CS3240 Interaction Design

Design Exercise

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Design Task 1: Futuristic Interaction

Introduction

My design idea is Dance MiRror, a Mixed Reality (MR) application to teach users dance moves and choreographies. While wearing an MR headset and using a skeletal tracking depth sensor, the application can display a mirrored view of the user's pose, provide step-by-step guidance and performance feedback to the user via visual cues.

The interface of Dance MiRror is designed for a hypothetical futuristic MR device that would support the suggested interaction methods that are suitable for Dance MiRror.

Motivations

With the advent of Korean pop (K-pop) music and culture, many people are drawn to unique dance choreographies. Many fans often become inspired or interested to learn how to dance, and would refer to dance videos on YouTube. They have to identify and replicate the dance on their own, which often involves a tedious process of having to replay each segment of the video many times, and possibly at a slower playback speed.

Some professional dancers already upload dance teaching videos or tutorials online that people can follow along to. However, there is a lack of user control and interactivity on these platforms.

Through an application, the user could have more control over their learning process. Additionally, other visuals can be provided that can help the user with the process of learning a dance, such as having a mirrored view to be able to observe one's own movements and receive feedback on their dance.

Key User Task

The key user task to be designed is to learn the steps to a dance choreography. The target user group for this task are casual dancers who like to dance as a leisure or to stay active. With Dance MiRror, they can do so at the comfort of their own homes and at their own pace.

The task can be broken down into the following subtasks:

1. Select a dance choreography they wish to learn
2. Watch the dance steps
3. Learn by trying out the dance steps for themselves
4. Receive guidance for the dance steps
5. Put their dance moves to the test
6. View their test results

User Flow

The following flowchart shows how the user would interact with the application.
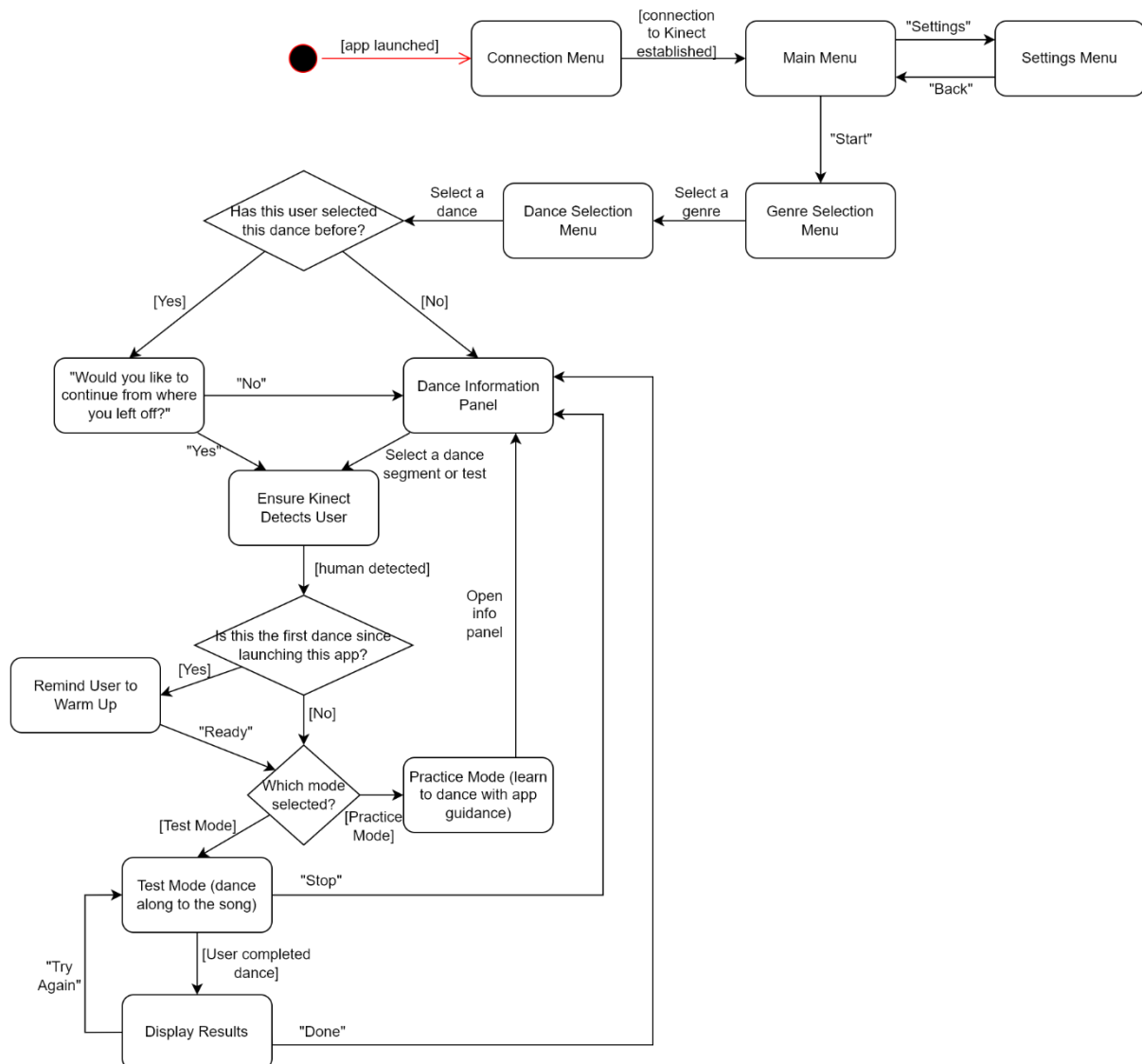
Application Concept and Features

Technologies Required

Suppose a hypothetical MR device that can be worn by the user on their head over their eyes, like a glasses or headset. This hypothetical device should:

- Support MR, i.e. superimpose spatially aware digital 3D content onto the glass screen
- Be able to detect hand gestures from the user for user interactions
- Be lightweight and suitable for physical activities
- Support voice commands (optional)
- Have mechanical/haptic function buttons, e.g. along the side of the device

The software capabilities today can meet the requirements of this MR device, however it is not a feasible for an untethered or wireless device due to limited computational power.

Additionally, to detect the user's skeleton for skeletal tracking and pose estimation, a depth sensor is required, such as the Microsoft Kinect or Orbbec Astra. The depth sensor can be connected to a computer which can run a program perform the skeletal tracking and pose comparison, and act as a central server for the MR device to receive sensor data from wirelessly.

System Setup

Users should have a 2-3m space around them when using Dance MiRror to ensure they have enough space to dance. The depth sensor should be placed facing the user and 0.6m to 1.8m above the ground, and the user should stand at least 1.4m away from the sensor. A diagram depicting the random setup is as follows.
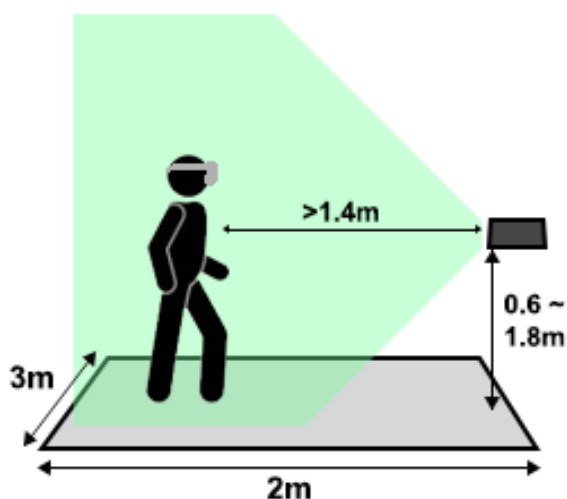

User Interaction Methods

The following are proposed interaction methods to be supported by the hypothetical MR device. The user will use these interaction methods to interact with the Dance MiRror application. The main

interaction method is **Tapping**, although the alternative methods allow the user to use what is most comfortable or convenient for themselves or the situation.

Tap: This input can be used for making selections or decisions when there is a menu panel or tappable object available. Users can perform what is equivalent to a "click" or "tap" on digital screen interfaces via a pinch motion using their index finger and thumb, when the user's fingers are at the physical location of where the interactable object is digitally superimposed onto. The following is a diagram of the 'Air Tap' gesture for the Microsoft HoloLens. The pinch motion should be similar to this gesture.


1. Finger in the ready position   2. Press finger down to tap or click
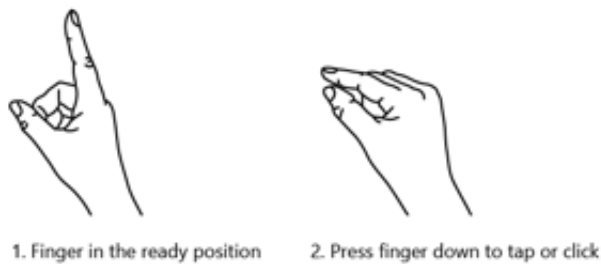
Voice: An alternative user input method to allow the user to invoke an action or provide a response via saying out specific command words or phrases.

Mechanical/Haptic buttons: Mechanical or haptic function buttons can be embedded onto the MR device, which can be an alternative user input method that can be customised by each application. These buttons should be used sparingly, as there should not be too many buttons on the device.

MR Objects

The different MR objects in Dance MiRror can be categorised by how they interact or display information to the user. These are:

- **Menu Panels**: Most of the menu panels are designed as interactable 2D displays that keep themselves positioned in front of the user, using a tag-along concept to comfortably remain in the user's range. The panels are angled about 30 degrees from the ground to remain comfortable for the user to read the content and be able to tap on the interactable buttons.
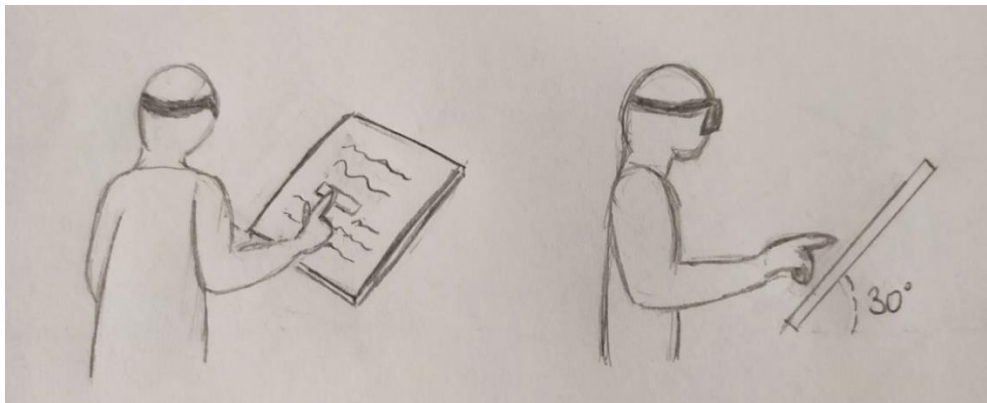

  o The Menu Panels are: Main Menu, Settings, Genre Select, Dance Select, Dance Information, Test Mode Results

