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Assignment on Virtual Reality and Physically-Based-Simulation - Sheet 1

Due Date November 06, 2023

Exercise 1 (Virtual Reality, *3 Credits*)

(a) Try to define the following in your own words. Use no more than 2 sentences per concept: Virtual Reality, Virtual Environment, Immersion, Presence, Fidelity and Suspension of Disbelief.

(b) Imagine the following scenario: You are standing on a glass floor, from beneath that glass floor a virtual skyscraper is being projected, so that you can see your own body standing on the virtual building. Is that AR or VR? Provide some arguments for your position.

Exercise 2 (Lab Demos & IPQ, *4 Credits*)

We want to compare the different demos you will see in the lab on Thursday. Answer the Igroup Presence Questionnaire (IPQ) in the tables following for each the demos you tried. The IPQ is a scale for measuring the sense of presence experienced in a virtual environment.[1]

Note that an answer to a question is depicted as an integer scale from -3 to +3 (including 0). For example, for the first question (G1), -3 corresponds to "not at all", +3 corresponds to "very much", while 0 would be "neutral" between these maxima. Cross in the circle corresponding to the scale number for each respective question for each demo in tables 2, 3 and 4.

In the "Lab_Demos_Eval.zip" you will find a Python-file "vr_sheet1_exercise2_plots.py" and accompanying CSV-files for each demo with the IPQ-questions. Extract the ZIP, fill in the CSV-files with your values for each IPQ-question (each row is a group member) and run the Python-file from the containing directory. You should get three PNG-files, one for each plot, in the same directory similar to figure 1. Include the PNGs in your submission for your group. You will need the Matplotlib and Numpy packages to run the script.

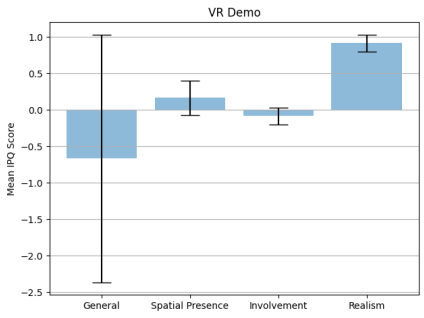

Figure 1: Example evaluation plot.

[1] http://www.igroup.org/pq/ipq/download.php/

IPQ Name	English Question	English Anchors
G1	In the computer generated world I had a sense of "being there"	not at all–very much
SP1	Somehow I felt that the virtual world surrounded me.	fully disagree–fully agree
SP2	I felt like I was just perceiving pictures.	fully disagree–fully agree
SP3	I did not feel present in the virtual space.	did not feel–felt present
SP4	I had a sense of acting in the virtual space, rather than operating something from outside.	fully disagree–fully agree
SP5	I felt present in the virtual space.	fully disagree–fully agree
INV1	How aware were you of the real world surrounding while navigating in the virtual world? (i.e. sounds, room temperature, other people, etc.)?	extremely aware–not aware at all
INV2	I was not aware of my real environment.	fully disagree–fully agree
INV3	I still paid attention to the real environment.	fully disagree–fully agree
INV4	I was completely captivated by the virtual world.	fully disagree–fully agree
REAL1	How real did the virtual world seem to you?	completely real–not real at all
REAL2	How much did your experience in the virtual environment seem consistent with your real world experience?	not consistent–very consistent
REAL3	How real did the virtual world seem to you?	about as real as an imagined world–indistinguishable from the real world
REAL4	The virtual world seemed more realistic than the real world.	fully disagree–fully agree

Table 1: Igroup Presence Questionnaire.

Exercise 3 (Unreal Engine: Scenegraphs, Components & Basic Inputs, *4 + 4 Credits*)

Please make yourself familiar with Unreal Engine 5 (UE5), and it's editor. Also take a look at the Unreal Engine 5 Documentation.

In this exercise, the goal is to create an actor constructed from different parts arranged in a scene graph and to make it move on a simple user input.

Figure 2: Here is how the character could look like. Disregard the UI for this exercise.

(a) Create a new Unreal project. Please start from a blank project and do not include the starter content to keep the project size small.

(b) In the project, create a new actor that looks similar to the character in Figure 2. You can model the individual parts with transformed *Sphere Mesh Components* or use external 3D models.

