

Audio Classification in Eastern Iceland

Ella Linder

Earlham College

Richmond Indiana

eklinder22@earlham.edu

Abstract

This project proposal focuses on the current difficulty of monitoring water traffic data in a fjord in Iceland, and how this project will help create a streamlined approach to collecting, organizing, and displaying said data. The main algorithm created will use artificial intelligence and machine learning to create an audio classification tool in order to monitor sea life and fjord health in Eastern Iceland. When the project is complete, it will be open for public use for any researchers, in environments similar to Iceland, to use.

Introduction

Earlham's Icelandic Field studies collect multiple types of data from Skalanes, Iceland every summer. One of those types is video and audio samples taken from multiple different places in the fjord next to Skalanes. This helps researchers view different types of wildlife in the fjord such as whales, fish, and seals; and over the course of several years, will help to determine how humans may influence animal traffic there. Currently, the method of collection is attaching several Go Pros to

buoys scattered across the water for several hours. A person then has to manually go through this footage and chart what they find. There are two main problems with this current setup, however: there are only a handful of hours of data collected every year, and a person has to spend many more hours parsing through this data and charting it. Because of this, I decided to make a project solving this issue. I plan to use a hydrophone placed off of a pier with its own power source, in order to collect audio samples year-round. I then plan to create an audio classification algorithm utilizing artificial intelligence and machine learning tools to automatically parse through, organize, and identify sources of sound, in order to create a graphical interface that Iceland researchers can easily read and understand.

This will then help the IFS and other research teams in Iceland to monitor and measure fjord health throughout the years more effectively.

Survey

Audio classification does exist, and it is more frequently used in research fields such as medical and

environmental research in order to diagnose and monitor people and animals. Unfortunately, public access to such programs is scarce, and/or not well aligned with Earlham's Icelandic research. One study that did line up well, "Underwater Sound Classification Using Learning Based Methods: A Review" - published by Muhammad Azeem Aslam, on *ScienceDirect*, was focused on reviewing a collection of 250 recent research papers concentrated on machine learning and sound classification for underwater sound samples. It highlights different processes and methods of the design and creation of such algorithms, and how research groups similar to the IFS (Earlham's Icelandic Field Studies) have utilized these programs to benefit their research. It also contains a list of publicly available programs, but there are only a select few in total, and they are difficult to access.

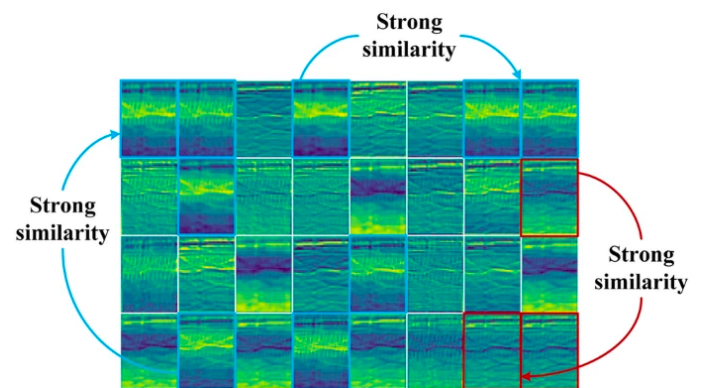
With this project, it would not only be used by Earlham's IFS group, but also other universities that send research teams to Iceland, and it would be publicly available for use.

The primary goal of this project is to create an audio classification algorithm that can collect, organize, and graphically display marine traffic in Icelandic fjords to monitor marine health over the course of several years, in order to benefit research teams who wish to research marine life and human activity in surrounding areas.

Design

The first step of this project is to begin by manually taking long audio samples and cutting them into sections.

Sections of silence and sections of noise. Doing it manually first will help in understanding the process of how to automate this section. From there, I will create an algorithm that will automatically take these long audio samples with an assortment of sound sources from an audio library, and cut them into pieces. Then it will create a "trash folder" where it will then send the pieces of silence to. I can then test the accuracy of this program by comparing it to my manual output, and seeing if it matches, and if there were any audio samples that were put into "trash" that were not silence. The second step is to expand it, to then divide up the audio samples by frequency range. The reason for this is that every noise source has a certain frequency range it creates, and it will be easier to determine the correct source if we can eliminate what it is *not* first. From there, I can create an image of the audio sample, and then apply image classification to the image set. For each step of the process, I will test on a small data set that I will also separate manually in order to test its accuracy.