- **Notice Panels**: The Notice Panels are screens placed in a fixed position in front of the user some distance away (so that the user can read them comfortably without having to move from their current position), perpendicular to the ground. They mainly act to inform the user.
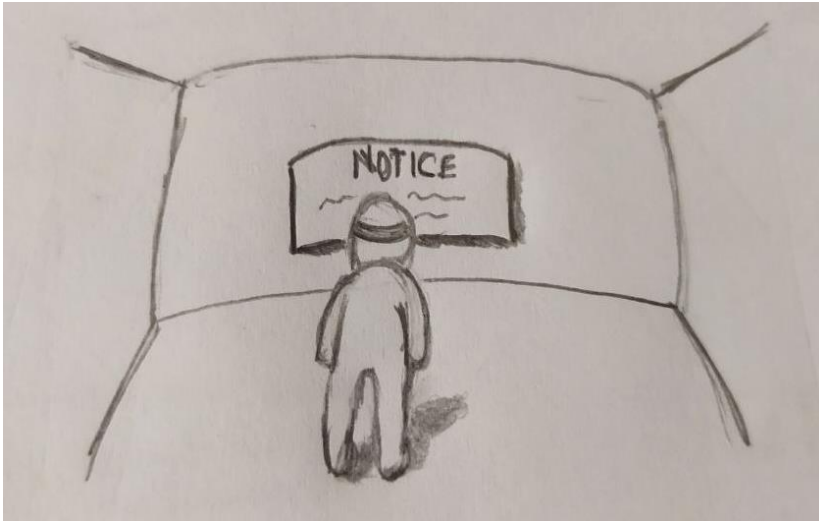
  o The Notice Panels are: Warm-Up Reminder, Stand in Front of Sensor, Tracking Lost

- **Dancers**: The Dancers are 3D humanoid models that represent the mirrored view of the user and the instructor. The Dancer that mirrors the user will be positioned in front of the user, while the Dancer that represents the instructor will be placed to the right of the mirror. They are placed some distance away from the user such that both Dancers are comfortably in the user's field of view.
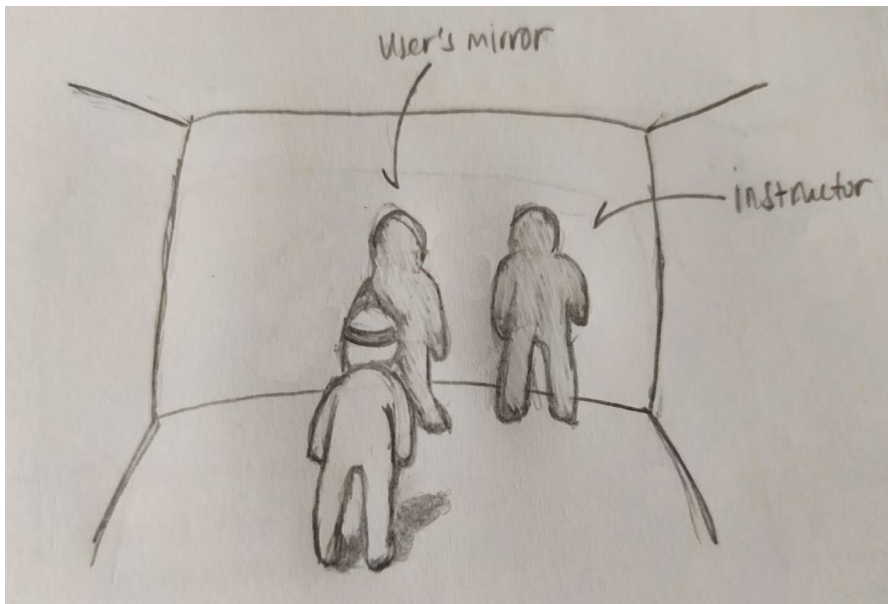

  o Depending on the user's preference, which can be configured in the application settings, the Dancers can either be rendered as a dark silhouette or with textures, and the rendering of the skeletal joints can be toggled on or off.
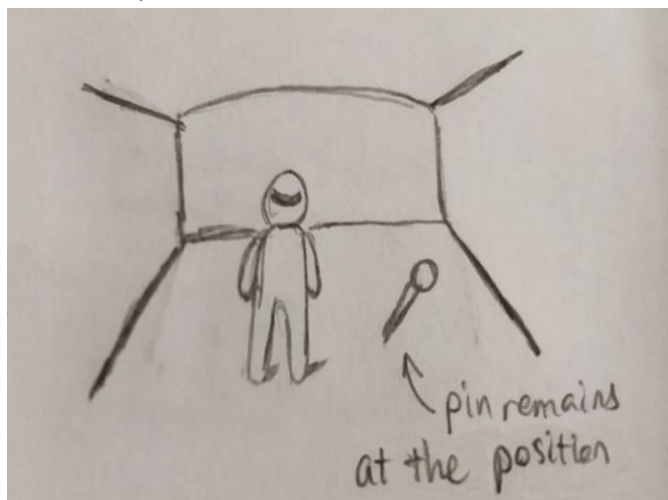
- **Control Panel**: The Control Panel is a menu panel that allows the user to control the instructor during Practice Mode. It additionally allows the user to place it away to avoid it being a visual distraction or accidental interactions with it.

  How the Control Panel works:
  1. The Control Panel tags along the user and always positions itself in front of the user.
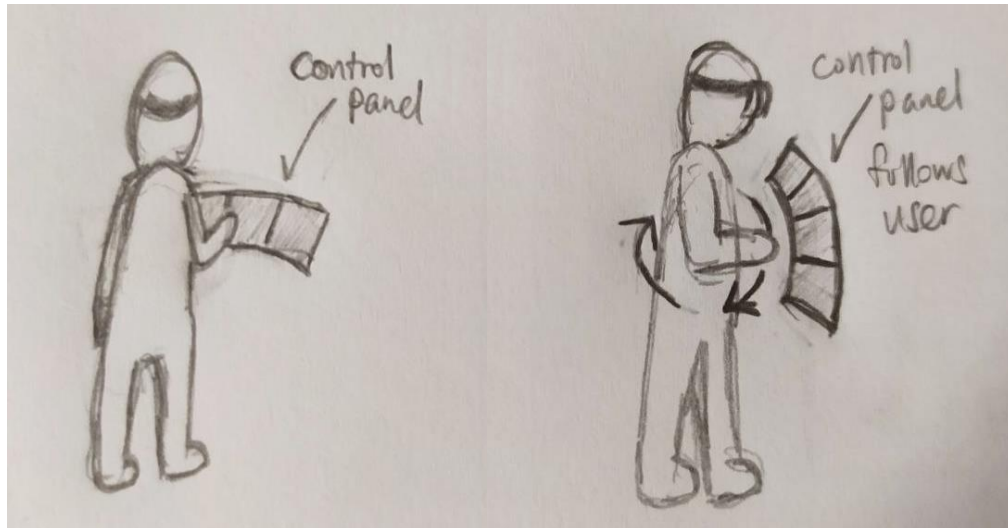
  2. When user taps on the pin on the Control Panel, the Control Panel closes.
  3. A pin takes the place of the Control Panel at the position where it was pinned and remains fixed at its position.

  4. After the Control Panel is pinned to a world position, to reopen the Control Panel, the user needs to 'Tap' the pin two times.

  Alternative ways to interact with the Control Panel:
  o **Voice**: Use the voice command 'Menu' to bring up the Control Panel regardless of its pin location.
  o **Function button**: Press a function button along the side of the MR device to bring up the Control Panel regardless of its pin location, or close it.
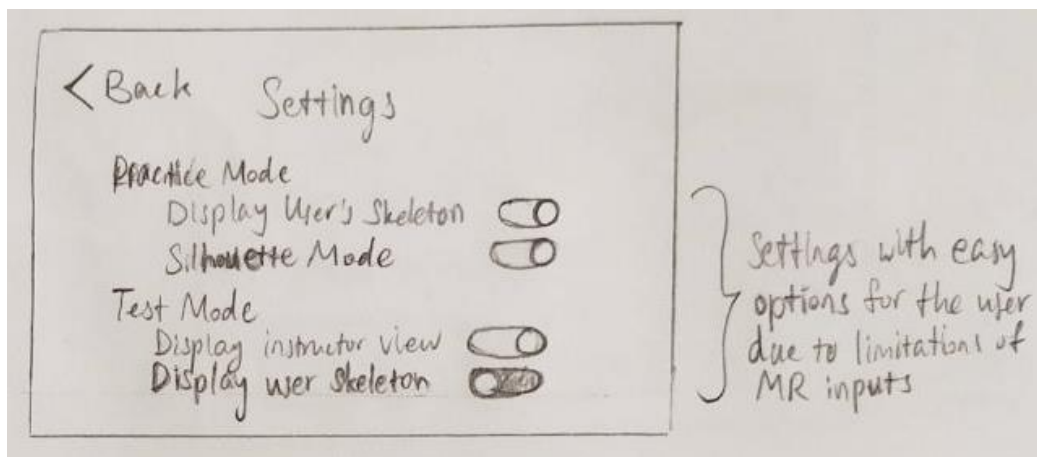
Wireframes (Lo-Fi)

1. Menu Panel: Main Menu
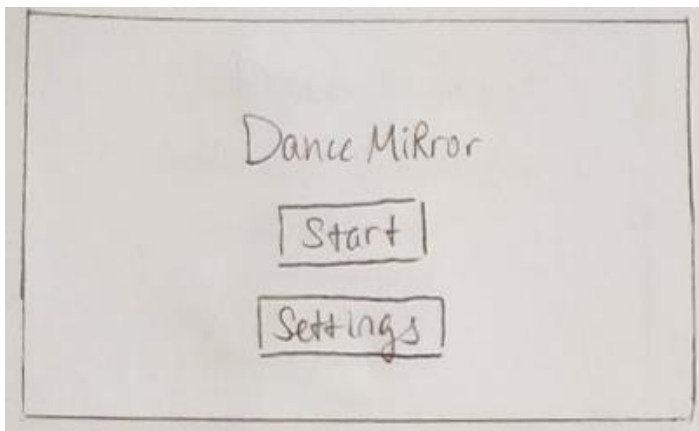

2. Menu Panel: Settings Menu

Simple options are provided to provide easier interactions and avoid cognitive overload to suit the more restrictive MR interaction methods.

3. Menu Panel: Genre Selection Menu

Each option has an image to provide visual references for the user (reduce cognitive load). Taking into consideration that a menu panel should not be too large for the user, only a few options are shown at once. The 'next' and 'previous' arrow buttons are used to go to the next or previous pages if there are more than 6 options.

