Statement of Originality:

Statement of Original Work: I certify that the concept of the prototype, part of the prototype scene in Unity, and the logic on the interactions between circuit playground's movement and the Unity screen is my own original work. In the construction of this prototype, I also used various external resources, which include YouTube tutorials, the help from the Unity forum and the tutorials form the Adafruit website. All the external sources I used in prototype three construction will be listed below.

[1] The codes that obtain the keyboard inputs in countdown.cs: Unity tutorial, retrieved from https://learn.unity.com/tutorial/lesson-1-4-use-user-input-to-control-the-vehicle?uv=2020.3&projectId=5caccdfbedbc2a3cef0efe63#5cbe3969edbc2a191e639152, last accessed 19/10/2022

[2] Port setting for unity and Arduino communication in countdown.cs: Class Tutorial, retrieved from https://learn.uq.edu.au/bbcswebdav/pid-8211376-dt-content-rid-47444573_1/courses/DECO2300S_7260_61655/2022-W07%20Tutorial.pdf, last accessed 19/10/2022

[3] Receive port values code in countdown.cs: Class Tutorial, retrieved from https://learn.uq.edu.au/bbcswebdav/pid-8211376-dt-content-rid-47444573_1/courses/DECO2300S_7260_61655/2022-W07%20Tutorial.pdf, last accessed 19/10/2022

[4] Change object color code in countdown.CS: Class Tutorial, retrieved from https://learn.uq.edu.au/bbcswebdav/pid-8211376-dt-content-rid-47444573_1/courses/DECO2300S_7260_61655/2022-W07%20Tutorial.pdf, last accessed 19/10/2022

[5] Port Setting code in prototype3_arduino: Class tutorial, retrieved from https://learn.uq.edu.au/bbcswebdav/pid-8211376-dt-content-rid-47444573_1/courses/DECO2300S_7260_61655/2022-W07%20Tutorial.pdf, last accessed 19/10/2022

[6] Change color of unity panel in countdown.cs : Unity forum, Retrieved from https://answers.unity.com/questions/866047/changing-unityuipanel-color.html ,last accessed 19/10/2022

[7] Timer tutorial in countdown.cs : Youtube tutorial, Retrieved from https://www.youtube.com/watch?v=ijAN0QI70UU , last accessed 19/10/2022

[8] Buttons& Slide switch code in prototype3_arduino: Adafruit tutorial, retrieved from https://learn.adafruit.com/circuit-playground-lesson-number-0/buttons-slide-switch , last accessed 19/10/2022

[9] Capacitive touch code in prototype3_arduino: Adafruit tutorial, retrieved from https://learn.adafruit.com/circuit-playground-fruit-drums/hello-capacitive-touch , last accessed 19/10/2022

[10] The play tone code in prototype3_arduino: Adafruit tutorial, retrieved from https://learn.adafruit.com/circuit-playground-music/the-circuit-playground-library, last accessed 19/10/2022

Basic Details:

Name: Chi Heng Jeffrey Hui

Student Number: 46587590

Practical Session: Thursday, 10am

Tutor: Tahlia Slater

The Concept:

Most of us have experience in driving, and most of us should experience fatigue driving in some extent, which can be driving back home after whole day of work or driving for long-hours during a road trip. We all know fatigue driving is very bad, since it is very hard to focus. In addition, it is very dangerous. The best way to handle the fatigue is to takes some test, but it may not feasible all the time. Under these circumstances, we need a solution to keep the driver alter and stay conscious while they are driving, so creating a driver alert system would be a perfect solution.

The driver warning system is a reminder system, which will take drivers head movements data and eyes movement data as the input and provide corresponding feedbacks to the driver.

The driver warning system has two modes, which are “low” and “high”. “Low” mode will be triggered when the driver’s fatigue level to adequate. In “low” mode, the application will provide normal sound feedback and temperature feedback to the driver. The objective of “low” mode is to provide initial alter to driver, which prevent them getting sleepier.

“High” mode will be triggered when the driver’s fatigue level is high, which means they can barely focus on the road or already fall asleep. “High” mode is an urgent of the system, since the driver is not paying attention to the road, and danger can happen any time. In “high” mode, feedbacks are aggressive. For instance, both vibration feedback and aggressive sound feedback are triggered. The objective of “high” mode is to help the driver retrieve consciousness or stay awake in the shortest amount of time, so that keep the driver safe.

The goal of the driver warning system is to keep driver away from fatigue driving and keep them away from danger.

