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CS 491 Capstone II Computer Science  
Spring 2022  
Option 2 – Audio Surveillance System

Engineering Notebook

Week 1:

In this first week of the sprint, we decided to continue out work from the first semester and expand upon the Audio Surveillance System using microphone arrays, a Raspberry Pi, and machine learning for classification. We determined Dr. Wang would be our new product owner as Dr. Cheng is no longer one of our instructors. Because we had an additional teammate join us, and because we were reviewing our work from the first semester, we went over the demos, code, and documentation from last semester to get everyone on the same page. We redistributed big concept responsibilities, the three big tasks being the UI, the localization of sounds in a room (with pure and mixed sounds) and the classification algorithm using machine learning. We also went into the GitHub and ZenHub to evaluate the tasks from last semester that was completed/abandoned to clean it up and prepare it for the work we will be doing this semester.

Week 2:

This week, we broke our big tasks down into more specific and actionable tasks and started adding them to our GitHub and ZenHub. We added them to some of the existing tasks from last semester that were either beyond out semester scope or that we planned to leave for this semester. Some of these tasks we updated for specificity and names for redistribution across our team with our added teammate. We also workshopped and finalized our Product Vision using our product vision from last semester with updates information based on what we learned last semester and what we hope to achieve this semester. We also worked through and finalized our product backlog, moving some of the tasks to this sprint with team members assigned to each one. For the most part, we are continuing with the basic responsibilities we had last semester, with mine being the classification neural network that feeds into the user interface. After discussing the overview of the project, Dr. Wang suggested some ways for me to address the issues I had last semester with my python code with some resources he had, so I helped finalize these other deliverables until he sent me this information.

Week 3:

After receiving several deep-learning audio classification resources from Dr. Wang, I started to reevaluate the way we would do the classification for our system. Originally, I planned on using Sci-kit Learn for our neural network, because I was familiar with it and knew that it would be able to perform the classification for our audio files. In the articles and tutorials I received, many of these other projects use TensorFlow and Keras to create a neural network and perform the pre-processing for the .wav files. In my original plan, I did not include much data pre-processing except to address the number of channels to fit the code I was using. The microphone arrays we are using offer up to six channels for the sound files, but have the option of using either six, two, or one channel for programs. For our new code, we will still only be using one channel. The old code converted the sound files into spectrograms, which have a vaguely recognizable shape for different sounds, but the new code would use pictograms, which are broken into much shorter sound files and reveal more distinct patterns in the sound when graphed. These pictograms would undergo a fast Fourier transformation to put the values on a scale of negative one to one, making it more friendly for the machine learning algorithm. I spent this week learning these new concepts and taking notes on how they would affect our project. I then followed through the Python tutorial for how to implement these changes in CoLab. Before implementing this new code, I turned to the SDD and SRS to make these updates to the best of my ability to the documentation. I wanted it to reflect the new algorithm that we would be following.

Week 4:

I spent this week continuing to watch videos online explaining how to pre-process audio files for a machine learning algorithm, as well as prepared the first (of the semester) version of our SRS and SDD with the updates to our system. The video that Dr. Wang had directed me to was one part of a long series of related videos, so I continued with these videos to solidify our new process conceptually, while referring back to the code tutorial to draw connections between the big picture concepts and the code. We also began preparing our sprint demo for next week so we are ready to present the changes as well as the further development of our system.

Week 5:

So far this week, I have created the python environment for our new system by adding TensorFlow and trying out some of it’s features that we might need to use. I have started following the tutorial from CoLab, but I ran into some errors because of missing imports in the environment, so I’ve continued to address them to be able to run the full code. At this moment, I am able to import the .wav files and use Keras, and I will continue to expand on this after our sprint demo this week.