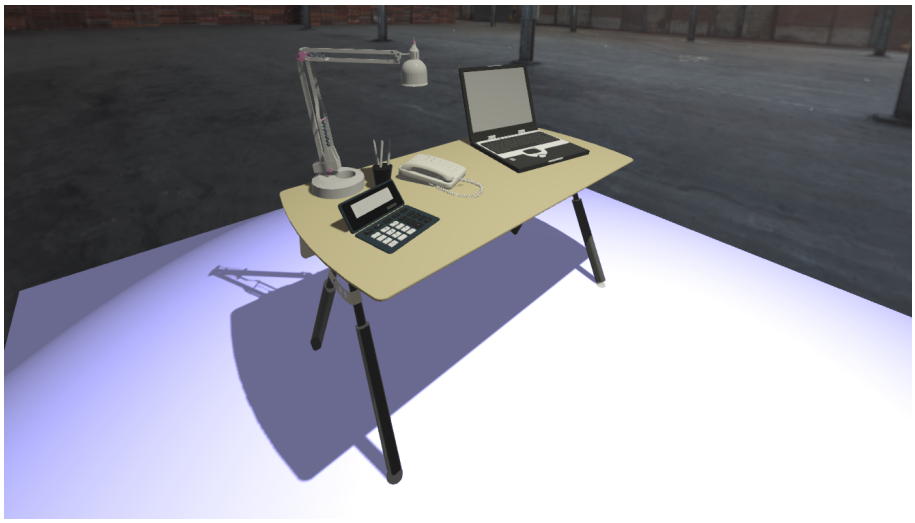
Virtual Reality
Winter Term 2018/2019

Assignment Sheet 6

In this assignment sheet, you are going to implement selection and manipulation techniques in one of our immersive Virtual Reality setups. Talk to the teaching assistants regarding the choice of a setup you want to work with:

- *Mitsubishi* 3D Television (Hostname: `perseus`)
- *Samsung* 3D Television (Hostname: `boreas`)
- Small Powerwall (Hostname: `athena`)
- Semi-Transparent Mirror Display (Hostname: `andromeda`)
- *HTC Vive* Head-Mounted-Display A (Hostname: `eos`)
- *HTC Vive* Head-Mounted-Display B (Hostname: `arachne`)

In the framework provided for this assignment sheet, an individual class is prepared for each technique to be implemented in the file `Manipulation.py`. The class `VirtualRay` is already fully implemented and can be used as a reference implementation for the other techniques. All techniques are derived from the base class `ManipulationTechnique`, which includes intersection and dragging functionalities. The class `ManipulationManager` initializes all techniques and provides a toggle mechanism to switch between techniques.



For your submission, please pack your exercise folder into a `*.zip` file and upload it to Moodle. Your are required to do so by **17 January 2019, 11:55 PM**. Group work in pairs of two is permitted. You will present and explain the submitted code in the lab class on **18 January 2018**. This assignment sheet contains tasks worth **12 points** and will be weighted by **20%** for your total lab class grade.

Exercise 6.1 (3 points)

Implement the *Depth Ray* technique to disambiguate between multiple intersections of a virtual pointing ray. For this purpose, add a marker to the ray which can be adjusted in depth using the roll angle of the pointing device. A function `get_roll(MATRIX)` to retrieve the roll angle from a matrix is given in the respective class. More information on the depth ray can be found in this publication[1].

Exercise 6.2 (3 points)

Implement the *GoGo* manipulation technique to dynamically adjust the translational control-display ratio of a virtual hand. For this purpose, use a piecewise transfer function with a 1:1 control-display gain for the first half of the arm's reach (35cm) and a non-isomorphic function for the remaining arm reach ($>$ 35cm). Print your combined transfer function with a graph plotter.

Exercise 6.3 (6 points)

Implement the *PRISM* manipulation technique to dynamically adjust the *translational* control-display ratio of a virtual hand. In each frame, determine the velocities of the input device along all three cardinal axes and decide which mappings to apply to the virtual hand. The velocity thresholds `MinS`, `SC` and `MaxS` are given in the respective class. The *PRISM* technique itself is thoroughly described in this publication[2].

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[1] Tovi Grossman and Ravin Balakrishnan. The design and evaluation of selection techniques for 3D volumetric displays. In Proceedings of the 19th annual ACM symposium on User interface software and technology (UIST '06). https://dl.acm.org/citation.cfm?id=1166257

[2] Scott Frees, G. Drew Kessler, and Edwin Kay. PRISM interaction for enhancing control in immersive virtual environments. ACM Trans. Comput.-Hum. Interact. 14, 1, Article 2 (May 2007). https://dl.acm.org/citation.cfm?id=1229857

Workstations

Each of the workstations is equipped with a tracked pointer and stereo hardware. Please do **not** move equipment between workstations and power off all your systems after work.

Mitsubishi 3D Television

The Mitsubishi Stereo-TV is usually set to stereo mode, and this setting is kept between sessions. If, however, the 3D mode needs to be re-enabled manually, open the on-screen menu, select `3D Mode` and switch to `ON Standard`. For tracking, use the ART tracking system controller located in the corner of the lab.

Samsung 3D Television

The Samsung Stereo-TV has to be set to stereo mode every time using the remote control since this setting is not kept between sessions. Open the on-screen menu, select `Setup` and switch the `DLP 3D/Dual-View` menu item to `ON-STD GLS` or `ON-INV GLS` (find out which of the options produces a proper stereo impression). For tracking, use the ART tracking system controller next to the display and the `DTrack` application located in `/opt/DTrack2_v2.13.0/DTrack2`.

Small Powerwall

Turn on the black power distributor right next to the projectors. Afterwards, turn on the projectors by pressing the power switches on the upper side. Furthermore, turn on the `athena` computer, which is located next to the projectors. For the shutdown procedure, double press the power switches on the projectors and turn off the computer. Then, wait one to two minutes for the projectors to cool down before also switching off the power distributor. For tracking, use the ART tracking system controller located in the corner of the lab.

Semi-Transparent Mirror Display

The semi-transparent mirror display requires you to select the `Ubuntu` session instead of `Gnome` on the login screen. Once logged in, make sure the output of the upper monitor is reflected along X using the tool `nvidia-settings`. For tracking, use the ART tracking system controller located in the corner of the lab.

HTC Vive Head-Mounted Displays

Switch on a computer with a HTC Vive and press `Esc` during the startup process to boot into Windows. Once logged in, open `SteamVR` pinned to the task bar. Plug the cables of the headset and the two lighthouse trackers in power sockets. When done working, remove these cables again and power off the machine.