At the end of the programming section, I can then use physical tools to connect everything together. Using a hydrophone underwater to collect audio samples, connected to a beagle bone to store the samples temporarily, then transferring that to a server to run the

program and return folders of the audio clips, and display a graph of the underwater activity on a webpage, the project as a whole will be complete.

Evaluation plan

I will be able to assess the accuracy of the program at every step of the way by doing what the program is doing, but manually, on a small dataset, so I can easily tell if it is working correctly or not, and if it is not working correctly, I can troubleshoot it fairly easily since I will be assessing it at every single step.

Contributions

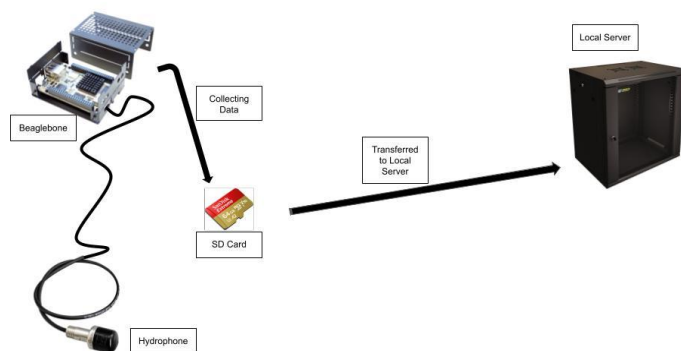
This project will be most helpful to the researchers who study at Skalanes, Iceland, but will also be available for anyone to use, so if there are people who want to research any marine traffic in Iceland, or areas with similar animal activity, they will be able to use it and study changes in environment and track human and animal traffic in water. It will benefit researchers of the fjord at Skalanes specifically, mainly due to a new construction of a fish farm there. If they can keep record of the difference in animal movement throughout the year, they can see if the fish farms influence animal activity in the fjord.

Risks

There are risks that may influence the outcome of the program, but that is to be expected. For example, I am expecting the program to at some point run into issues when the program categorizes the audio samples. No classification algorithm can be made without failed trials. However, expecting this means that I can plan how to combat these issues when they inevitably happen. As stated earlier, I am planning on manually testing each step and making sure it works correctly before moving onto the next step. If there is an issue with that step, I have several options on how to fix it. I have access to several studies that have made similar audio classification programs, and I have resources at Earlham such as professors and peers that would be able to help troubleshoot and solve issues that I may come across.

Special Resources

This project will not need many special resources; it primarily only needs equipment to collect and transfer data to a server, where it will then be automated from there, but the equipment is vital to the success of the project. A hydrophone is needed to record audio samples underwater, and a beagle bone or Raspberry Pi is needed to store the audio collected to an SD card. There may have to be a small power source connected to these two devices, as they might not be connected to a power grid. Other resources may include an online audio library, in order to train the algorithm, and a server to train and run the algorithm as well.



Timeline

The project would begin with writing small programs that do not use artificial intelligence and machine learning, for instance the program that will splice the audio, the program that collects the audio samples, and the program that sorts the splices by frequency range. Since they are light and help the classification algorithm process, they should be written first. From there, the next step would be to write a script that transforms the audio into a readable image, and then create a training set with the image samples, and train it until it can accurately sort them into the correct categories. Over the summer, I plan to work with IFS and set up the hydrophone in the fjord in Iceland. The final step after everything works correctly is to make a website interface that displays a graph of traffic through the fjord.

Citations

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- Author links open overlay panel Muhammad Azeem Aslam a b, a, b, c, d, Highlights•A comprehensive review of research and the latest developments in the field. •Highlight the contributions and challenges from over 250 recent research papers. •Discuss methods for vessel sound classification and fish sound classification. •Details, & Abstract Underwater sound classification has been an area of interest in the research community because of its applications in military. (2024, June 22). *Underwater Sound Classification Using Learning Based Methods: A Review*. Expert Systems with Applications. <https://www.sciencedirect.com/science/article/pii/S0957417424013654>
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