The Purpose of this testing round:

As mentioned in the concept, “high” mode will provide more aggressive sound feedback and vibration feedback to user. The research aspect of prototype 3 will mainly target the aggressive sound feedback of the “high” mode. Sound patterns can make sound feedback stronger and more aggressive when presenting to the drivers. There are many patterns, which may create various effectiveness to the application. More specifically, prototype 3 will explore the pattern on sound pitch, and see what kind of pattern will provide the best effectiveness to the system. Constant pattern and random pattern are the patterns I will explore in prototype 3. Constant pattern means the sound pitch will not change when it rings. For instance, if it rings ten seconds, the sound pitch will not change throughout the time. On the other hand, random pattern means the pitch will change randomly. For instance, if it rings ten seconds, the sound feedback for the first 5 seconds can be low pitch, and the sound feedback for the last 5 seconds can be very high pitch. Random pattern means the pitch value changed every second, and the pitch value is determined by a random number which is generated by the system.

The goal of prototype 3 is to test these sound pitch patterns and find out which will provide better effectiveness and user experience to our testers, so that I can implement the most effective approach to my concept in the future.

To meet the requirements of the evaluation, there are things that I need to include and exclude during the construction of the prototype.

There are different things I need to include, for instance, I need to have a clear metrics that can measure both patterns effectively and with no bias. Having the right metric while constructing the prototype is important, since the metric can help us evaluate both patterns and differentiate the differences between these patterns, so that we know which performs better and we can get the conclusion.

There are things I need to exclude as well, for instance, I need to make the prototype as intuitive as possible. Although having a more detailed approach will help you understand your research aspect better. But I also need to understand the testers may not totally understand what I am trying to do, even I try to explain as much as I can. Making the prototype simple and easy to understand is needed and I need to exclude complex designs and having too many steps in my prototype.

The research question of this prototype: How we convey the sound feedback can make differences on the effectiveness of the system. Constant pattern of sound feedback and random pattern of sound feedback are some common patterns. Both seems legit and efficient, but we want to know which fits better in the driver alert system concept, so that we can use the most effective approach and make the alert system more accurate and useful for the drivers.

Hypothesis: Random pattern will create different pitches when the alert rings. The difference on the pitches can create more fluctuation, which will increase the alertness of the ringing signal, so random pattern sound pitches is better than constant patten sound pitches.

The Form of the prototype:

The prototype is very similar to a reaction time game. In the Unity game screen, there are 5 black boxes. On the circuit playground, I used aluminum foils to create 4 buttons and attached them to the capacitive touch-sensitive pads. The top left aluminum foil button corresponds to the top left box of in the Unity game screen. The top right aluminum foil button corresponds to the top right box in the Unity game screen. The bottom left aluminum foil button corresponds to the bottom left box in the Unity game screen. The bottom right aluminum foil button corresponds to the bottom right box in the Unity screen. The bottom long rectangle box represents the space button on the keyboard. Inputs are obtained from the circuit playground and the keyboard, since I want to slightly increase the complexity of the inputs, so that it is not too easy for the testers. When the testing session starts, either of the sound pitch patterns will be played in the background and the Unity game will get started as well. Testers need to focus on the Unity game screen, as one of the boxes will turn green suddenly. When the testers realize a box turn green, he/she needs to press on the corresponding aluminum foil button. In example, if top left box turns green, the tester needs to press on the top left aluminum foil button. When the correct button is clicked, the timer will stop, and it captures how fast the tester reacts when the sound pitch pattern played in the background.

The following section shows some images which will help understanding the form of the prototype.

Screenshots:

