Guess! Where is the sound coming from?

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1. Project concept

Imagine that when you're walking on the street, you hear someone calling your name; or when you're alone at night, you hear a strange noise...can you detect which direction the sounds are coming from? This ability is important for human beings, but there exist individual differences. Some people are good at telling the source direction of sounds, while others find it difficult. Therefore, we aimed to build a game in which people are allowed to try if they are capable of locating the source of sounds.

Besides, with multimodal senses, people always process information from the outside world from different kinds of perceptions, such as visual, auditory and haptic cues, but there are people who are disabled in some senses. We wanted to invite our audiences to imagine if they can also rely on one of their senses, which, in our project, is the auditory sense. If the users fully concentrate on their hearing, without any visual cues, what kind of experience they would have? We wanted to create this experience by inviting them to wear an eye mask and be fully immersed in the sound world.

2.Game design

We planned to build a sound-human interactive game that allows users to guess which direction the sound is coming from. We were inspired by the film *House of Flying Daggers*. In the film, there was a scene where a blind dancer listened to the sound of stones hitting drums (https://www.youtube.com/watch?v=p-nmfwQdkeM). The drums were around her in a circle, and the sounds of drums created an impressive stereo audio effect.

Figure 1. Screenshot of the film *House of Flying Daggers*

As shown in Figure 2, in our game, there would be one user, standing at the center of six speakers placed as a circle.

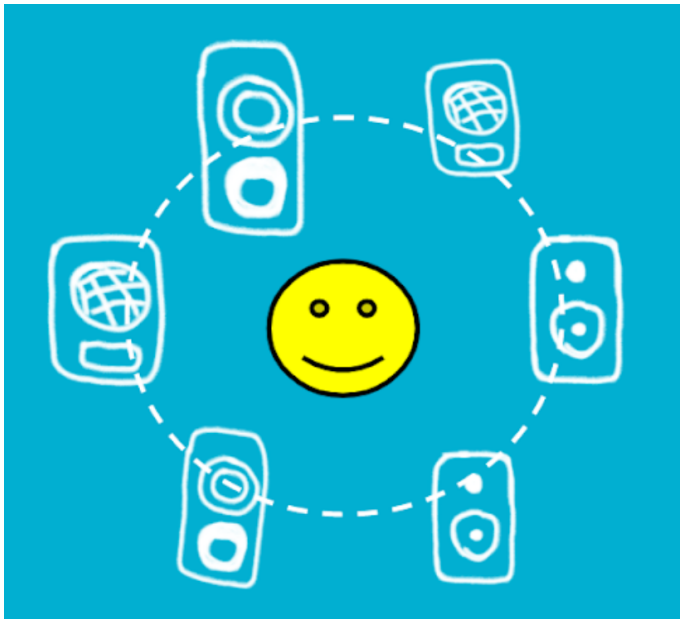

Figure 2. Sketch of a user standing at the center of six speakers

Here is a description of the game rules. When the game starts, there will be a sound played by one of the six speakers. The user, wearing an eye mask, is expected to face the direction of the sound correctly and press the button to confirm his/her choice of direction. If their guess is correct, the next round will start. The existing sound will be speeded up, and after several seconds, a new sound will be added, being played by one of the rest five speakers. They have to guess the direction of the new sound. If their choice is correct, they will go to the next round and another new sound will be added again, played by one of the other four speakers. There will be six rounds in total. In each round, there will be a new sound added to the existing sound(s) from a new speaker. The users' task is to detect the direction of the new sound. If their guess is not correct, the game will go back to the previous round, so they have to do the last round again.

3. Hardware and technology

3.1 Output: sounds and speakers

Sounds are the only output in this project. There are two kinds of sounds. The first kind is the sound playing as targets. The users have to listen carefully to those sounds and try to detect the direction of them. There are six different types of sounds, which can be distinguished from each other so the users can tell which one is the newly added sound.

The second kind of sounds is the feedback sounds. When the user's guess is correct, there will be a winner sound effect to let the users know that they've guessed correctly. If they have guessed wrongly, they will hear a failure sound effect. After they have completed the final round, a final win sound effect will be played. Both the two kinds of sounds used as outputs in this project are manipulated and controlled by pure data.

As mentioned above, there are six speakers. We placed them on six chairs in a circle, as shown in Figure 3. In the game, each time the six sounds would be assigned to the six speakers randomly, to make sure that the users can't win this game by memorizing the order of the speakers.