Additionally, it is intended that for experienced users, they can use voice as an input method to select a genre. They can say the name of a genre, even if it is not displayed on the current page.
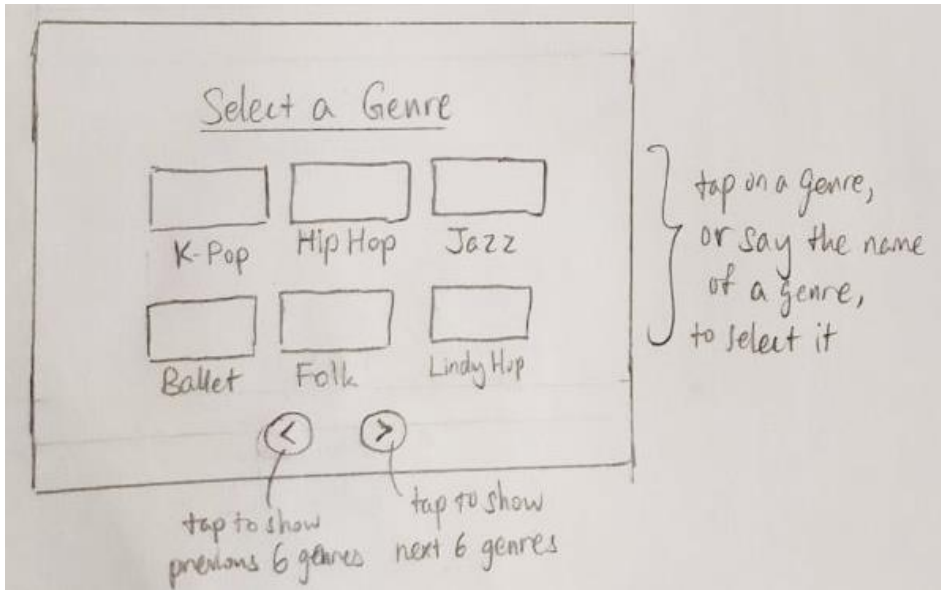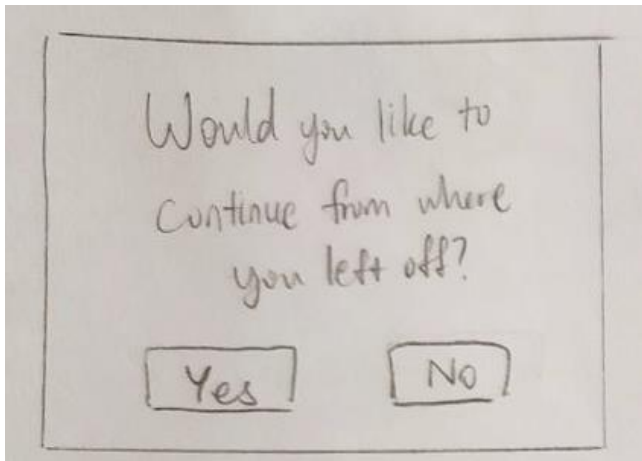

4. Menu Panel: Dance Selection Menu

The design is similar to genre selection. In addition, the indicators "NEW!", "In Progress", or their test score, offer information about the user's application usage and progress.
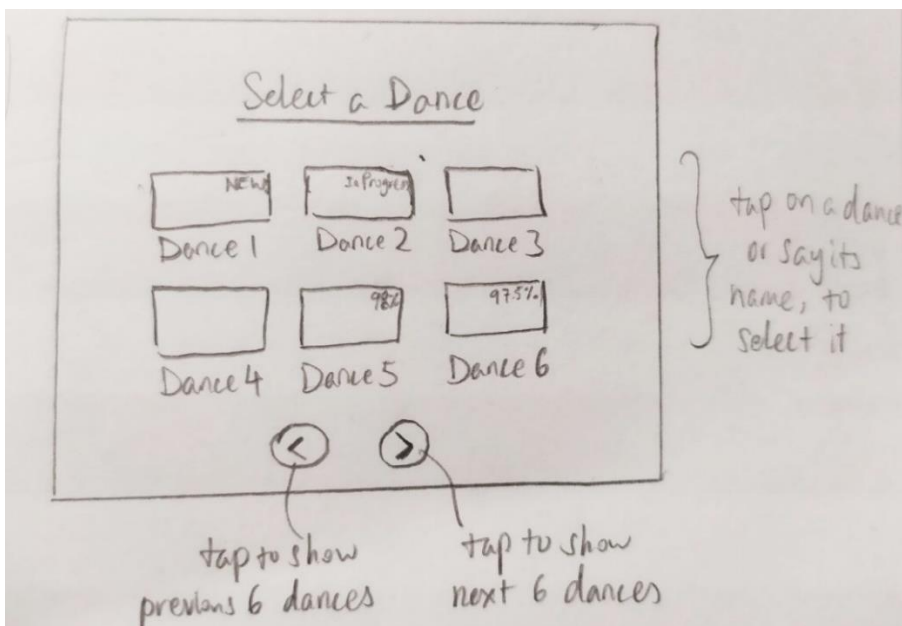
5. Menu Panel: Ask to Continue

If this is not the user's first time selecting a particular dance, this panel will be displayed to the user. This panel gives users the option to continue from the previous time they selected that dance, thus giving a shortcut for users who already wish to continue from where they left off, such as if this is one of their multiple sessions for a particular dance.


6. Menu Panel: Dance Information Panel

If it is the user's first time selecting a particular dance, or they chose 'No' for the previous panel, users will be shown a panel displaying information about the selected dance.

On the left of the panel, there are different tabs. These tabs let users navigate to the part of the dance they wish to learn, or test what they have learnt with Test Mode.

The first panel users see will be a description about the selected dance.
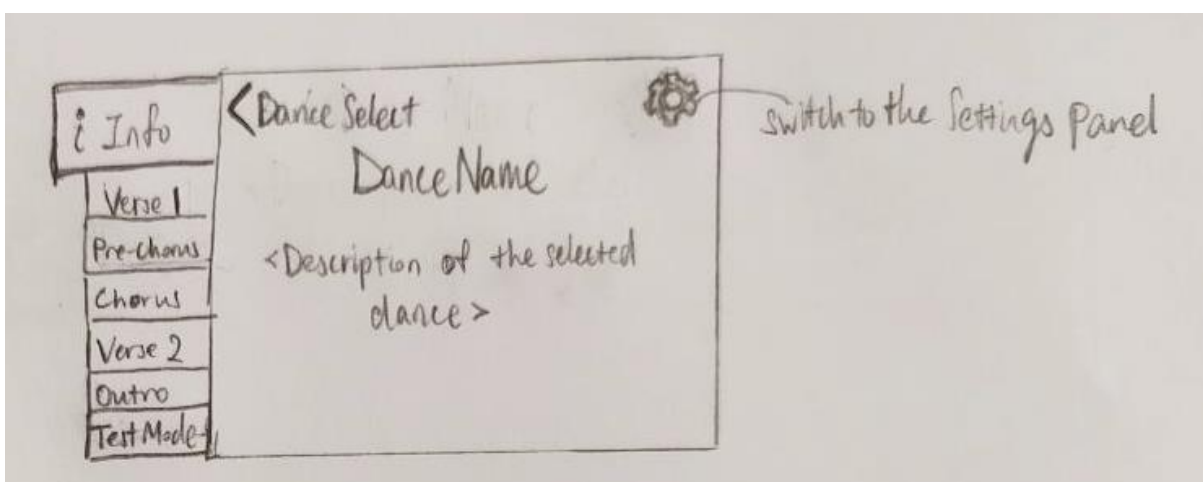
When the user selects a tab, they can watch a video clip of the dance section and choose to Practice.
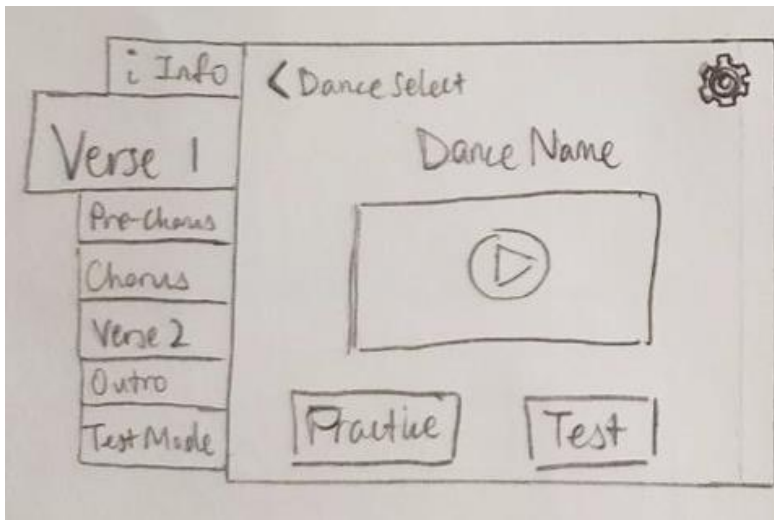
If the user selects the 'Test Mode' tab, they can choose to enter Test Mode to test what they have learnt. If this is not their first attempt, information about their previous attempts can be displayed.
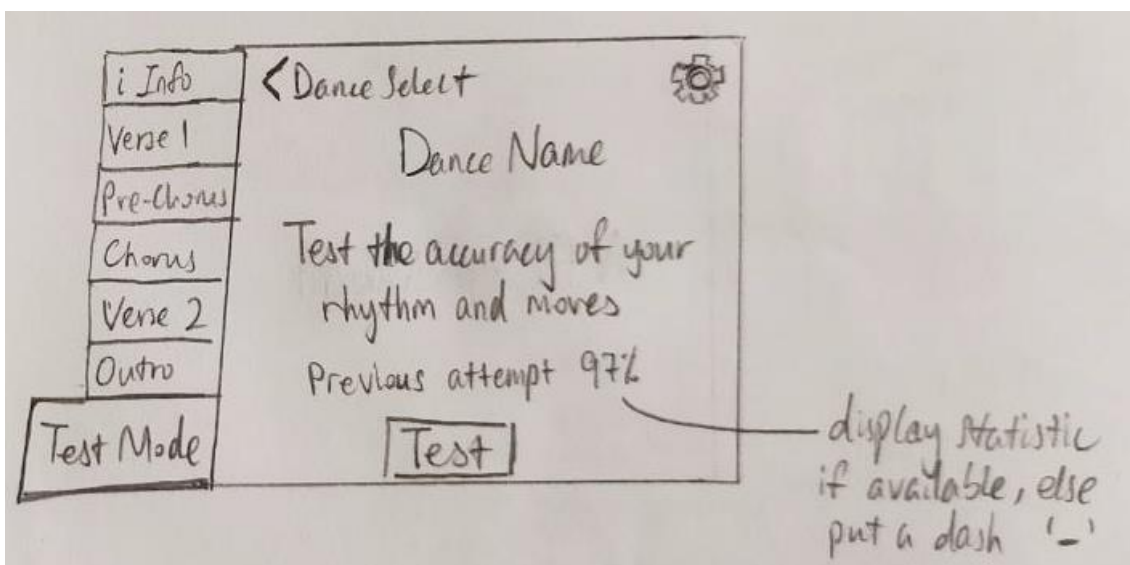
7. Notice Panel: Warm-Up Reminder

If this is the user's first time entering Practice Mode or Test Mode since the application was launched, this panel will be displayed.

This is a notice panel instead of a menu panel so that it can be clearly read by users, and remain in a fixed position to avoid disrupting the user, as the user would be moving around when warming up. Users must walk up to the panel and tap the "Ready" button when they are ready to begin dancing.
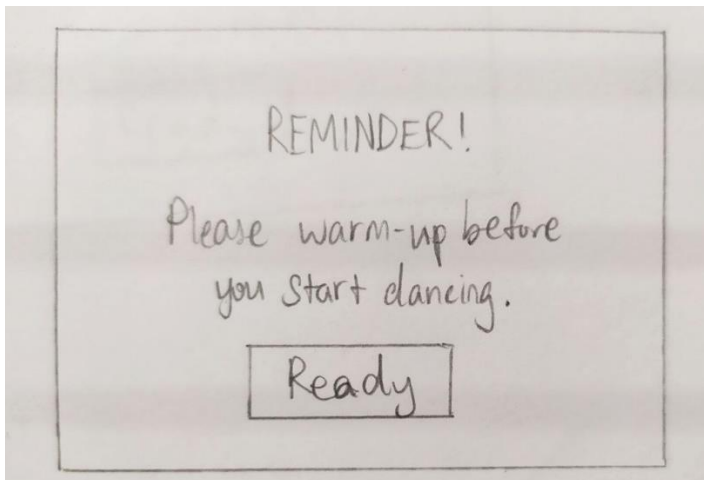

8. Notice Panel: Stand in Front of Sensor

This panel will be displayed until the sensor is able to detect the user. To give user some time to process the information on the panel and get ready to dance, it will be displayed for at least 2-3 seconds. Otherwise, unfamiliar users may get confused by what was required of them if they fail to finish reading the panel.