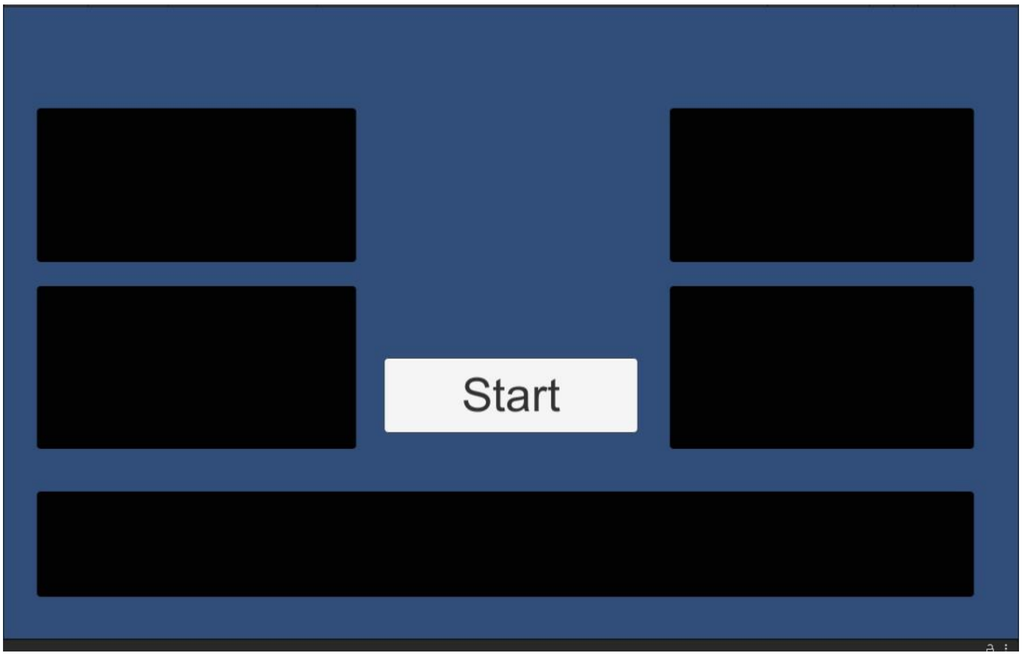

Image1: This is the initial Unity game screen

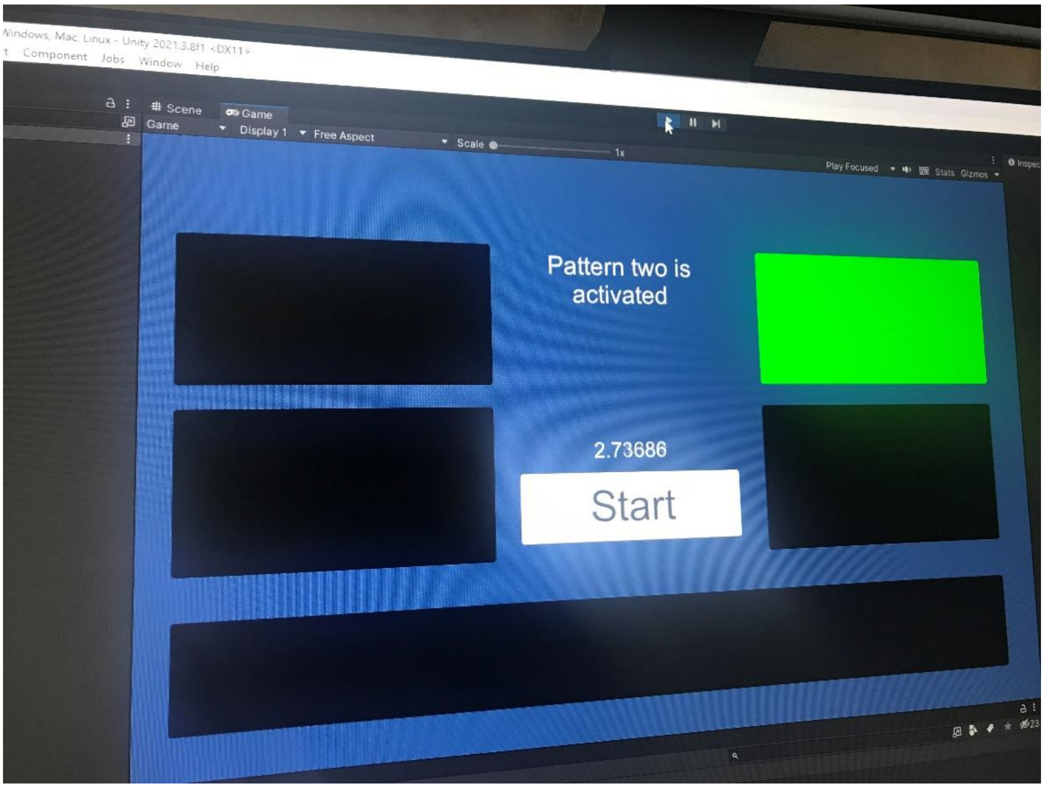

Image 2: This image shows one of the rectangles changes to green at a random time.

