Statement of Work, CSCI E-115 (Spring 2025)

Title: AI-Driven Acoustic Monitoring to Support Communities in Biodiversity Conservation
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Background and Motivation:
Biodiversity is facing an unprecedented crisis, with species extinction occurring at rates 100 to 1,000 times higher than the natural background level (IPBES, 2019). As the foundation of healthy ecosystems, biodiversity provides essential services such as clean air, water purification, climate regulation, and food security. Its decline is now considered the second biggest global risk to humanity (World Economic Forum, 2025). Indigenous communities play a crucial role in conservation efforts, as their territories are estimated to hold 80% of the world's remaining biodiversity. However, these communities often lack the financial resources, technological tools, and institutional support needed to effectively monitor and protect their lands. Without accessible and scalable solutions, ecosystems will continue to degrade, resulting in irreversible losses.

To address this challenge, we propose an AI-powered acoustic monitoring system designed to empower indigenous communities in biodiversity conservation. By leveraging AI to analyze acoustic data, our system enables real-time species identification and ecosystem monitoring, allowing communities to detect changes and threats before they become critical. This technology also creates new economic opportunities—acoustic monitoring supports specialized ecotourism initiatives such as birdwatching tours in remote areas, generating sustainable revenue. Additionally, by providing robust biodiversity data, the system facilitates the development of high-integrity biodiversity credits, offering a financial mechanism to support conservation efforts.

Scope and Objectives:
Current AI models for acoustic monitoring are not adequately trained to identify local and endemic bird species, many of which are threatened with extinction. While open-source models like BirdNET (https://github.com/kahst/BirdNET-Analyzer) can automatically detect up to 6,000 bird species, they include only a limited number of endemic species, leaving critical gaps in biodiversity monitoring.

Our objectives are to:
1) enhance AI-driven acoustic monitoring by integrating local, endemic species into an open-source model (BirdNET) to enable more accurate bird identification and localization
2) support ecotourism initiatives by developing a user-friendly multilingual digital platform (mobile app and web dashboard) that provides:
- Interactive maps with bird location data based on acoustic detections.
- Bird status indicators and descriptions (e.g., endemic, threatened, or migratory).
- Audio recordings and spectrogram visualizations to enhance experiences.
- Birdwatching routes based on recent detections, guiding visitors to key observation spots.

3) develop a multilingual AI-powered chatbot integrated into the mobile app and web platform to provide real-time assistance by answering queries related to bird species, birdwatching spots based on recent acoustic detections, and other educational content.

Source of Data:
We will use as a case study the Yanachaga Chemillen National Park in Peru, which hosts 550 bird species. Due to time constraints, we identified a priority list of 9 local or endemic bird species for monitoring from the literature review (See the list in the Annex). We will obtain labelled recordings of these species from XenoCanto, one of the largest global repositories of wildlife sound recordings (https://xeno-canto.org/).

Description of Data:
The dataset consists of audio recordings of animal species vocalizations in various formats (e.g., WAV, MP3) with associated metadata. The metadata includes species name (scientific and common name); recording location (GPS coordinates and habitat type); date and time when the recording was captured; recording quality (user-rated quality scores from A, highest to E, lowest); and background noise levels (indications of interfering sounds such as, human activity, wind, or other species). This dataset is well-suited for fine tuning our AI model (BirdNet) because it provides a diverse collection of real-world bird calls, including local and endemic species.

Preliminary Design:
The application will consist of two components:
1) Tourist Interface, a user-friendly interface designed for visitors, offering interactive maps, bird species location and other relevant information
2) Knowledge Chatbot, an AI-powered chatbot that provides real-time support, answers questions about local bird species to enhance the visitor experience.

Challenges and Risks:
We propose conducting a transfer learning based on BirdNet, which may present challenges, particularly due to the limited number of recordings available for our priority species on Xeno-Canto. To improve the model's ability to generalize, we may need to apply data augmentation techniques such as pitch shifting, time stretching, and background noise addition. These methods can help create a more diverse and robust training set.

Milestones (final project due on May 10):
1) Data collection and preprocessing, February 27
2) Fine tuning / transfer learning of the BirdNET model, March 9
3) Backend implementation, March 23
4) Frontend implementation, April 13
5) Chatbot integration, April 30
6) Final testing and deployment, May 8

References
- INRENA. 2008. Aves de la selva central peruana: levantamiento de información ornitológica del Parque Nacional Yanachaga Chemillen
-Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2019. *Global Assessment Report on Biodiversity and Ecosystem Services.*
-World Economic Forum (WEF). 2025. *Global Risks Report 2025*.

Annex: Priority birds,
which are also attractive for ecotourism

	Number of recordings in Xenocanto
Colorful & Spectacular Birds	
Rupicola peruvianus	158
Andigena hypoglauca	64
Aulacorhynchus coeruleicinctis	27
Rare & Elusive Birds	
Doliornis sclateri	11
Pipile cumanensis	49
Gallinago jamesoni	56
Tinamus osgoodi	20
Fascinating Behavior & Display Birds	
Pionus tumultuosus	15
Hapalopsittaca melanotis	11

Source: INRENA (2008).