This notice also complements how the user would have likely gotten too close to the depth sensor to tap the "Ready" button in the previous panel during their first time, and needing the user to step backwards to be in the sensor's range.
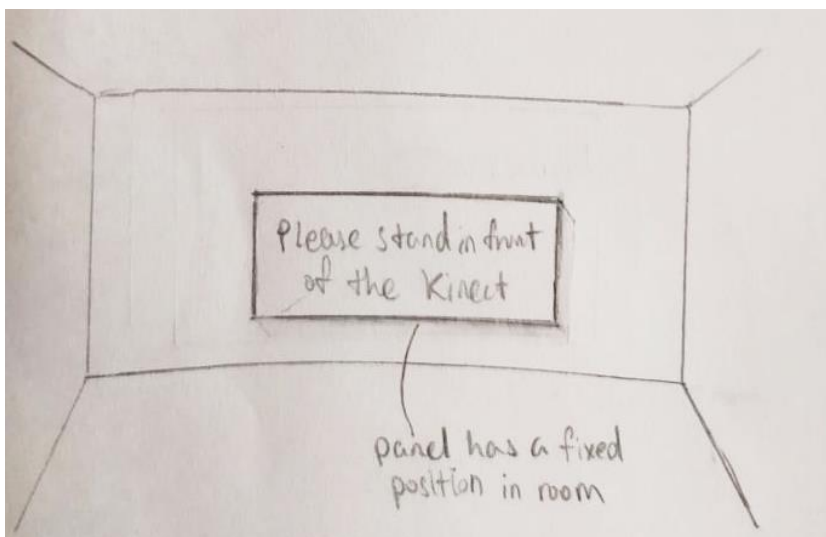
9. Practice Mode layout

In Practice Mode, the user's mirror Dancer is positioned in front of the user. The instructor Dancer is positioned to the right of the user. The instructor Dancer is where the dance animation clips are played for the user to observe the dance moves for learning.
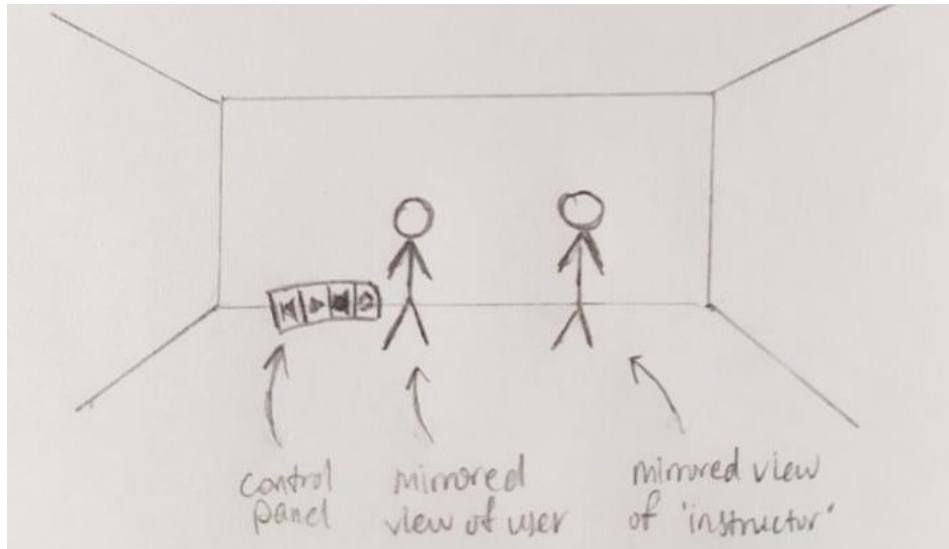

10. Control Panel

The Control Panel provides the following actions in Practice Mode:

- "Skip Previous" and "Skip Forward" buttons go to the previous or next 8-count in the dance.
- The "Play" or "Pause" button resumes or pauses the instructor Dancer's animations.
- The "Repeat" button toggles looping for the instructor's Dancer's animation. Upon being toggled on, the animation of the current 8-count dance move will be looped.
- The "Help" button toggles guided sequence mode. Starting with the current 8-count dance move, the instructor animates each move and holds the pose for the user to follow along.
- The "Info" button opens the Dance Info Panel. The user can revisit the dance information, access the Settings panel, go to another segment of the dance, enter Test Mode, or return to Dance Select Screen.
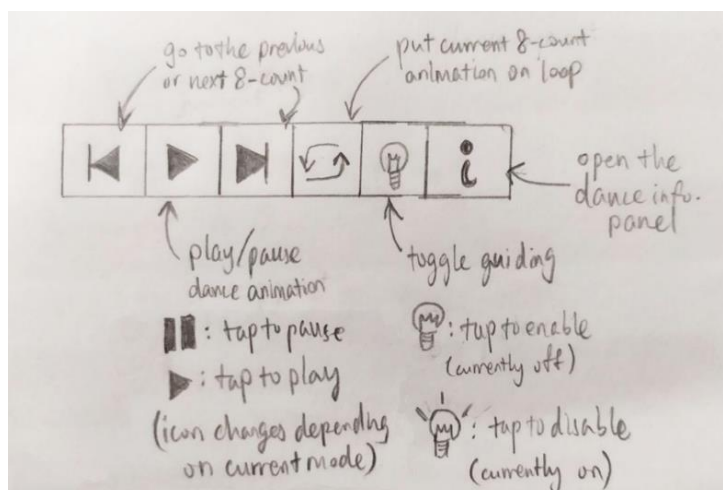
11. Notice Panel: Tracking Lost Error

The application pauses, and the Dancer silhouettes (if Silhouette Mode is enabled) or models will become darker in colour.
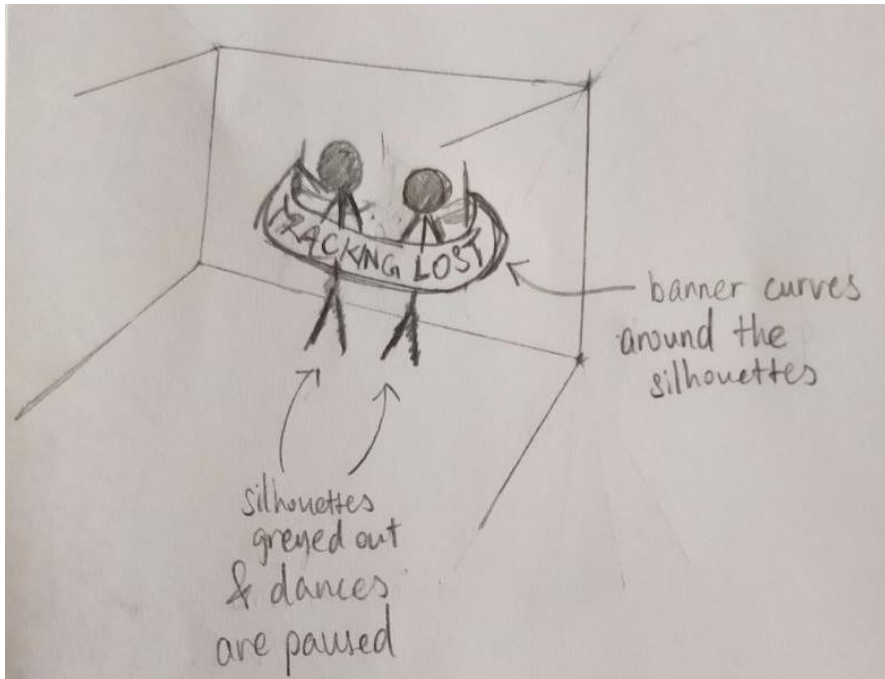
12. Menu Panel: Test Mode Results

The user can view the results of the test as an indication of how well they have mastered the dance. From this panel, the user has 3 options:

- "Watch Playback" to watch their moves play out on the user's mirror,
- "Try Again" to go for another attempt, or
- "Done" to return to the Dance Select Screen.
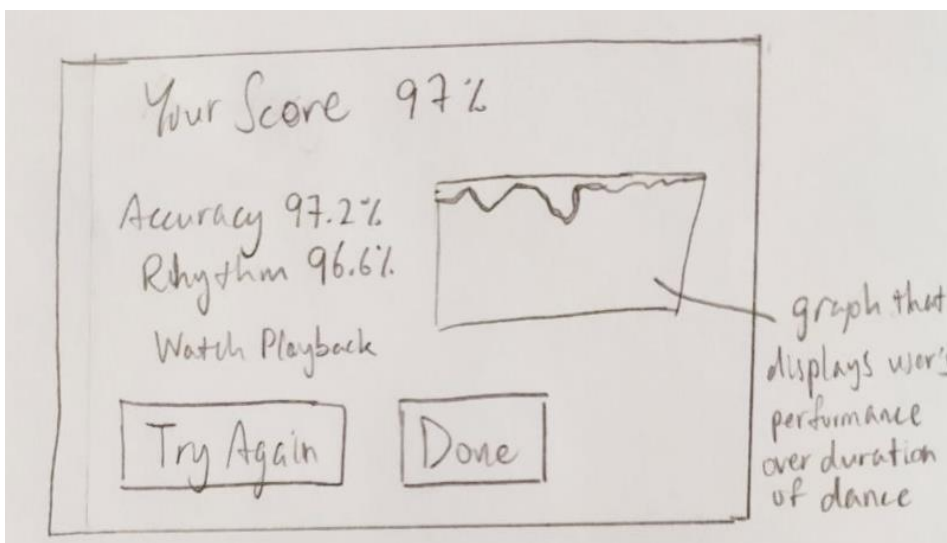
Moving to Hi-Fi

Some overall design decisions are made for the interactive prototype (Hi-Fi), which will be discussed in this section. These decisions take the characteristics of the MR platform into consideration.

Colour Palette

Warm colours are energetic and passionate, which I feel conveys the energy in dancing. Therefore, I chose orange as the primary colour and yellow as the secondary colour. The primary colour is used for major action buttons, and secondary colour used for minor action buttons and UI separations. The shades chosen are not too bright to suit the MR needs.

For MR platforms, a large area of bright colours could cause eye fatigue for the user. Thus, a dark colour would be preferred as the background colour for panels. The background should be more neutral in colour, like grey. Blue provides a contrast with orange and yellow. Thus, I chose to use a dark shade of blue grey for the panel background colour.

Other colour standards for designing content for MR include:

- Not using #000000, as that will not be rendered due to how rendering is done. A very dark grey can be used to substitute black, such as #1E2124 (R 30, G 33, B 36).
- Not using #FFFFFF for white as it would be very bright. #EBEBEB (R 235, G 235, B 235) is used instead.

Based on the above decisions, the following is Dance MiRror's colour palette:

Primary colour	Secondary colour	Secondary colour variant
#F58500	#FFD260	#C51800

Background colour	Secondary background colour	Error background colour
#2B416C	#546485	#752A2A

Font colour on primary	Font colour on secondary	Font colour on backgrounds
#EBEBEB	#1E2124	#EBEBEB

Displaying Voice Commands

A text is displayed on or beside each interactable button. As these buttons can be triggered via voice instead, the text represents the voice command that can trigger the button. This text is associated with the button via locality, and additionally explains to the user the functionality of the button.

Placement of Panel Buttons

As majority of people are right-handed, it would be more likely that a user would use their right hand to perform the 'Tap' interaction. Thus, the buttons on the menu panels are placed either in the middle or right of the panel, where it is easier for the right hand to perform the 'Tap'. If a menu panel has two buttons, and one of the buttons is expected to be the more commonly picked option, the more commonly picked button is placed on the right.

