Project Idea

### Overview

The Mimi-box is a ‘party friendly’ casual party game with game design focused on user interactivity through voice input. This ‘fun for all ages’ game device has the players speak to the box to try and imitate their fellow players voice playback, it then scores the players based on how closely they have mimicked their fellow player all within given turn-based rule sets and game modes, points are awarded for most modes so players will try their best to be the top mimic each round. The Mimi-box also utilises pre-recorded pre-stored voice lines from a ‘game host’ that will guide players and interchange between various situations to maintain entertainment. This game encourages spontaneity and creativity of player’s using their voice while utilizing accents, tongue twisters and any assortment of sounds the player can muster to throw the opponent off, with the primary intention of inducing unique, ridiculous game play with high replay ability.

### Motivation

The motivation behind the gameplay aspects and decisions made into the design of the Mimi-box are inspired by the normalization of household party games during the COVID-19 pandemic. We want family and friends to have a new interactive form of entertainment to enjoy due to the given circumstances that Australia and the rest of the world is in.

At the current time with "Social distancing" in place throughout Australia, people have been unable to meet each other, let alone interact in forms of entertainment outside of online media, gaming, or movies. From the 2006 study that showed "the average 15 to 34-year-olds spends just under 3 hours with friends and 10 hours with their family each weekend" we have simple statistics we can draw upon along with the given situation of COVID-19 that brings our project a clear aim, to facilitate the popularity of interactive party games, fulfilling the human need for social interaction. The Mimi-box is all inclusive, with voice recognition technology not requiring accurate pronunciation (or even the same language), having a low base skill level requirement, and the game design encouraging fast paced interactions in social groups. Therefore, the Mimi-box project will be able to fulfill these aforementioned social interaction needs and become a game product people can use to feel closer together.

Melbourneinstitute.unimelb.edu.au. 2020. [online] Available at: <https://melbourneinstitute.unimelb.edu.au/\_\_data/assets/pdf\_file/0007/3376879/ri2020n08.pdf> [Accessed 20 October 2020].

Description (design, Gameplay)

The concept for a basic run of the game doesn’t involve too much, after starting the game with 2 or more players, the first user will input the number of players and then record a sound / message when prompted by the Mimi-box. Prior to the first input, each of the players will need to input their name so each user input can be identified. When ready the player can press 'speak', this button will allow the user to record their input to be stored by the Mimi-box, then pressing skip will start the game which will first instruct the player of how the game works, with the emphasis on recording a voice that is difficult for other players to repeat. After which the next and or all player/s will attempt to imitate what the first player sounded like and the individual with the highest accuracy will be considered the winner of the game/ round.

A secondary game mode of the box called funny mode will pull from a pre-stored library of sound effects and sentences, which when played-back asks the players to imitate the sound collectively in turn, whomever is the closest wins said round, or moves on without elimination. These voice recorded inputs by players will have a timer to have the inputs be properly comparable, this means you as a player are on the clock to provide your statement, joke or accented sentence or whatever the player is capable of choosing within the frame of ten seconds.

The physical device is a raspberry pi that utilizes java and frontier series to compare the MEL-Frequency spectrum of a user input determined by contrasting the difference in frequency/ pitch between the inputs which will determine the most efficient match. This is how a given winner of a set game of Mimi-Box is decided, without any player input the game will pause and using the skip button is how to have the game continue between turns.

The physical design of the box is a 10cm x 10 cm case that closely resembles a hexagonal prism that can be seen (link here), holds the interior mechanisms audio and power within the casing with the boxes centre of mass being focused around the base, the device itself is generally expected to be utilized by children and or youth or perhaps adults that are inebriated, therefore, the device needs to be shock absorbent and liquid resistant to reduce direct damage to the functional hardware. The powering of the device will require 6xAA batteries that are found underneath the device in a screw bound compartment, the box has majority of its user inputs taken on the faces at the top of the case consisting of five buttons, one button for ‘power’, two buttons for ‘volume’(up/down) control, a button for ‘skip’ which also acts as a user’s continue button located on one side, while on the other side hosts the last button ‘speak’. Under the speak button and behind the case there are small grated holes, when the speak button is held the microphone behind the grated holes will record clear and concise audio inputs, and on the top an output speaker for the device to communicate the directions and next instruction.

(Mel frequencies)

Docs.nvidia.com. 2020. Audio Spectrogram — NVIDIA DALI 0.26.0 Documentation. [online] Available at: <https://docs.nvidia.com/deeplearning/dali/user-guide/docs/examples/audio\_processing/spectrogram.html#:~:text=error%3A%200.00359%20dB-,Mel%20spectrogram,by%20humans%20as%20being%20equidistant.> [Accessed 20 October 2020].

