**Unity project description: Affective touch v1**

The project aims to simulate the apparent tactile motion illusion with the visual feedback - brash movement. The movement is presented on the right arm of the participant. The project was created based on the WAVY project with 4 bowls and different object sensations.

**Scene and setup**

The Unity scene contains the table that the participants are going to rest their hand, and the VR avatar connected to the VR controllers that is the virtual representation of the participant’s body. When the experience starts, the painting brash appears above the right arm of the avatar and it is moving simultaneously with the haptic motor activation. The brush's speed is adjustable and varies depending on the experiment condition, which can be congruent or incongruent with the apparent tactile motion (ATM) velocity.

A hand reaching out to the right of a wooden floor

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Figure 1. The view on the scene during the play mode.

**GUI**

The project includes a graphical user interface (GUI) with two buttons:

* Next Trial Button: Initiates the experiment by activating the AudioClips and beginning the first trial. Allows you to switch between trials by changing the audio files associated with the AudioClips.
* Create Experiment Files: : Generates a "GeneretedData.csv" file containing the trials description

**Scene**

The table and the haptic Vibrator representations were taken from the WAVY project. The avatar and the connection between it and the Meta Quest controllers were created using this tutorial: <https://youtu.be/v47lmqfrQ9s?si=miLBTrVVaKXqPLLi>

The brush asset is obtained from CGTrader (<https://www.cgtrader.com/free-3d-models/household/household-tools/cc0-paint-brush-3>).

**Scripts**

All scripts that control the haptic actuators, establish communication protocols and manage connection (COM Serial) with the haptic device are adapted from the WAVY Unity project. The ATM is based on the collision detection scripts (HapticColliderTrigger) from the same project. HapticDevice, HapticManager scripts remain unchanged.

All new and changed scripts are presented below:

1. **HapticColliderTrigger\_1**

This script must be attached to a GameObject along with the HapticSource() script.

Specify the source assigned to the HapticSource (representing a step in the ATM).

Assign the HapticDevice that will be activated and play the audio file from HapticSource.

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1. **AudioSamplesGenerator:**

Attach this script to a GameObject that functions as the HapticClip.

Used to store audio files for playback through vibrators.

Assigns audio files based on the "GeneratedData.csv" file, varying audio source and brush movement speed. The script needs “auto\_file\_list.txt” to properly decodes the keys of the audio files names (values).

Variables:

* The variable Audio File is automatically assigned based on the trial number and the file GeneretedData.csv.
* The variable brush\_script should be assigned to the brush GameObject on the scene.
* The Trial\_numb is the trial number that the script is reading the information from the GeneretedData.csv.
* The Actuator\_numb is the variable that determines which music files will be captured for which HapticDevice according to the Trial\_numb. E.g., Actuator\_numb = 1 reads the audiofiles for the Actuator 1 in the GeneretedData.csv.

The structure of the “auto\_file\_list.txt” file should be as follows: “1.1,signal60\_1\_1\_75” (key, value). The key should be separated from the value (name of the audio file without “.wav”) with “,’. Each of the pairs key,value should be separated with Enter.

Each of the ATM contains three audio files which should be describe as follows:

* 1. First audio file
  2. second audio file
  3. third audio file

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1. **Create\_table\_final**

The script creates the “GeneretedData.csv” that contains the file containing trial descriptions: trial number, brush speed and the audio files that should be displayed using each of the actuator.

The sample of “GeneretedData.csv”:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Trial | Brush duration | Actuator 1 | Actuator 2 | Actuator 3 | Rank | Magnitude estimation |
| Trials 1 | 10 | 1 | 2 | 3 | X | X |
| Trials 2 | 1 | 4 | 5 | 6 | X | X |
| Trials 3 | 6 | 1 | 2 | 3 | X | X |
| Trials 4 | 4 | 4 | 5 | 6 | X | X |

Variables:

* NumOfATM – number of ATM
* NumSpeedsForATM – number of speeds that are going to be tested for each ATM
* NumStepsOfATM – number of Audio files used to simulate ATM (as we are using three motors now, the number here should be 3
* BrushSpeedsForATM1 – list of lists of speeds for each of the ATMs. The speeds should be added directly in the C# script. The brush speeds should be given in cm/second.

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1. **Brush\_movement**

The script must be attached to the brash GameObject on the scene.

It uses two variables: startPoint and finishPoint representing the start and finish positions of the brush movement.

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The movement of the brash is activated by the StartForwardMovement() function.

1. **Button\_Next\_Trials\_Start**

This script aims to change the audio files used in HapticClips between trials and activates HapticDevices to play the HapticClips. The script is automatically detecting all HapticDevices and HapticClips in the scene.

**GUI**

1. **Next trial button**

The button activates the audio files and brush movements. It also allows you to change between trials. The OnClick() function of this button have to be connected to the StartForwardMovement() for the brush GameObject and ChangeTrial() function from the NextTrial ButtonObject.

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1. **Create\_experiment\_files**

The button creates the “GeneretedData.csv” file.

The OnClick() function of this button have to be connected to CreateCSV() function form the Create\_experiment\_files ButtonObject.

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IMPORTANT! Sometimes the Unity is working slow so check if there is a new file before starting the experiment.