Back Button on Menu Panels

A back button is placed on the top left of the menu panels. This allows users to easily return to the previous screen if they wish to undo an action, or have easy reverse navigation. At the same time, its placement at the top left prevents it from being accidentally tapped on.

Interactive Prototype (Hi-Fi)

Link to Hi-Fi: https://www.figma.com/file/INLhy4L5CO1VTcjBd9f0g6/Dance-MiRror-(CS3240-Design-Exercise)?node-id=0%3A1

MR Prototype in Hi-Fi

To make the Hi-Fi more closely resemble an MR application, an image of a room is used as a backdrop to represent the environment Dance MiRror might be used in. The sizes of the MR content are not scaled to the size of the room image.

For UI elements, fill colours are set to 85% opacity to represent that the MR holograms would be slightly see-through when rendered onto the physical screen.

Panels

Figma does not support 3D content or Perspective view. Menu Panels are placed to the right of the frame, while Notice Panels are placed in the center of the frame.
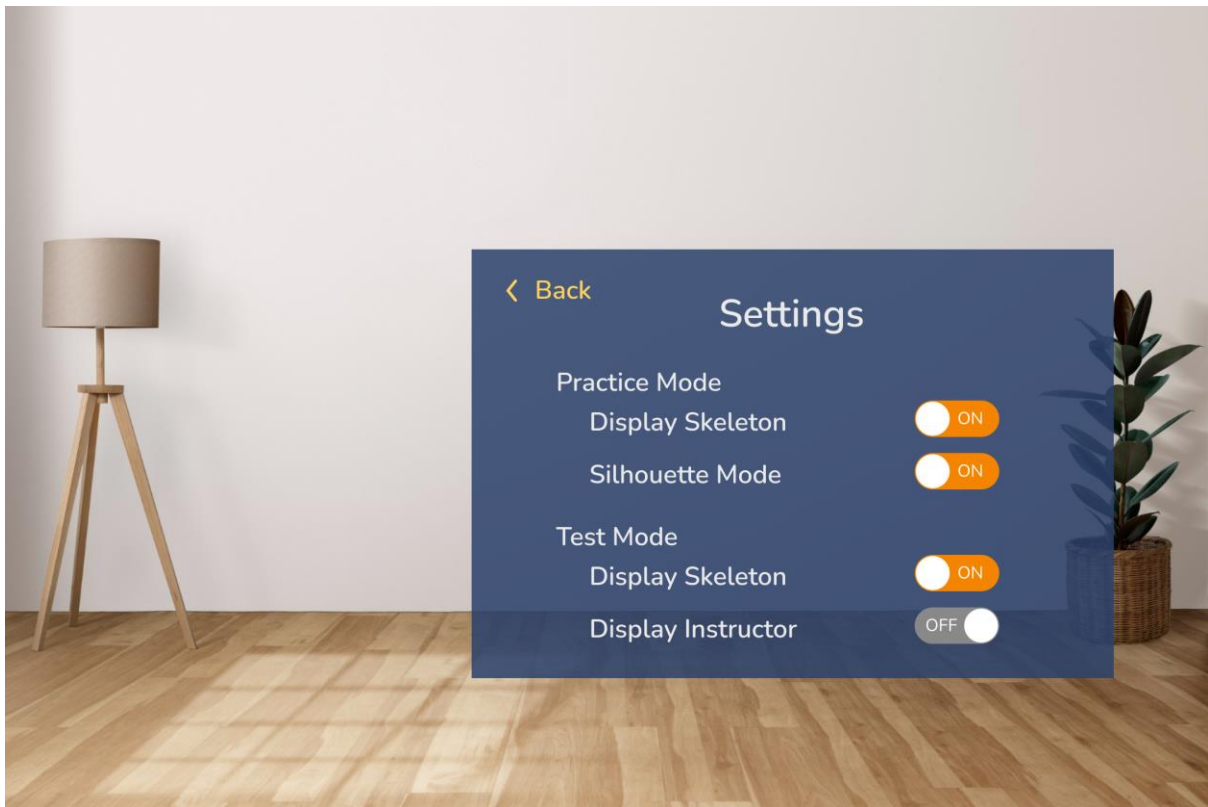
Hi-Fi Screenshots and Notes

Minor adjustments or features in the design not discussed earlier in the report will also be elaborated upon in this section.
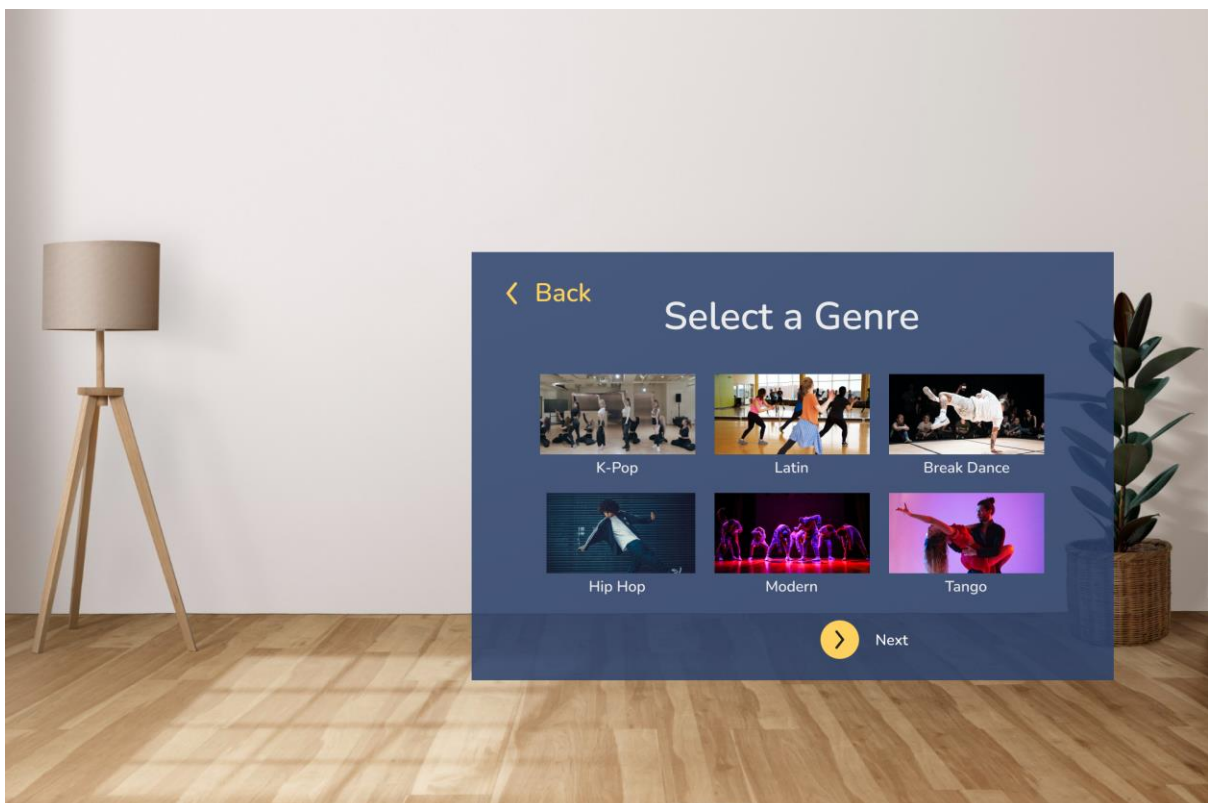
1. Menu Panel: Main Menu
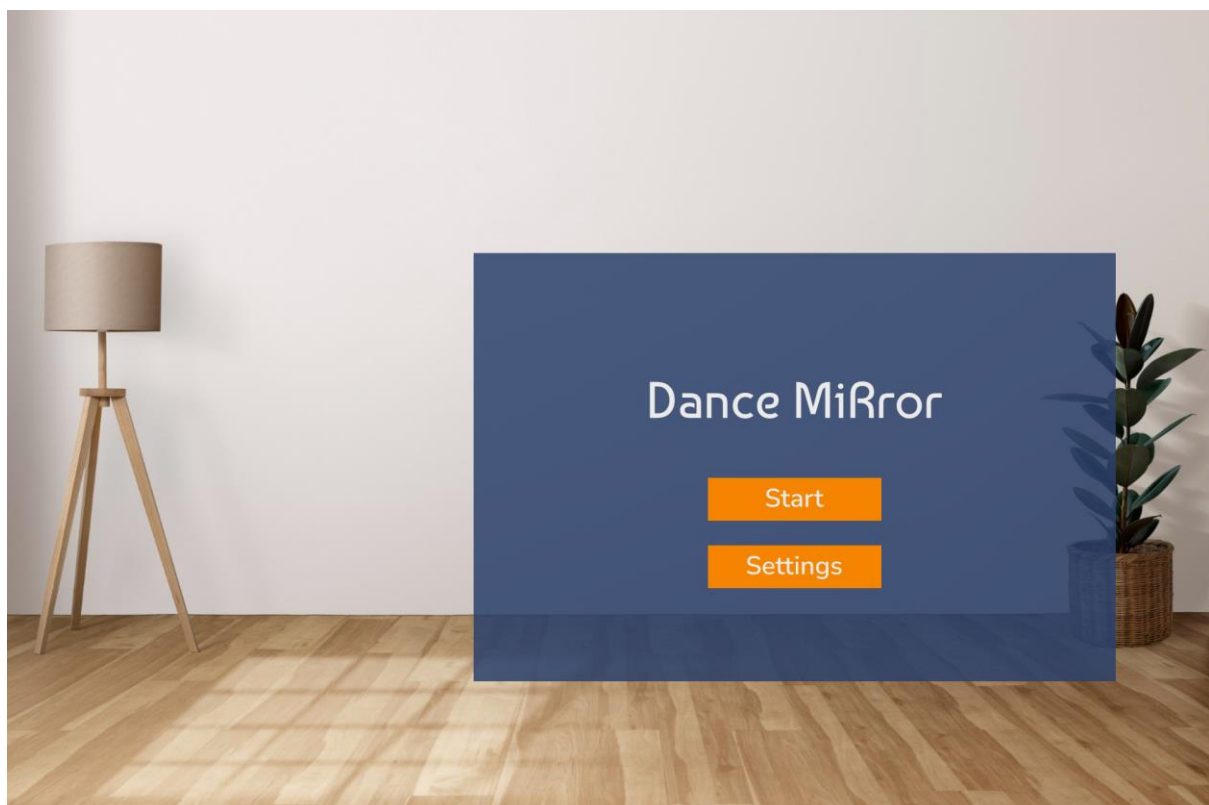
2. Menu Panel: Settings Menu

3. Menu Panel: Genre Selection Menu

4. Menu Panel: Dance Selection Menu

The indicators have been changed to "NEW!", "In Progress", or "Completed". For "Completed", the test score is placed at the bottom. The indicators have different colours to make them visually stand out from each other.