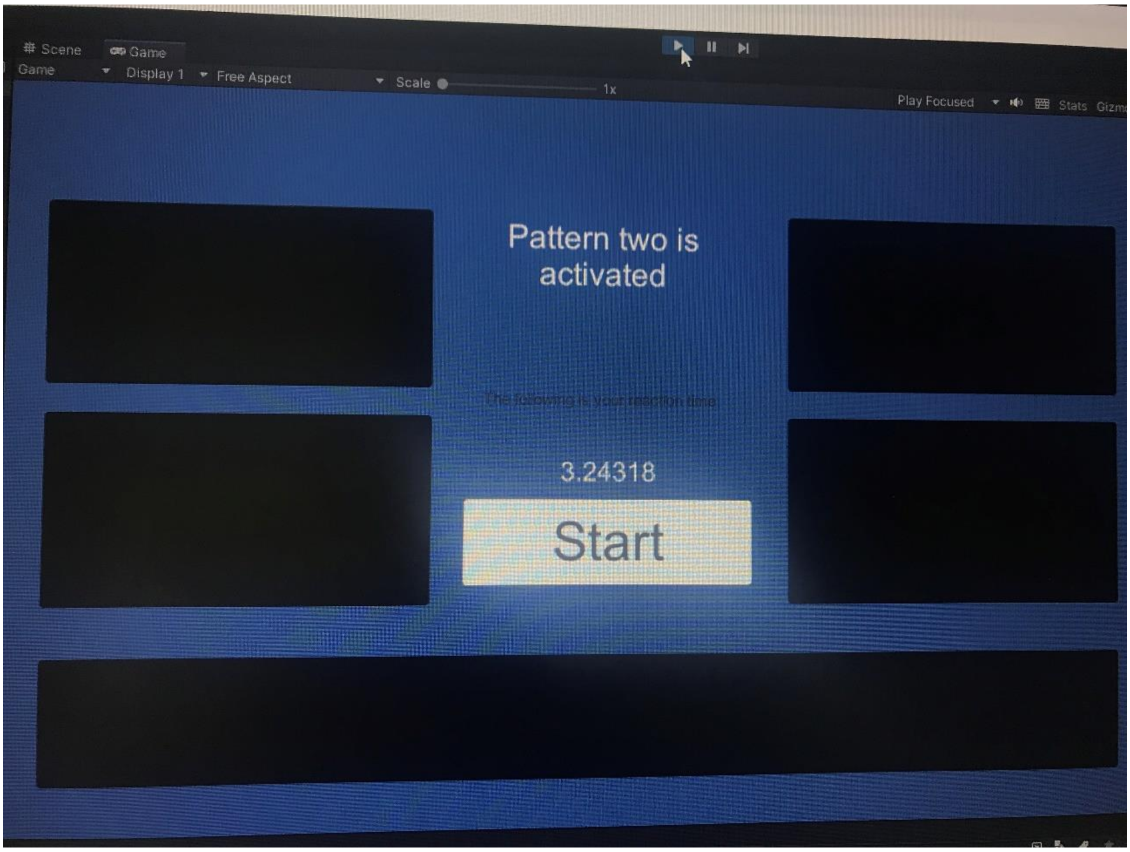

Image3: If the tester pressed the correct aluminum button, the timer stops and show the reaction time.

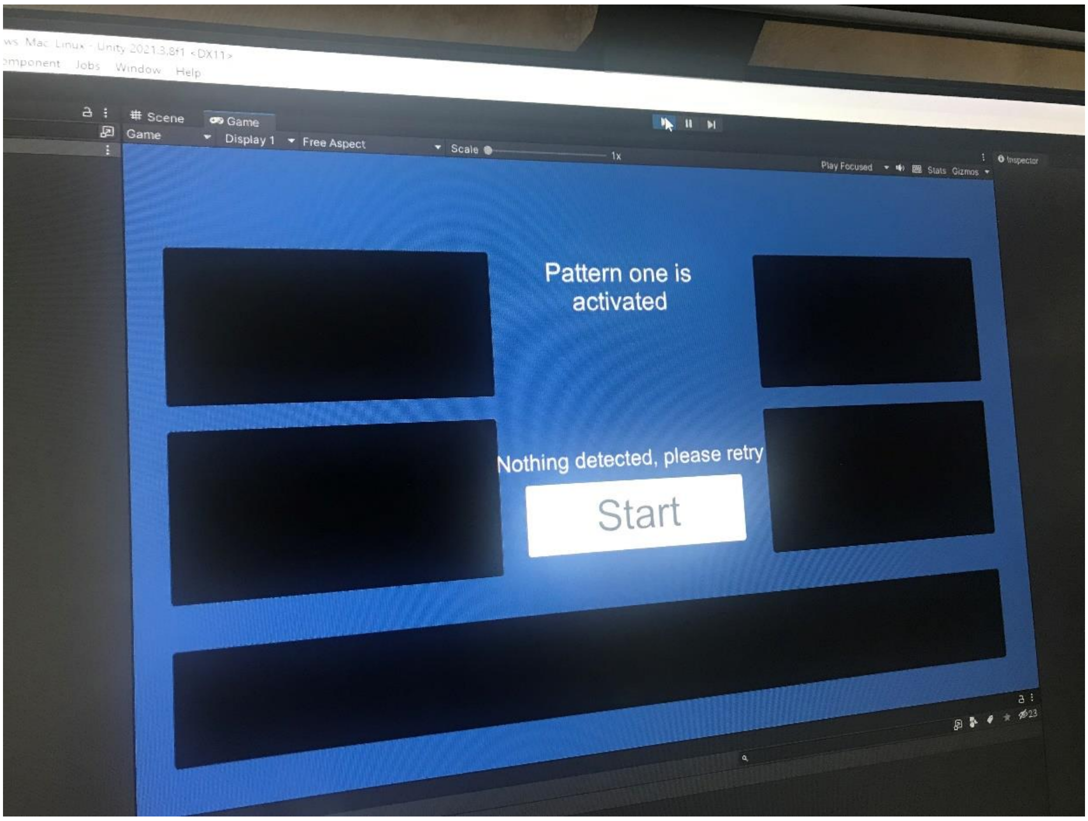

Image 4: If the correct button press is not detected, it would show the screen above.