Figure 3. Photo of the six speakers

3.2 Input: direction and button

To know the users' choice of direction, we needed to use a compass sensor, which can sense the direction that the sensor is facing and sending the signal back. We also used two microbits to transfer and analyze the signals to the pure data. We chose to use the microbit because it has a compass so we can know the direction of the person standing with the compass and it can communicate wirelessly with a PC.

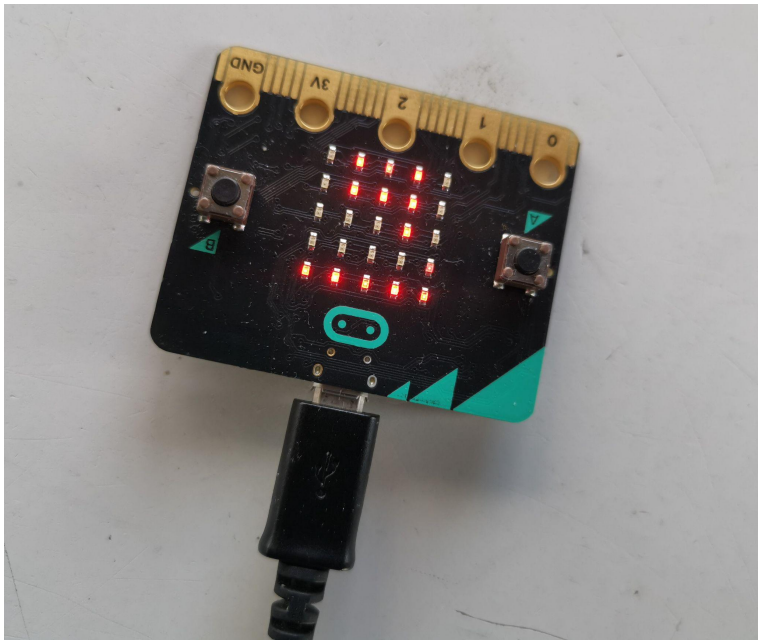

Figure 4. Photo of a microbit

The coding of this part was done in python. To fix the position of the compass sensor, the sensor has been attached to a headband. The user has to wear the headband so we can read the data of directions.

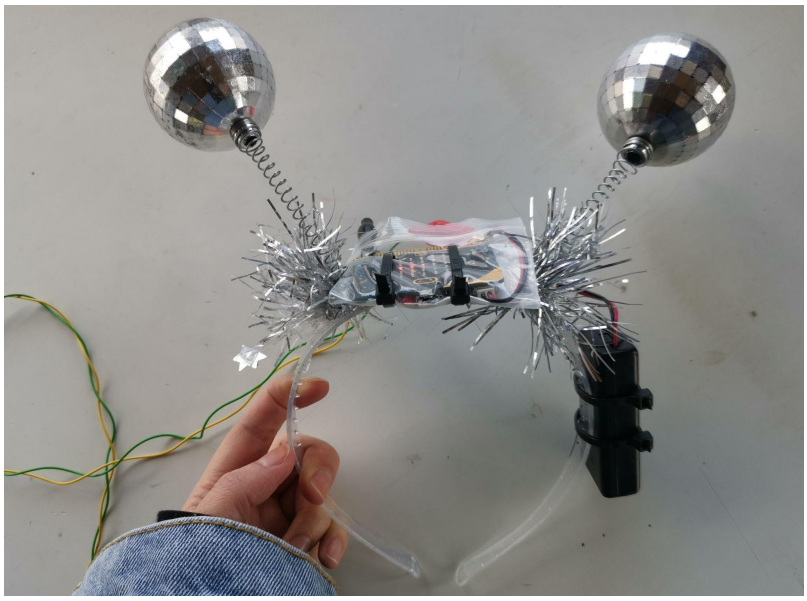

Figure 5. Photo of the headband

We also used a button to allow the users to confirm their guess of direction. The signals from both the compass sensor and the button would be received by the python code, and then be sent to the pure data patches. A graph of this process can be found below.