Additionally, the "Genre: " text is added to the menu. This is to remind users of their navigation to reduce short term memory load.
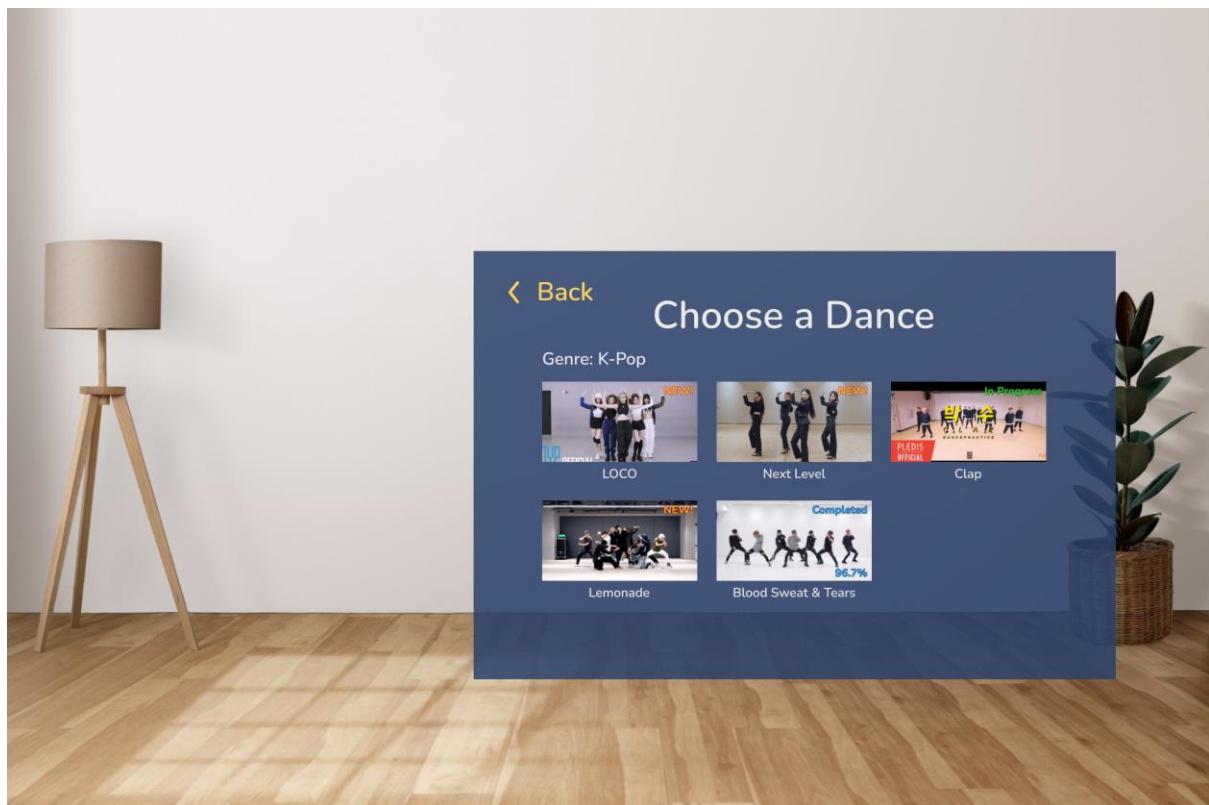
5. Menu Panel: Ask to Continue

It is expected that users would like to continue from their previous session, or familiar users do not revisit the Dance Information Panel. Thus, the preferred option is placed on the right as per the design choice. The other option is set to a different colour to so that there is colour separation, and is given a more muted colour so it does not distract the user from the option on the right.
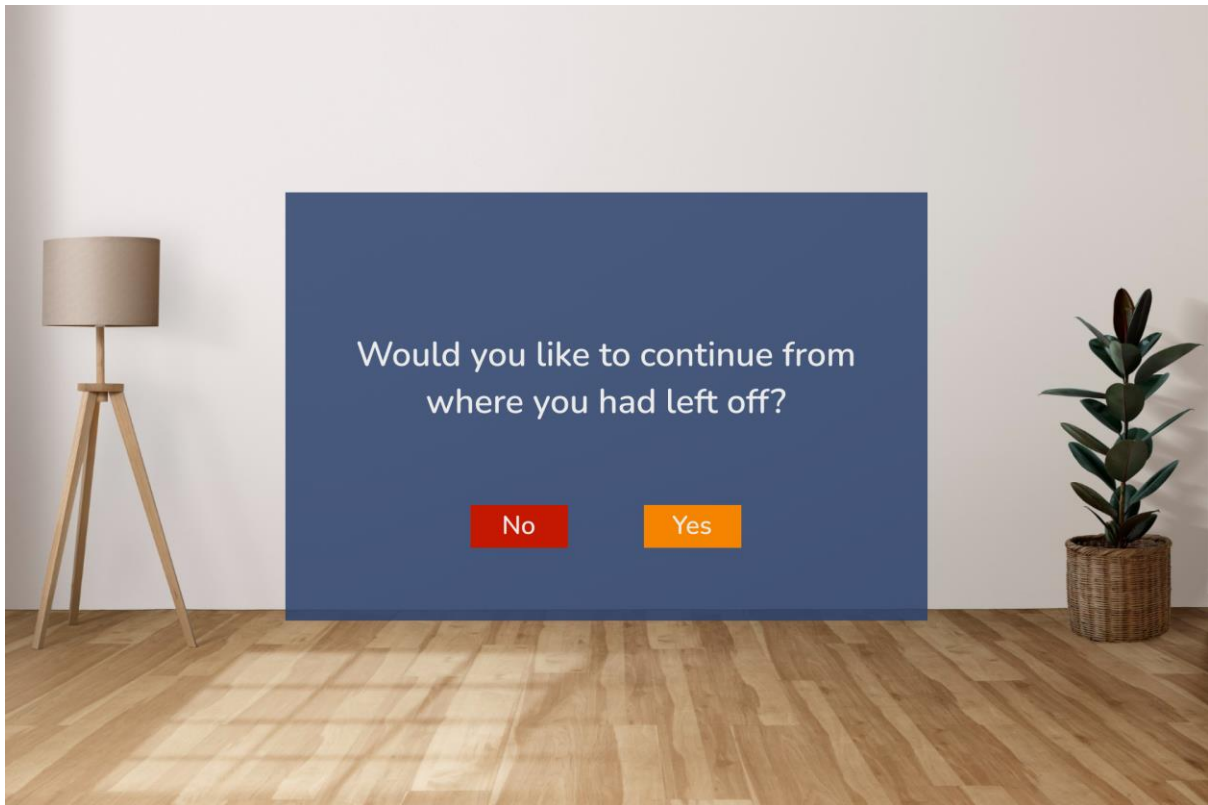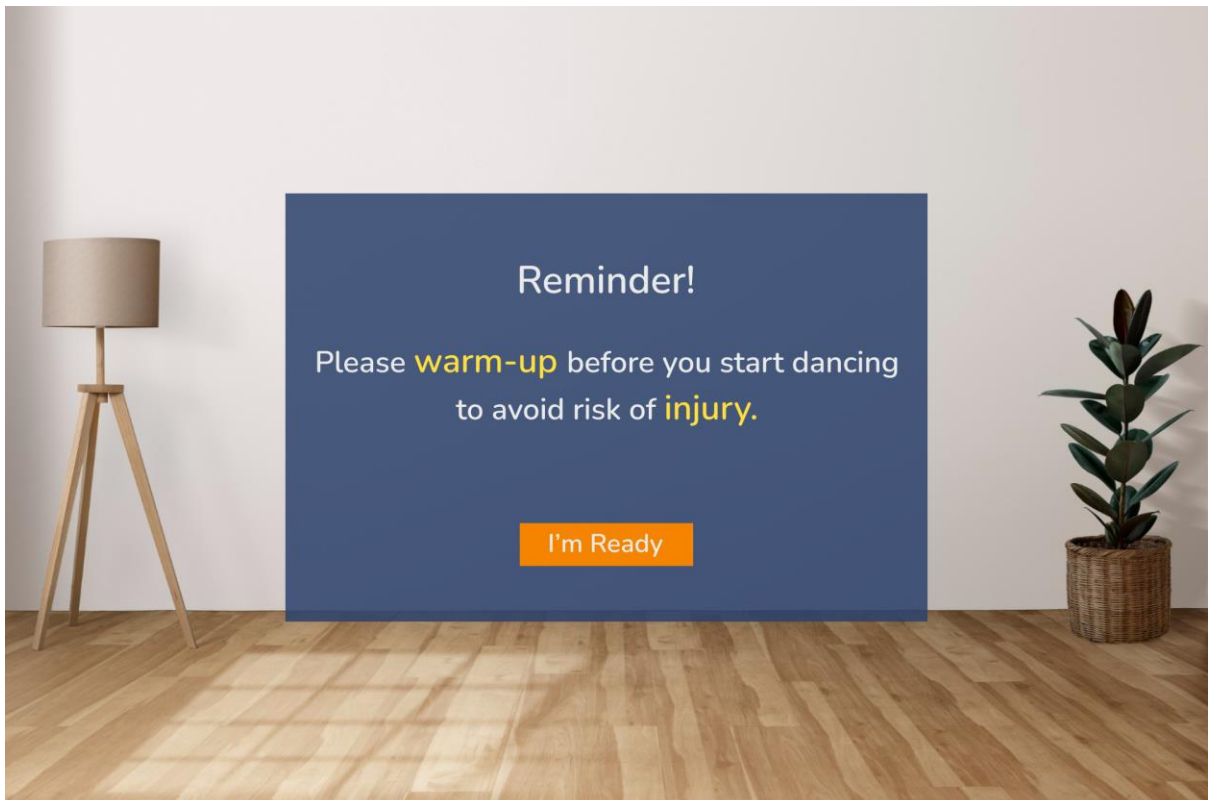
6. Menu Panel: Dance Information Panel

