

User Guide for Volumetric Projective Space Software (VPSS)

v1.1.0

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1. Prerequisites and Requirements

1.1. Hardware

To ensure proper operation of the application, the following hardware is required:

- Ultraleap Hand Tracking camera (the Leap Motion Controller 2 is recommended).
- A computer meeting the minimum system requirements:
 - for Windows devices:
 - Windows® 10, 64-bit
 - Intel® Core™ i3 processor, 5th generation (must support AVX instructions),
 - 2 GB RAM,
 - USB 3.0 or USB-C port (USB 2.0 is sufficient for the original Leap Motion Controller),
 - for Apple devices:
 - macOS 11,
 - Apple Silicon chip or Intel® core i5 (must support AVX instructions and have at least 4 cores),
 - USB 3.0 or USB-C port (USB 2.0 is sufficient for the original Leap Motion Controller).

1.2. Software

The **Ultraleap Gemini** software (version 5.2 or later) or **Ultraleap Hyperion** software (new version) must be installed. It is available for download on the official Ultraleap website here: <https://www.ultraleap.com/downloads/leap-motion-controller-2/>

2. Installation and Launch

2.1. Downloading the Application

The application is currently available for download at our **GitHub repository**, where you will find versions for both Windows and macOS. For example, to download current version 1.1.0 for the Windows operating system, navigate to the compressed file **VPSS_v1-1-0.zip** (see Figure 1). When downloading the macOS version, the file has the same name. Download this file to your computer.

GitHub link: <https://github.com/RadasPesa/VPSS>

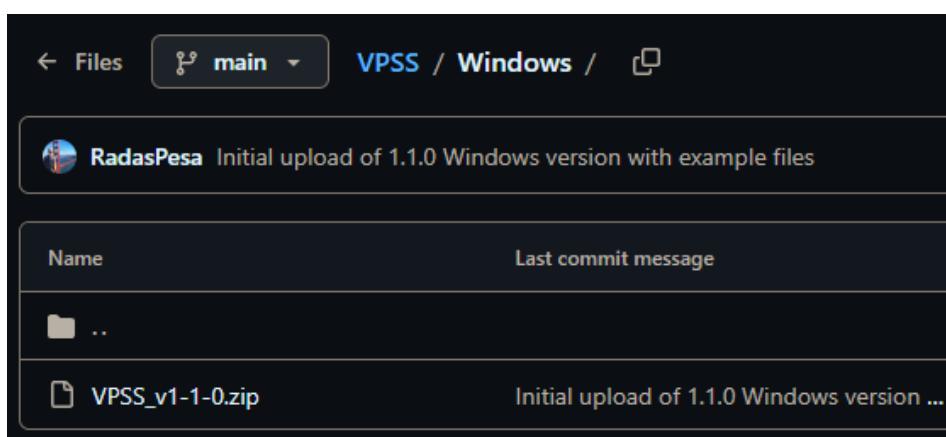


Figure 1: View of the application file in the GitHub repository.

2.2. Launching the Application

Launching the application itself is very straightforward, as no installation is required (the application is already provided in a ready-to-run state).

Windows

- On the Windows operating system, extract the downloaded archive. You should see a folder with the same name. Open this folder to view the files required to run the application. Only one file is relevant for launching the application: **VPSS.exe**. Open this file and the application should start.

macOS

- When using macOS, first extract the downloaded archive. You should see a file with the same name and the **.app** extension. To launch the application, hold down the **Control** key, click the application icon and select **Open** from the context menu. Then click **Open** again to confirm and the application should start.
After this initial launch, the application can be opened normally by double-clicking. When downloading a newer version, however, this initial procedure will need to be repeated.

In both cases, after a successful launch, you should be taken to the application's main menu, shown in Figure 2 **Figure 2: Main menu of the application..**

