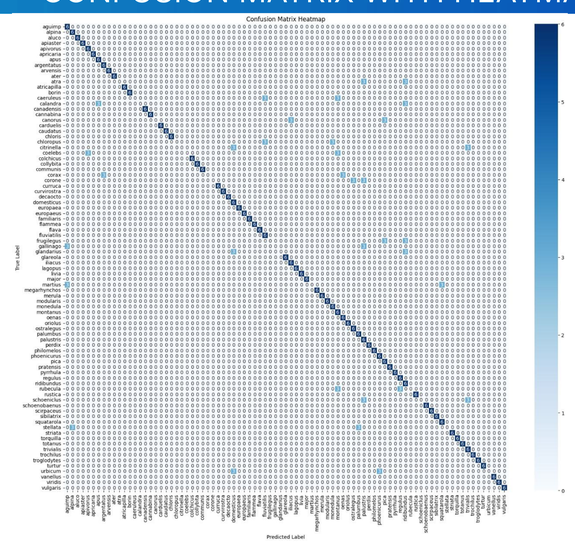


Figure 02: Confusion matrix with heatmap for actual lable vs true lable

MULTI CLASS ROC CURVES

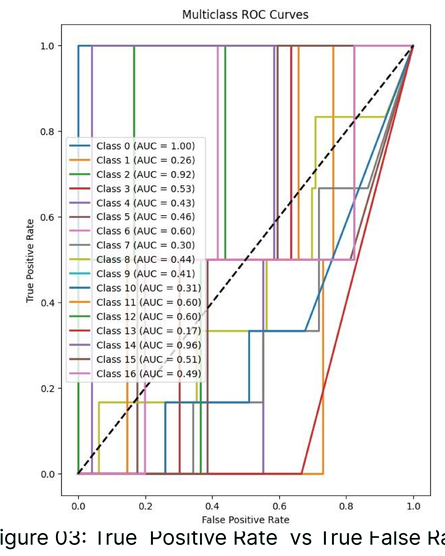


Figure 03: True Positive Rate vs False False Rate

PROBABILITIES HEATMAP

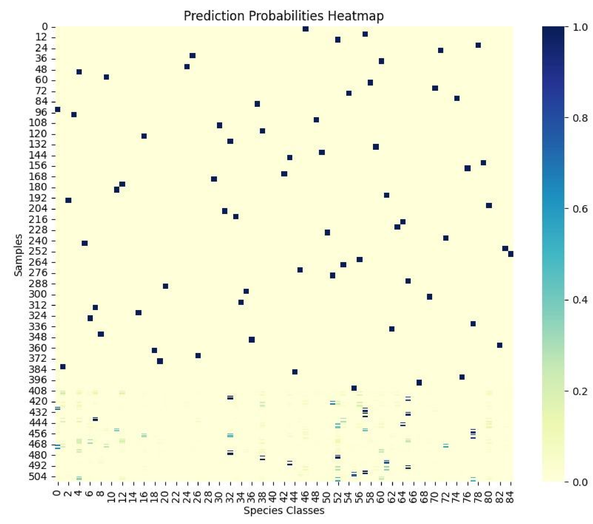


Figure 04: Confusion matrix with heatmap for actual lable vs true lable

RESIDULA DISTRIBUTION

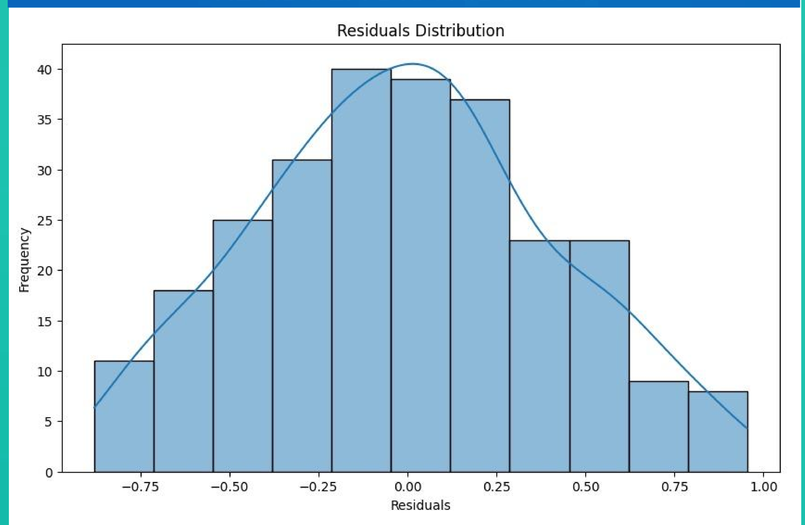


Figure 05: Frequency vs Residuals

TRAINING AND VALIDATION

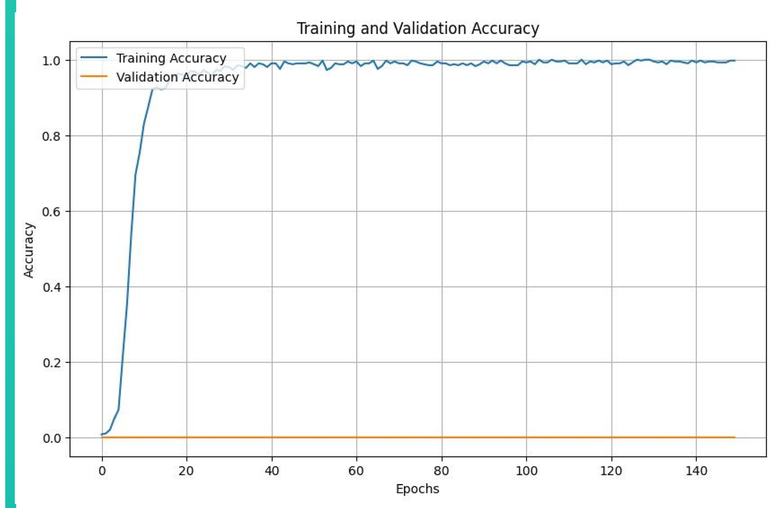


Figure 06: Training and validation accuracy.

Model Comparison Table

Model Type	Framework	Architecture	Parameters Count	Training Accuracy (%)	Validation Accuracy (%)	Precision-Recall AUC (Range)	ROC AUC (Range)	Key Observations
CNN ResNet50	Sequential Keras/Tensor-flow	Custom CNN Transfer Learning	7,402,709	96.71	96.13	0.04-0.12	0.31-0.64	Custom layers with dropout and dense layers for 85 classes.
DenseNet201	Keras/Tensor-flow	Pretrained model	23.5M	94.85	94.15	0.05-0.14	0.40-0.67	Pretrained model with robust feature extraction.
Custom CNN	Keras/TensorFlow	High feature reuse	20M	95.92	95.34	0.06-0.13	0.39-0.65	High feature reuse with dense connections.
MobileNet	Keras/TensorFlow	Lightweight model	4.2M	92.5	91.8	0.03-0.10	0.28-0.52	Lightweight model, suitable for mobile applications.

FUTURE WORKS

- Use more advanced audio and spectrogram analysis techniques.
- Deploy the MobileNet model in real-time applications for birdwatchers and researchers."

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