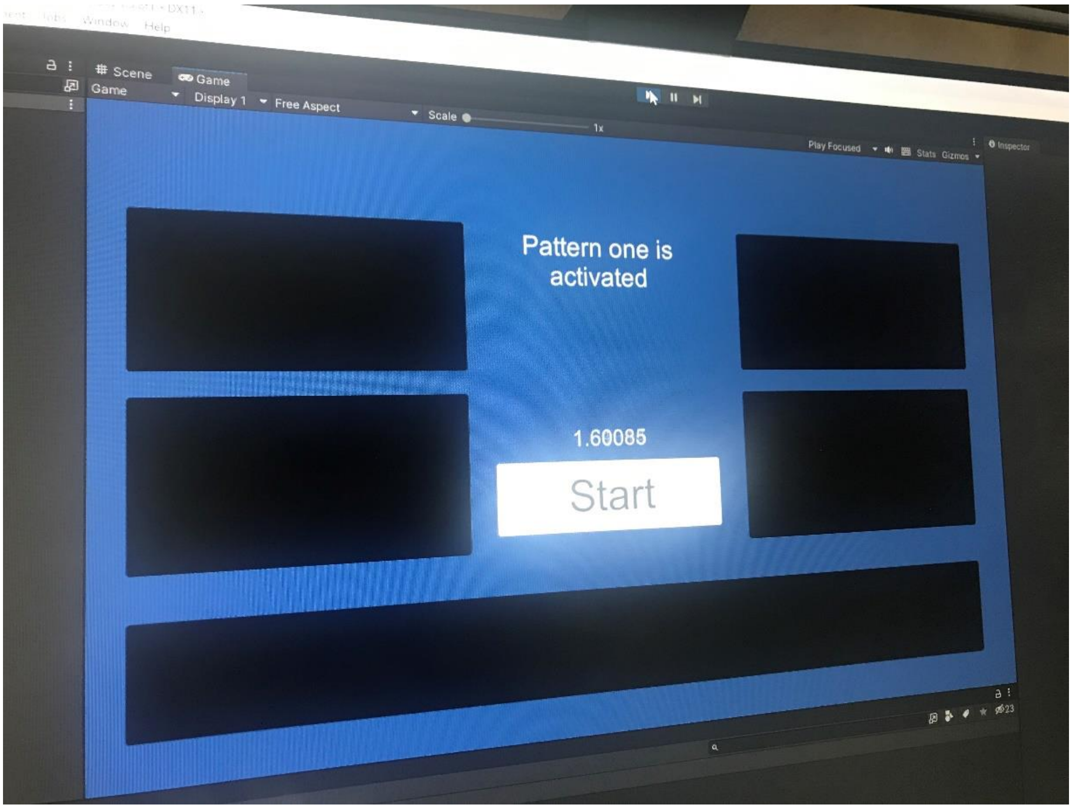

Image 5: As mentioned before, there are 2 patterns to test. When pattern one is enabled, it will show the text “pattern one is activated”.