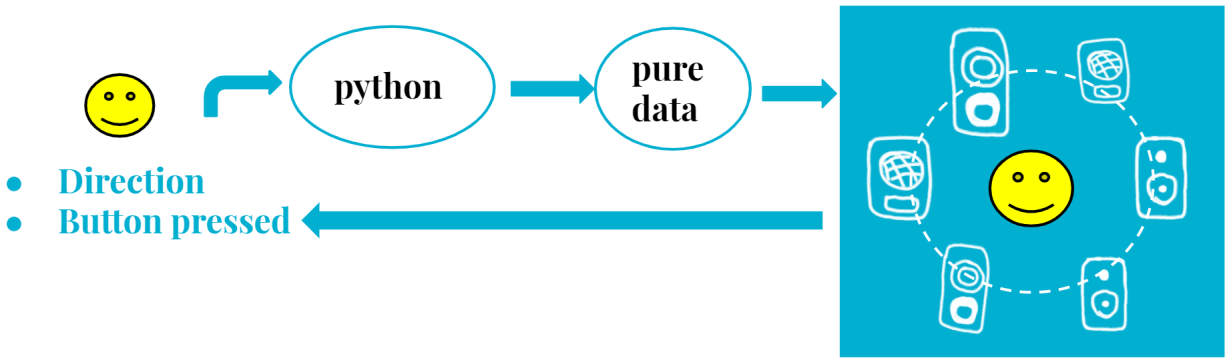

Figure 6. Graph of the signals

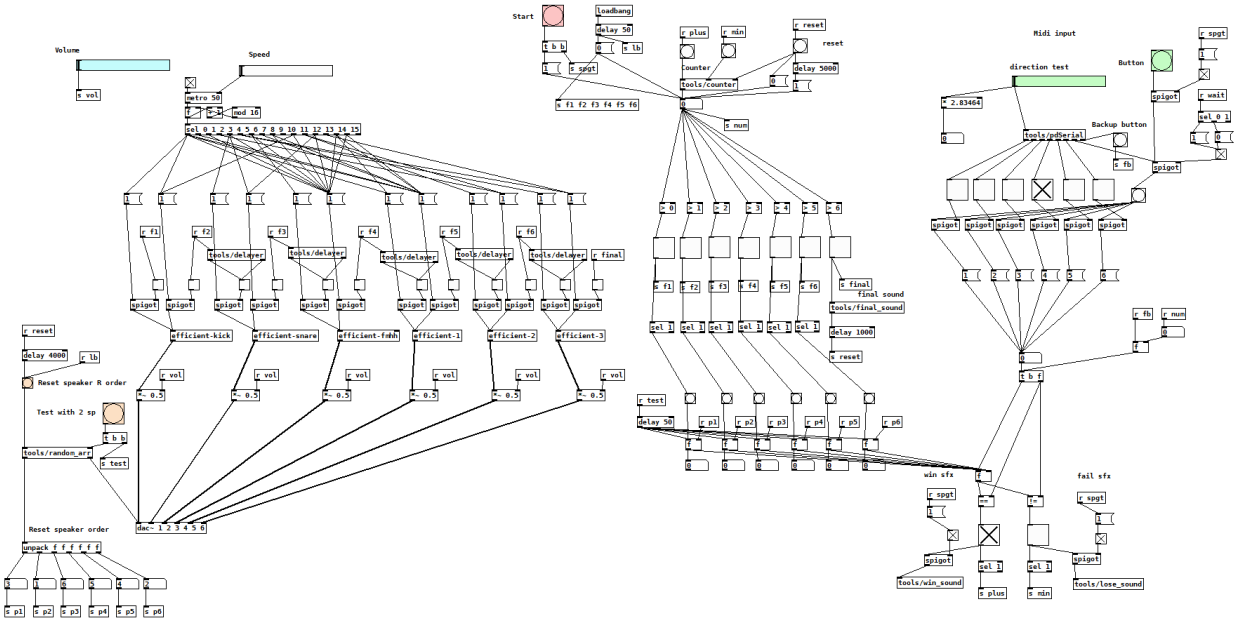

Figure 7. Screenshot of our main pure data patch

4. Result

After multiple times of calibration and adjustment, now the hardware and codes can work perfectly as we planned. Here are two photos of us playing the game.

Figures 8&9. Photos of us playing the game

After user testing, we found that this interactive sound game system we built can effectively test users' ability to detect sound directions and give them the right and wrong feedback.

A video of our output can be found here (https://www.youtube.com/watch?v=vjIJd_R3oZ8). Pure data patches and python code will be uploaded. A 'readme' file can be found in the code folder as well, including steps of using the patches.

As for future directions, we can make one speaker play multiple sounds or make multiple speakers play one sound at the same time to increase the game's level of difficulty and playfulness. We can also explore different kinds of sound textures and

combinations and their influence on human detection of sound directions. We hope to invite more people to be immersed in the amazing auditory world and to think about the various interactions between humans and sounds.