Artificial Intelligence 1
CS 5314
Spring Semester

Audio Analysis / Situational Awareness
Project Proposal

TEAM

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Gabriel Miki
Derek Gomez

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Part I - Team Member Qualifications

Guillermo Lopez

- Graduate student with experience in full stack development along with working knowledge of ML tools such as tensor flow. I have taken. My knowledge is derived from my time as a researcher under Dr. Villanueva and a machine learning class taught here at utep by Dr. Deblasio. The result of these experience resulted in the development of two web application for the city of el paso and a ML project focused on detecting suicide probability.

Jose Vega

- Graduate student with a background in Machine Learning and Optimization research. I am familiar with machine learning tools and have worked on building applications such as a mallard classifier that is now used by the Texas and wildlife department. This application uses neural networks in order to predict the type of mallard species as well as specific traits such as its sex and plumage using data provided by the Utep biology department.

Gabriel Miki

- Undergraduate student with experience in web development. Currently working as an Undergraduate Teaching Assistant and as a Research Assistant for both the Computer Science Department and the Physics Department. Most of my experience is based on personal projects, which allowed me to get experience with several libraries and APIs, such as the numpy, icecream, TKInter and CustomTKInter libraries, and the OpenAI API and telegram bot API.

Derek Gomez

- Undergraduate student proficient in object-oriented programming, I am currently engaged in developing a cutting-edge penetration testing tool infused with artificial intelligence as part of my Software Engineering course. Alongside, I have independently crafted various small-scale projects spanning web development and object-oriented programming domains. My commitment to continual learning and advancement within the realm of computer science is unwavering, and I approach challenges with fearless determination.

Part II - Project Idea/Goal

In gaming knowing a person's location can be the deciding factor of a victory or a defeat. We aim to develop an AI for Counter-Strike: Global Offensive also referred to as CS:GO that enhances the gaming experience by providing the user with an audio detection tool that identifies the general direction of players. This project centers on utilizing sound analysis techniques using machine learning to provide players with useful information about the general location of players through the analysis of footsteps. CS:GO's audio feature is the key fundamental of the game which allows players to determine the direction of enemy movement based on audio cues. Utilizing this key feature to leverage a useful interface with information on the directionality of players will drastically impact the gaming scene.

Furthermore, our goal is to implement an AI capable of analyzing in-game audio and translating it into visual indicators. By doing so, players who may face challenges in utilizing audio cues can still gain

valuable insights into the location of opponents. The AI will aim to achieve audio signal processing using machine learning and real-time visualization to offer an immersive useful tool for players. To further this project we would likely try to implement this audio analysis outside the realm of gaming into the real world to help individuals with hearing impairments gain information based on the sounds around them in an interactive display. While this is not expected to be completed during this time this is something the team would enjoy to explore outside of this class.

Part III - Required Resources

Resource 1 - Counter-Strike: Global Offensive
The main resource of this project will be centered around the game CS GO where we will use custom maps to gather necessary audiorial data to develop the data necessary to test our end product. For more context CSGO is a first person tactical shooter where both visual and audio data is required to be effective at the up levels of competitions. We know this because players on the competitive stage are able to discern the general activity and location of an opposing player by merely listening to the footsteps and other sounds made by them.

Resource 2 - Hardware Tools
Since we are dealing with the real time analysis of auditorial data some hardware will be needed to make the end product effect. In other words, in order to capture the stereo audio produced from the game it is necessary to split the audio into two channels though the use of cable adapters and two usb audio cards to handle the dual channel. In total, the cost should come out to around 30 dollars, however we can cut the price down by a bit though the use of the integrated audio/mic jack on our computers. All in all, the required hardware should be inexpensive at best.

Resource 3 - Data Resources
Seen as this is a realm of gaming that is not widely researched the data resources that we will need will need to be generated by the team. This will be completed by using the previous hardware tools in addition to the team going into the Mirage map and creating audio files and labeling the direction manually. While this is a long process this will be required in order to successfully complete the project. For the sake of time we will only be focusing on the Mirage map. There are various maps in CSGO however, footsteps may be different based on differing terrain due to this we will reduce the scope to only one map.

Part IV - Deliverables Outline

Below we will be describing what will be expected to be delivered for each deliverable. In addition to how we plan to determine evaluation metrics for our results.

Interim Deliverable:

For our interim deliverable we plan to have created our team Github which will include our audio dataset and three different coded AI algorithms which analyze audio based on our research. We will also include our current state of our report which should consist of the research we found in addition to our

evaluation of the current models based on our metrics explained below. We also plan to have a UI developed which will show cardinal directional output in the form of arrows going up, down, left, and right. The GUI will not yet be connected to the model as we will still be finalizing our model in addition to working out the real time feeding of data into our model that will be completed on the final deliverable.

Final Deliverable:

For our final deliverable we plan to have a fully functioning cardinal GUI which detects player location based on the audio output and is displayed in real time. In addition we will have an in depth report which highlights the models used, their metrics and the model chosen based on the evaluation metric criteria. In addition we will include a section indicating our process for data collection.

Evaluation Metrics:

We will use standard metrics such as accuracy, precision and recall, along with a confusion matrix to measure the performance of the model with data from our data set. The confusion matrix will give us a good indication of each model's behavior. Then we will test it on live game play by utilizing the game replay recording function to obtain the location of players on the map. From there we will flag the result with a 1(positive) or 0(negative) if the AI was able to correctly tell the general location of a player when there was a player nearby. As a result, the performance metric for the in game result will be the ratio of positive flags to negative ones.

Part V - Task Breakdown

Task Format:
-> Task (Date due) (Team Member Primarily Responsible for task)

Task Breakdown:
-> Create team GitHub to store team artifacts including but not limited to dataset, source code, and documentation. (2/29/2024) (Guillermo Lopez)
-> Researching available options for audio recording (3/5/2024) (Gabriel Miki, Derek Gomez)
-> Generate audio dataset (3/16/2024) (Jose Vega, Guillermo Lopez)
-> Researching 10 AI algorithms that are standardly used for audio analysis(3/11/2024)(Jose Vega, Derek Gomez)
    -> Obtain and code 4 different audio AI algorithms (3/16/2024)(one per person)
    -> Preliminary test our 4 different algorithms (3/18/2024) (one per person)
    -> Begin writing report based on research obtained (3/24/2024)(one per person)
-> Develop our UI interface to show direction of players (3/15/2024) (Guillermo Lopez)
-> Integrate UI with AI model and test to ensure seamless integration. (4/10/2024) (Guillermo Lopez, Gabriel Miki)
-> Finalize AI Algorithms (4/15/2024) (one per person)
-> Complete the Report (4/20/2024) (everyone)

Bonus – Not in Task Breakdown this would be only completed if the rest is done before expected
-> Integrate diagonal movement processing in addition to our standard cardinal directions.