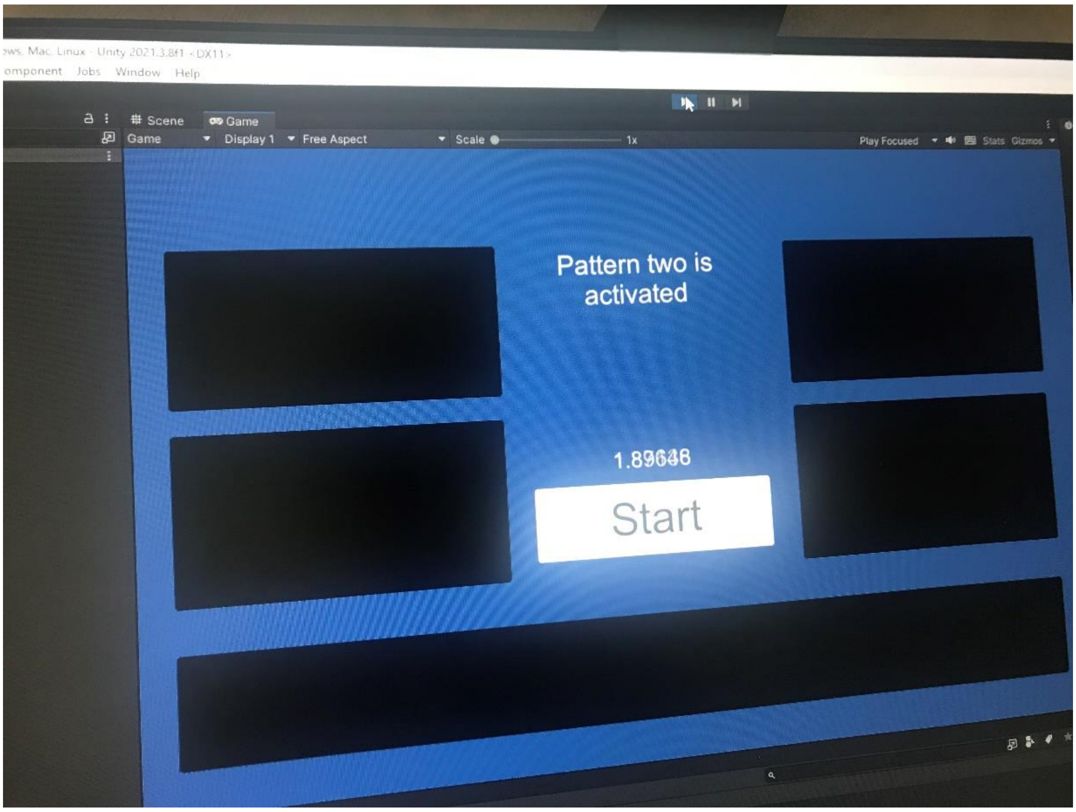

Image 6: When pattern 2 is activated, it will show the text “pattern two is activated”.

Photographs of physical artefacts:

Image 7: This is the circuit playground. There are 4 self-made aluminum buttons, and they are attached on the capacitive touch-sensitive pads on the circuit playground.

Interaction diagrams:

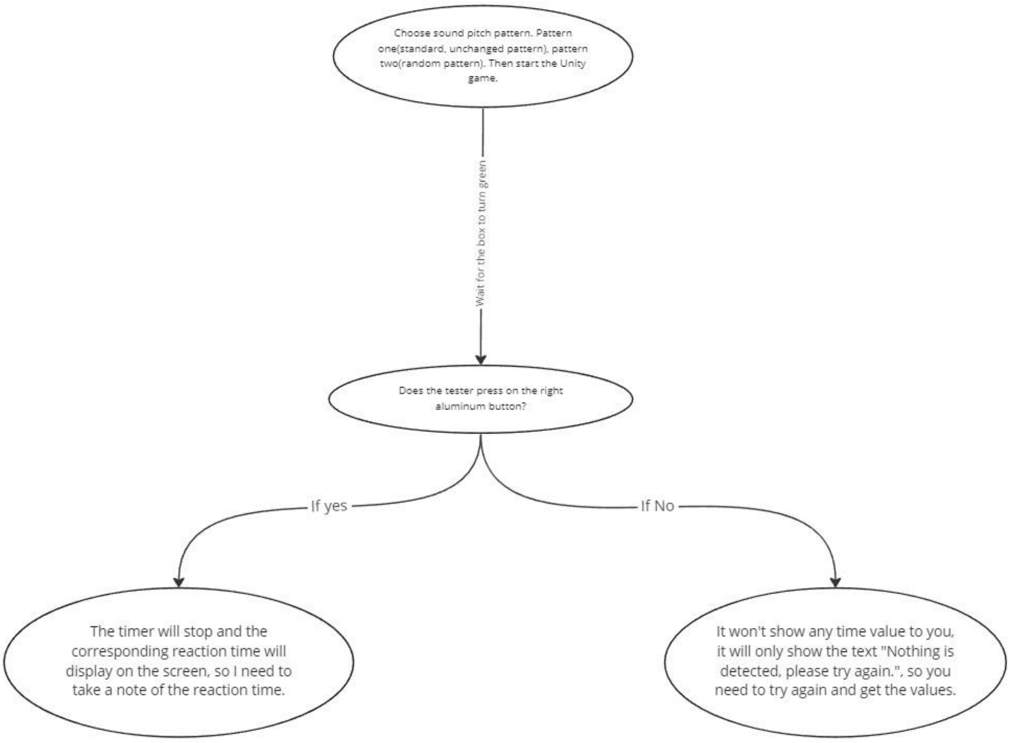

Image 8: This interaction diagram shows how the prototype works. It explains from the starting point to the ending point.