The design places the action button on the right for consistency. The tabs have also been shifted to be on the right for consistency and easier usability.
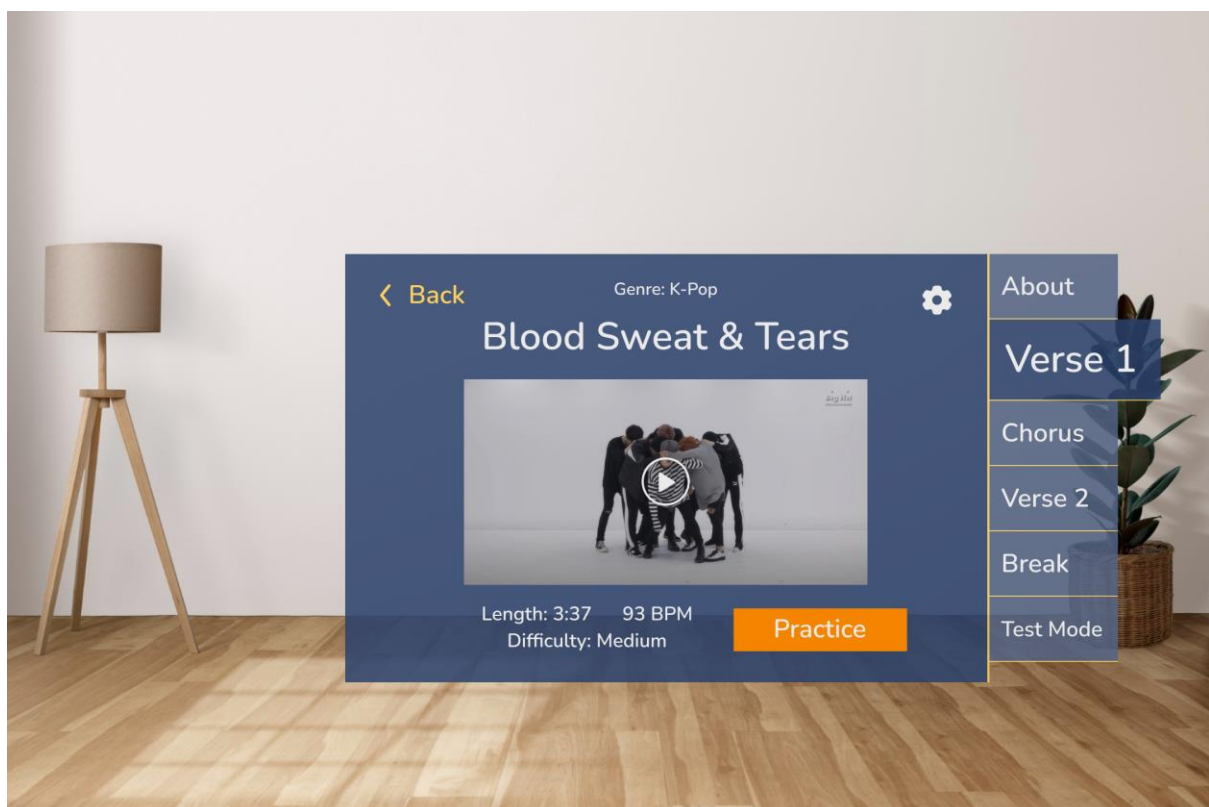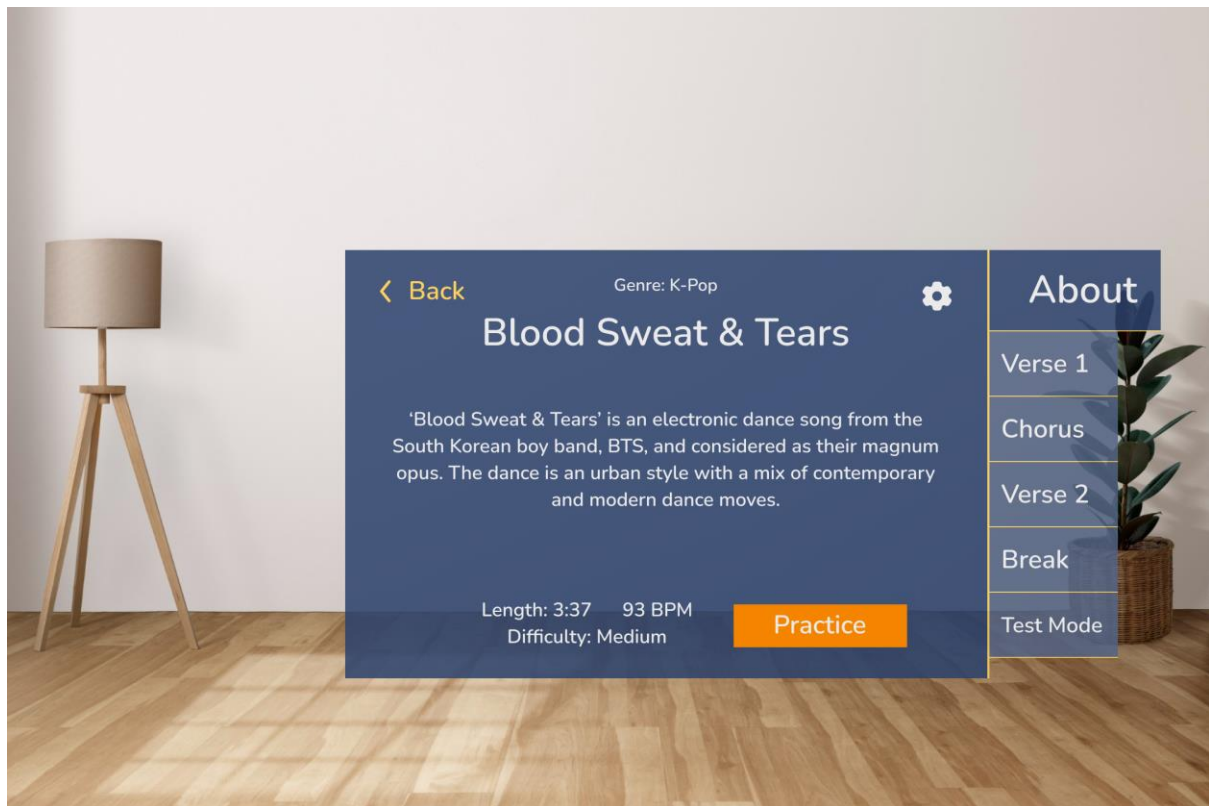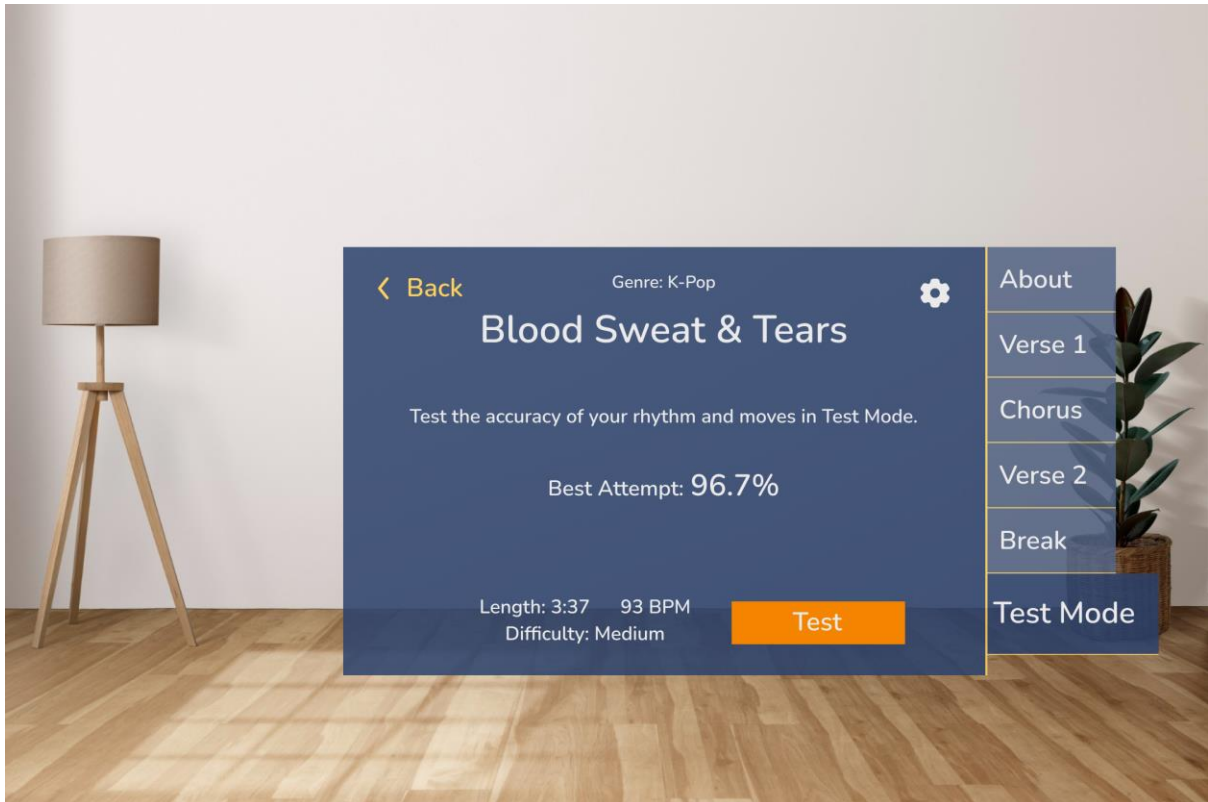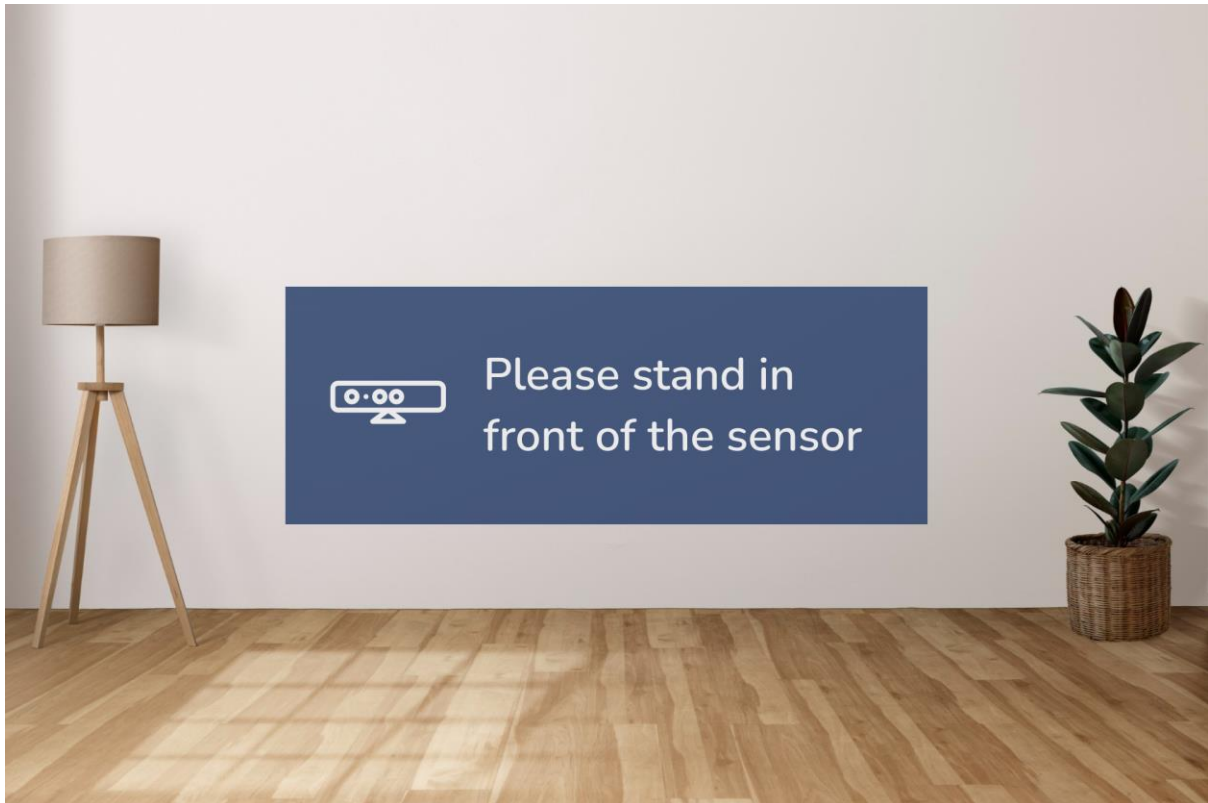
7. Notice Panel: Warm-Up Reminder

The secondary colour is used to draw the user's attention to the important key words.

8. Notice Panel: Stand in Front of Sensor

The notice is kept simple for readability and clarity, and an icon of a depth sensor is used to add visual reference, to avoid cognitive overload for the user.