### Tools and Technology

The technology at hand is a Raspberry Pi Zero set up to run the game through a java code program. That program will take the users voice inputs as a measurement in Hz, then make an excerpt of the given audio signal from this user's voice input, then the users input, and take the frontier transform (a composition of a signal over time given as a function that is subsequently broken into its constituent expressions of frequencies). From there you have to map the powers of given powers in correlation to the Mel spectrum specifically utilizing Triangular overlapping windows which provides the pitch of the speech given decibels/ amplitude of a dictation.

This can be used to compare the users pitch of input, to do as said the program needs to take the log of the each of the recorded Mel frequency's, there after performing a discrete cosine transform with the list of Mel frequency logged powers.

That has become the resulting signal that the other players are intending to match with, this is a MFCC's, in order to have the box perform a comparison it will be necessary to compare each of the recorded Mel frequency's as matrices with identical vector signal size. Hence 10 seconds each is chosen to be consistent per turn to have each matrix line up for this comparison more dynamically for the Frontier transformations, where taking the two inputs as A & B and the proposed distance between them being C which would function as (CxA)= X and (CxB) =Y ,(X/Y) = the distance between the two frequency MFCC's. This is called speaker adaptation, notably the first coefficient provided by the MFCC is an expression of loudness and should be disregarded when the intention of the device is the comparison of utterances.

The physical components of the case that are found primarily within the box are a Adafruit 12S MEMS Microphone for sound input as well an mini HAT, the Adafruit 12S 3W Stereo Speaker Bonnet mini Kit, using 12S digital sound to create clear crisp audio, with the intention of efficiency and Saving power, the Mimi-box uses 1 mono 40mm diameter 4 Ohm 3-watt speaker. The power is provided by a 6xAA battery pack connected via a universal battery eliminator circuit that is within the aforementioned bottom skew compartment for ease of battery change and safe use.

En.wikipedia.org. 2020. Fourier Transform. [online] Available at: <https://en.wikipedia.org/wiki/Fourier\_transform> [Accessed 20 October 2020].

En.wikipedia.org. 2020. Window Function. [online] Available at: <https://en.wikipedia.org/wiki/Window\_function#Triangular\_window> [Accessed 20 October 2020].

similarities, S., 2020. Speech Comparison Algorithm For Rating On Similarities. [online] Signal Processing Stack Exchange. Available at: <https://dsp.stackexchange.com/questions/7581/speech-comparison-algorithm-for-rating-on-similarities> [Accessed 20 October 2020].

## Skills Required

Given the Raspberry Pi is Linux base operating software, this particular case will need to install and set-up the device to be running java using Open-JDK as this is one of the most efficient ways to achieve development of variable loops and comparisons. Furthermore, this program requires methods to be called by taking inputs of the user as a discrete function which can then be compared against each other, we do this comparison to determine the winner of a round or game. After this, we instigate various while loops as well as actively declare the user’s inputs as variables that can be correlated to integer values to then be evaluated and compared based on intensity/ amplitude to see how accurate the repeat of a given sequence is. With that in mind array values will need to temporarily store the variables of the inputs we are matching and the recordings that are being compared against within a margin of error and loop back turn by turn.

The hardware challenges require the Mimi-box to have the microphone, pins and heads of each component individually soldered to the raspberry Pi. Thankfully the components themselves can be purchased from Adafruit and Pi hardware as an available direct bulk purchase and distribution batches, yet individual assembly is still required per unit production as well as development and implementation of java code to function for the game. This can be implemented in FFT to capture the input and have an active and a copy as to store one array, then to compare each active player against the first input and log each player’s score to display at the end of a round/game.

Linuxize.com. 2020. How To Install Java On Raspberry Pi. [online] Available at: <https://linuxize.com/post/install-java-on-raspberry-pi/> [Accessed 20 October 2020].

Web.archive.org. 2020. Java Implementation Of The FFT Algorithm — CMD-C && CMD-V. [online] Available at: <https://web.archive.org/web/20120312201547/http://blog.datasingularity.com/?p=53> [Accessed 20 October 2020].

### Outcome

Our projects intended proposed idea is a feasible and fun game for friends or family to enjoy on a causal basis. Mimi-box is intentionally creating gameplay that fulfills the social needs of the individual with the game design choice that invites inclusivity. It is designed to expand upon the voice recognition industry under the guides of creating an entertainment system that promotes creative social interaction as a standard of household party games. With a purpose to draw attention to our needs as people in a modern society and revitalize the party game category, using the innovation of the dynamic raspberry pi and supporting hardware and software to present to you the Mimi-Box.

Original References:

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Hardware for Project:

Raspberry Pi zero W https://www.raspberrypi.org/products/raspberry-pi-zero-w/

Microphone input https://www.adafruit.com/product/3421

Mini HAT https://www.adafruit.com/product/3346

Speaker output https://www.adafruit.com/product/3968

DIY Portable Raspberry Pi Power Supply https://www.makeuseof.com/tag/pi-go-x-ways-powering-raspberry-pi-portable-projects/