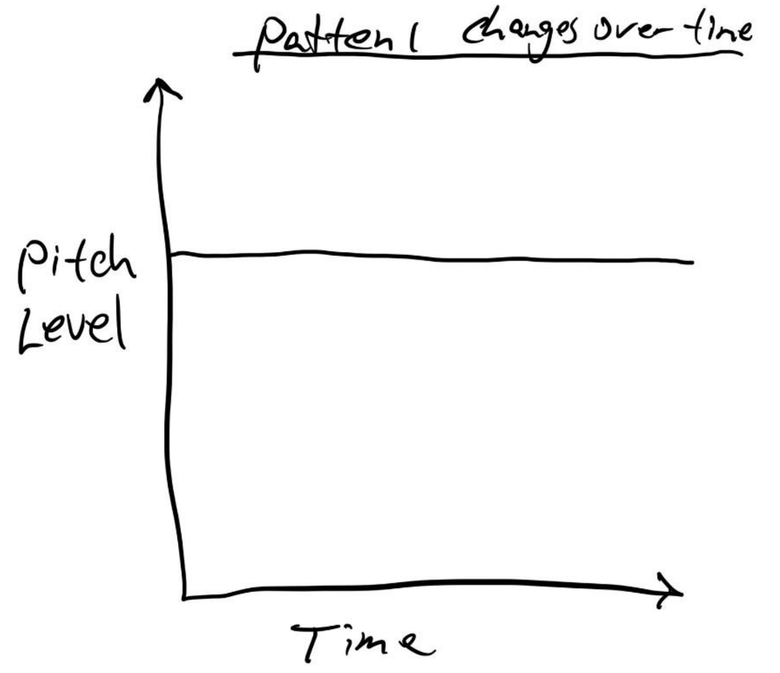

Image 9: This is how pattern one (constant sound pitches) looks like in a graph

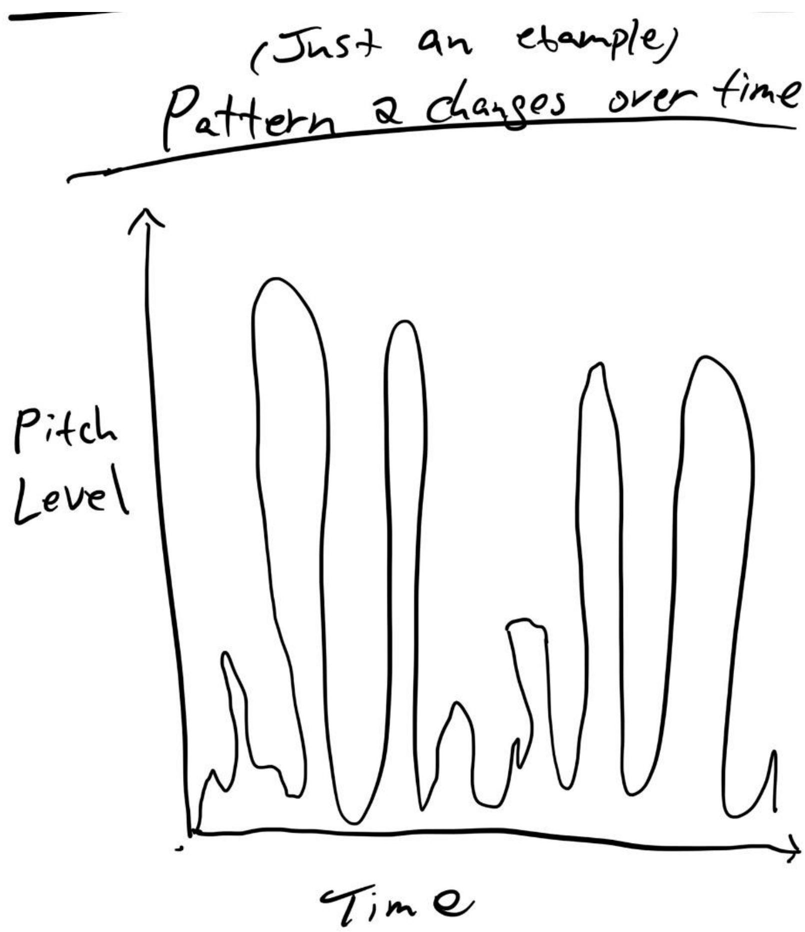

Image 10: This is how pattern two (random sound pitches) looks like in a graph

The Testing Approach:

Agenda:

Step 1: Introduce the concept and the aspect I want to test in the testing session.

Step 2: Explain the flow of the testing session, so that the testers know what they need to do in the session.

Step 3: Testing session begins, the testers will work with the prototype. I will record the testing data in the session.

Step4: Testing session on the prototype ends. Interview session begins. I will ask the testers different questions, so that I know how they think which will give me useful information for the conclusion.