9. Practice Mode (Silhouette Mode, Skeleton Enabled)

This is the view of the Practice Mode, with Silhouette Mode and Display Skeleton settings enabled.
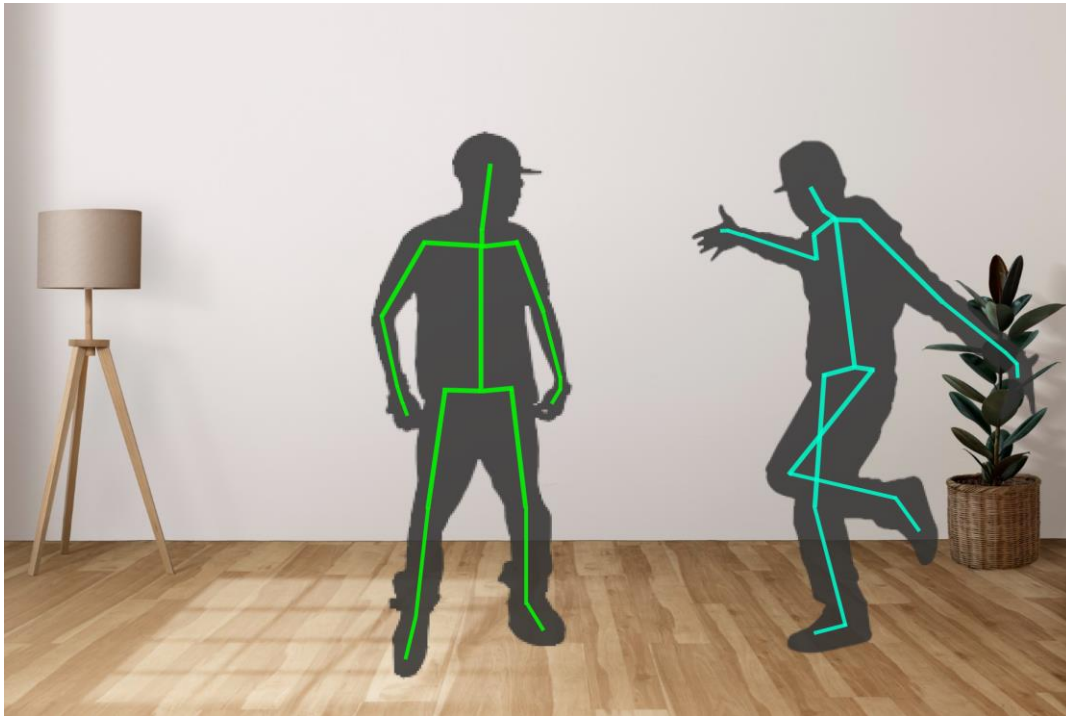
When the user turns on guidance, and if Display Skeleton is enabled, the bones will be highlighted in different colours to indicate if the position of that bone is correct. The guide will not continue until the user gets the step correct.

A darker shade of red and a lighter shade of green should be used for a more colourblind-friendly design.
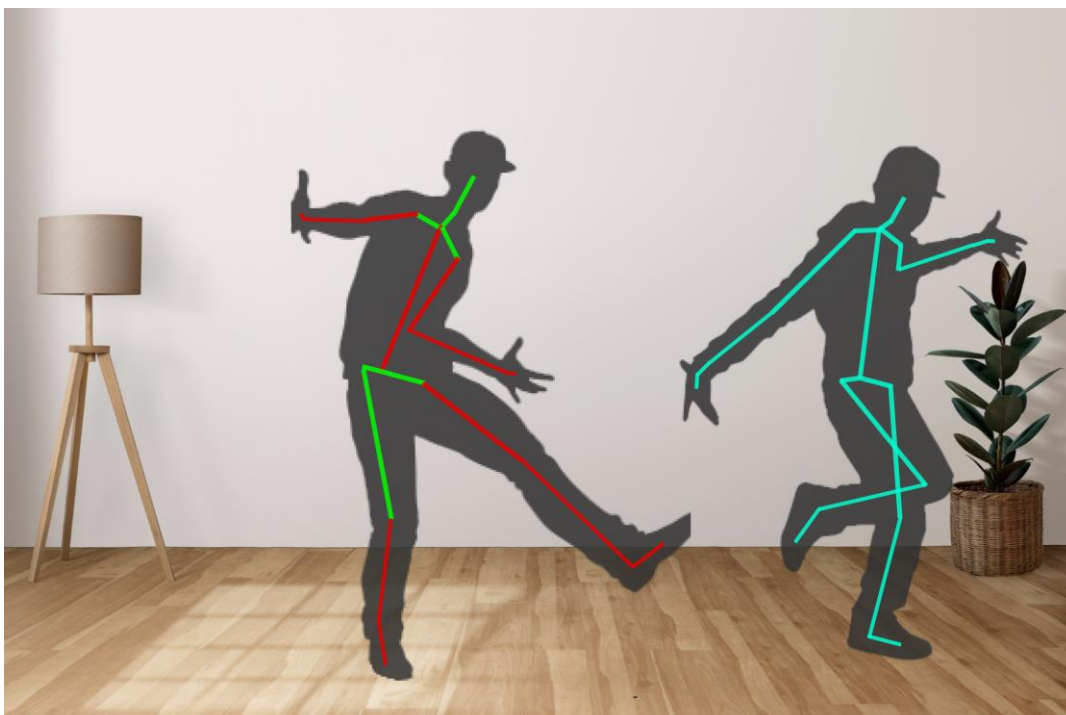
10. Control Panel

The pin is placed below the horizontal panel. It is placed to the right for consistency of action buttons leaning towards placements on the right.

Each button on the Control Panel has a corresponding text, which represents the voice command that can trigger the same action. To provide convenience for experienced users, these commands can be activated without needing the Control Panel to be brought up. The voice command 'Menu' can also be used to bring up the Control Panel.
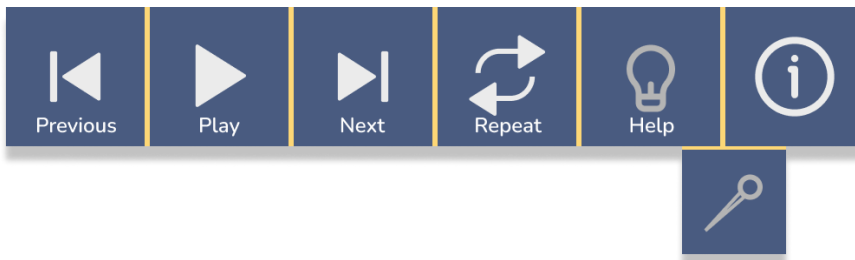
11. Notice Panel: Tracking Lost Error

Red is used as the colour of the notice panel as an indication of an erroneous state. The panel is placed in front of the Dancer figures.

The same depth sensor icon as the "Stand in Front of Sensor" panel is used to induce the same visual association to the depth sensor tracking.

12. Test Mode

This is the view of the Test Mode, with the Display Instructor and Display Skeleton settings disabled. Users can dance along to the song that is playing from the MR device's speakers.

If users would like to stop the test, they can either use the voice command 'Stop', or walk up to the Stop panel and 'Tap' it. This will bring them back to the Dance Information Panel.

13. Menu Panel: Test Mode Results

The "Done" button is placed on the right as it is the more dominant option in the user flow.

The "Watch Playback" button is in red, signifying that it is a secondary type of action that does not change the state of the application.

The Dancer figure(s) that were present in Test Mode remain in the scene when this panel opens. This allows the playback to seamlessly begin playing on the Dancer figures if "Watch Playback" button is tapped.
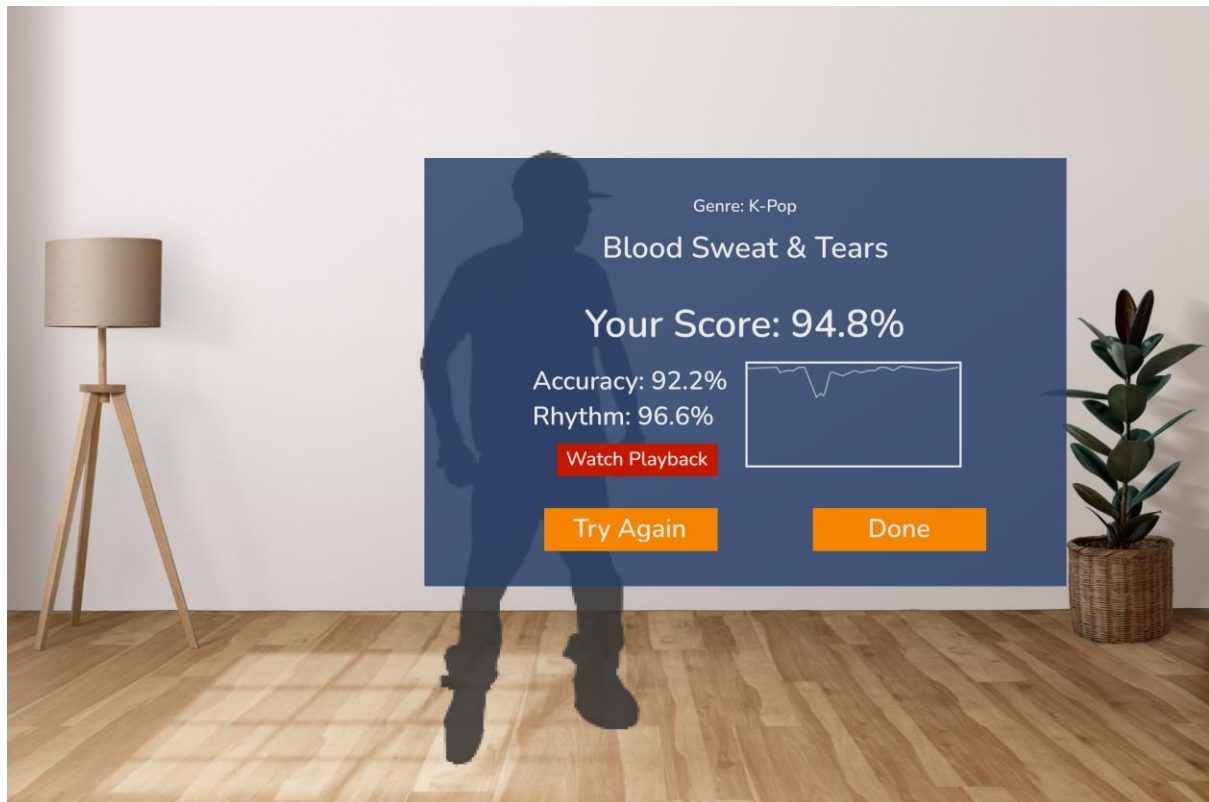
Credits

- Stick figure image used in setup diagram from **iStock**
- Air tap gesture diagram from **Microsoft Mixed Reality Docs**. Source: https://docs.microsoft.com/en-us/dynamics365/mixed-reality/guides/hl1
- Room image used as background in the Hi-Fi design from **rawpixel.com**. Source: https://www.freepik.com/free-photo/japandi-living-room-interior-design_19002698.htm)
- Control Panel's Icons from **Music Player Icons** https://www.figma.com/community/file/817778012095458763
- UI Icons from **Huge Icon Pack** https://www.figma.com/community/file/1090211207664351238
- **On Off Switch UI** https://www.figma.com/community/file/1047557978613263793
- Images used in Hi-Fi from **Unsplash** https://unsplash.com/
  - Photo by Maick Maciel on Unsplash
  - Photo by Danielle Cerullo on Unsplash
  - Photo by Breakreate on Unsplash
  - Photo by Kazuo ota on Unsplash
  - Photo by Ilja Tulit on Unsplash
  - Photo by Daniel Sturgess on Unsplash
  - Photo by Nihal Demirci Erenay on Unsplash
  - Photo by Fabian Schneider on Unsplash
- Human silhouettes used in Hi-Fi from **Adobe Stock**
- Kinect icons created by **Freepik**. Source – Flaticon: https://www.flaticon.com/free-icons/kinect

References

- Designing content for holographic display, Microsoft Mixed Reality Docs https://docs.microsoft.com/en-us/windows/mixed-reality/design/designing-content-for-holographic-display
- Color, light and materials, Microsoft Mixed Reality Docs https://docs.microsoft.com/en-us/windows/mixed-reality/design/color-light-and-materials
- Billboarding and tag-along, Microsoft Mixed Reality Docs https://docs.microsoft.com/en-us/windows/mixed-reality/design/billboarding-and-tag-along