(c) Make sure that rotating the head also rotates the nose and the eyes by defining them in a hierarchy.

(d) The arms and legs should have a joint at their rotation origin which rotates the respective limbs. Consider *Scene* components for this.

(e) Place the actor into a level that is loaded when the game starts.

(f) Draw the scene graph of your actor by hand or in a computer program.

Until now, we only have a static scene. Let's add some movement to the legs and let the user toggle it on or off. Here is an example of how the movement can look like: `http://cgvr.cs.uni-bremen.de/teaching/vr/uebungen/02_result.webm`

(g) Place a camera facing the actor into the level and set up the game to use this camera after the game starts. Consider the *Event BeginPlay* event in the *Level Blueprint* for this.

(h) Rotate the legs with a looping run animation.

(i) Make the animation speed configurable with a variable in the blueprint that is Instance Editable.

(j) Place at least two instances of your actor in the scene. Both actors should have different walking speeds, as you can see in the video.

(k) Using an input of your choosing (e.g. a specific button press, mouse click, etc.), implement a toggle that turns the animation on or off.

IPQ Name	-3	-2	-1	0	+1	+2	+3
G1	◯	◯	◯	◯	◯	◯	◯
SP1	◯	◯	◯	◯	◯	◯	◯
SP2	◯	◯	◯	◯	◯	◯	◯
SP3	◯	◯	◯	◯	◯	◯	◯
SP4	◯	◯	◯	◯	◯	◯	◯
SP5	◯	◯	◯	◯	◯	◯	◯
INV1	◯	◯	◯	◯	◯	◯	◯
INV2	◯	◯	◯	◯	◯	◯	◯
INV3	◯	◯	◯	◯	◯	◯	◯
INV4	◯	◯	◯	◯	◯	◯	◯
REAL1	◯	◯	◯	◯	◯	◯	◯
REAL2	◯	◯	◯	◯	◯	◯	◯
REAL3	◯	◯	◯	◯	◯	◯	◯
REAL4	◯	◯	◯	◯	◯	◯	◯

Table 2: Answers to IPQ-questions for the **Powerwall demo**. Cross in the circle corresponding to the scale number for each respective question.

IPQ Name	-3	-2	-1	0	+1	+2	+3
G1	◯	◯	◯	◯	◯	◯	◯
SP1	◯	◯	◯	◯	◯	◯	◯
SP2	◯	◯	◯	◯	◯	◯	◯
SP3	◯	◯	◯	◯	◯	◯	◯
SP4	◯	◯	◯	◯	◯	◯	◯
SP5	◯	◯	◯	◯	◯	◯	◯
INV1	◯	◯	◯	◯	◯	◯	◯
INV2	◯	◯	◯	◯	◯	◯	◯
INV3	◯	◯	◯	◯	◯	◯	◯
INV4	◯	◯	◯	◯	◯	◯	◯
REAL1	◯	◯	◯	◯	◯	◯	◯
REAL2	◯	◯	◯	◯	◯	◯	◯
REAL3	◯	◯	◯	◯	◯	◯	◯
REAL4	◯	◯	◯	◯	◯	◯	◯

Table 3: Answers to IPQ-questions for the **VR demo**. Cross in the circle corresponding to the scale number for each respective question.

IPQ Name	-3	-2	-1	0	+1	+2	+3
G1	◯	◯	◯	◯	◯	◯	◯
SP1	◯	◯	◯	◯	◯	◯	◯
SP2	◯	◯	◯	◯	◯	◯	◯
SP3	◯	◯	◯	◯	◯	◯	◯
SP4	◯	◯	◯	◯	◯	◯	◯
SP5	◯	◯	◯	◯	◯	◯	◯
INV1	◯	◯	◯	◯	◯	◯	◯
INV2	◯	◯	◯	◯	◯	◯	◯
INV3	◯	◯	◯	◯	◯	◯	◯
INV4	◯	◯	◯	◯	◯	◯	◯
REAL1	◯	◯	◯	◯	◯	◯	◯
REAL2	◯	◯	◯	◯	◯	◯	◯
REAL3	◯	◯	◯	◯	◯	◯	◯
REAL4	◯	◯	◯	◯	◯	◯	◯

Table 4: Answers to IPQ-questions for the **haptics demo**. Cross in the circle corresponding to the scale number for each respective question.