Process:

In the testing session, I mainly ask the testers to do the reaction time test, and test how fast they react to each of the sound pitch pattern. For each tester, I ask them to do 3 trials for each pattern, so the total attempt is 6 times. These data will be used to differentiate the effectiveness of each sound pitch pattern.

Due to the form of the testing session, testers are not able to interact with the hardware of the prototype. Under these circumstances, I can only tell testers to say “stop” when they see the green box on the Unity screen, and I will press the aluminum button for them. Due to the restrictions of an online testing session, this is the best I can do to minimize the impact.

After completing the test on the prototype, I will conduct an interview with the testers which will ask them some questions about my prototype. This information will be used to determine the evaluation outcome.

The interview focuses on qualitative feedback. In the interview, I focus on various aspects, for instance, the tester’s individual feelings on each pattern, how they feel when these patterns integrate into the testing context, and the individual preference when it implements to the driving context. The responses from these aspects help me to understand how other people feel, so that it can proof or correct my hypothesis.

Method for evaluation:

Observation, interaction with the prototype and interview are the method of evaluation in prototype 3. By using observation, I can observe how testers perform and how they feel through their emotions. Interaction with the prototype will give me quantitative data about each pattern. Interviewing the testers will give me qualitative data. By combining all types of evaluation method, it can proof or disproof my hypothesis, and give me an explicit answer to my research question.

Evaluation Outcomes & Reflection:

Results of the evaluation:

There are 6 people testing my prototype. Each of these candidates perform 6 trials. Within the 6 trials, 3 of them are for pattern 1, and 3 of them are for pattern 2. For pattern 1, I have 18 records. After doing the calculation, I realize the mean reaction time for pattern 1 is 1.80(rounded to 2 decimal places) seconds. For pattern 2, I also have 18 records. After doing the calculation, I realize the mean reaction time for pattern 2 is 1.60(rounded to 2 decimal places as well) seconds. From the quantitative data, it shows pattern 2’s reaction time is shorter and faster, so numerical data tells us pattern to is a more effective approach.

From the qualitative data, I also obtained some useful information from the testers. In example, one of the testers said various sound pitches can increase the alert level, since it is more irritative to our hearing, so it can bring better impact. Another tester also thinks using various sound pitches is better, since it is less boring and it will bring stronger sensational to the human, he used a very good analogy to explain his answer. He said fire trucks sirens usually have different pitches when it rings. When we hear the sirens, we can notice them very easily, and it alert us very well.

According to the quantitative results and the qualitative result from the evaluation approaches, I realize various sound pitches will give us a better reaction time, and participants also think it gives them more warning or alert when comparing with pattern 1(the constant sound pitch).

What conclusions can you draw about the concept from the results?

Based on the evaluation result, we know various sound pitches is more effective since participants tell us it is more alerted from their perspective. On the other hand, the numerical data also tells us various sound pitches has a faster reaction time. As my concept is about driver alert system, shorter reaction time means the driver can retrieve his/her consciousness faster, which means it can reduce the time of unconsciousness, so this is exactly what we are looking for. Picking various sound pitches is the right choice.

The changes you will make to your concept in response to the evaluation.

After getting the conclusion from the evaluation outcomes, we understand various sound pitches is more effective. This is what I assume in my hypothesis, so it proofs my initial assumptions is correct. To response to the evaluation, I will implement various sound pitches to the application, since it proofs it is more effective than the constant pattern sound pitches.

Discuss whether the prototype you created was sufficient to test what you wanted to test.

After the testing session, I get a lot of useful information, which help me to differentiate the effectiveness of each pattern. This information gives me an explicit direction to follow, and I fully understand which fits better in my concept, so the prototype I created in prototype 3 is sufficient to test what I wanted to test.

Testing Plan:

In the testing plan section of prototype 2's statement of delivery, I mentioned prototype 3 will explore the best combination of sound frequency and vibration frequency. Apparently, the research aspect of prototype 3 is not the same as what I planned before.

There are couple reasons to support this change. Firstly, if I want to test the vibration feedback, I need a vibration motor. To experience the vibration from the motor, we need physical interaction. As the testing session is online, it is not possible test any physical feedback.

Previously, I also planned to use the vibration of the unity game scene to simulate the vibration feedback from the motor. After considering it deeply, I realize creating vibration feedback through unity game scene is not the same as physical vibration feedback, since visual feedback is totally different from physical feedback. As they are not the same, conducting vibration feedback on unity game scene won't give us the results we are looking for.

Due to these reasons, I slightly changed my research aspect, and focus on how different sound pitch patterns affect the effectiveness of the application.

Miro Link:

https://miro.com/app/board/uXjVPKg8Wos=/?share_link_id=336998850504

Video Link:

https://drive.google.com/file/d/1HteMmmTabVaYpyyC_8UEcBKJ6UJA9-P7/view?usp=sharing