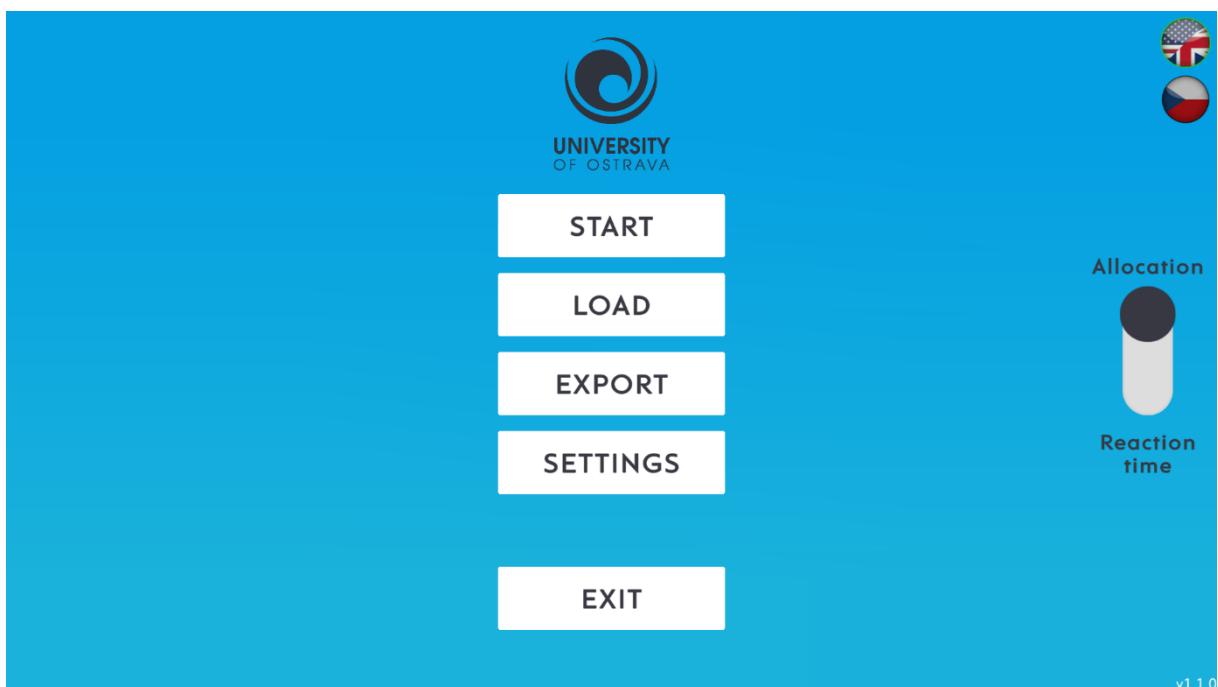


Figure 2: Main menu of the application.

3. Configuration

The first setting the user can adjust is the application language. In the top-right corner of the screen, it is currently possible to switch between English and Czech. In addition, the application supports two modes, which are displayed on the right side of the screen:

- Allocation – in this mode, users place points within a cube based on their subjective perception of the displayed term.
- Reaction time – in this mode, users only indicate agreement or disagreement with a pre-positioned point corresponding to the displayed term.

3.1. Allocation

In the allocation part the application allows users to configure basic controls and parameters according to their preferences in the “**Settings**” section. Click this button to access two sections: “**Controls**” and “**Options**”.

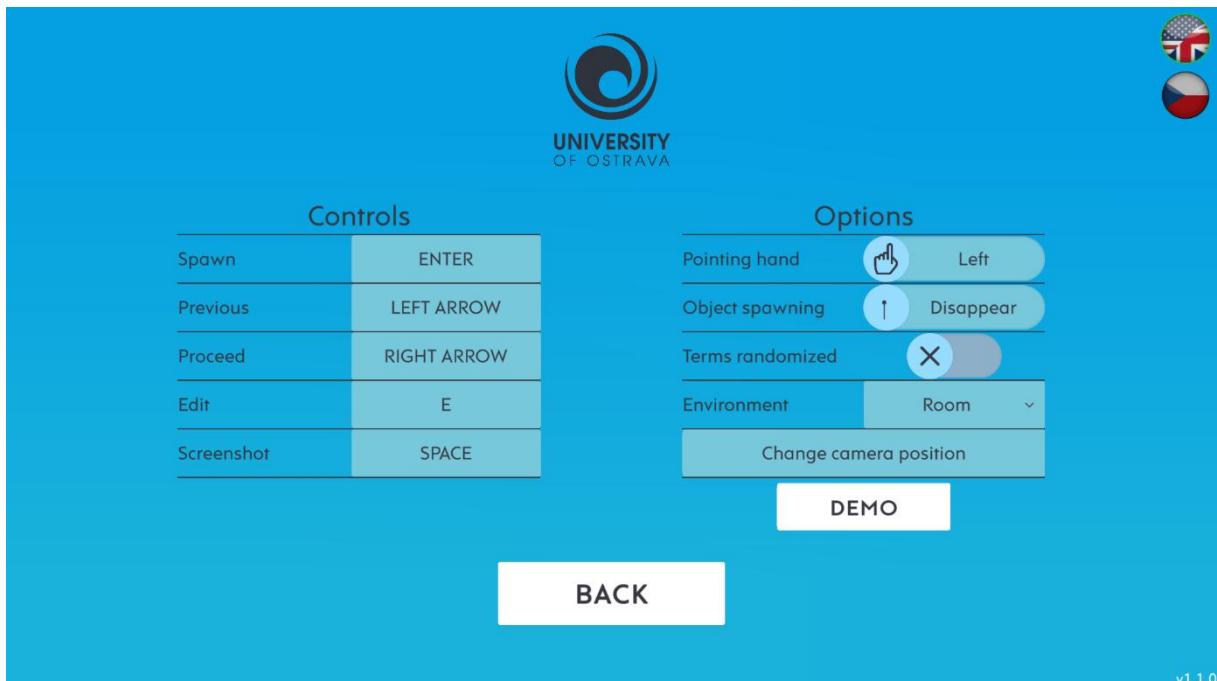


Figure 3: View of the Settings section in the Allocation mode.

3.1.1. Controls

In the “**Controls**” section, you can reassign buttons for various actions. Specifically, these are (together with their default settings, as shown in Figure 3):

- **Spawn <Enter>** – places a term (3D object) at a designated location within the cube. This action can also be performed using a double-pinch (thumb and index finger) on the opposite (non-dominant) hand – see Section Object Allocation for more details.
- **Previous <Left arrow>** – moves to the previous term, either for viewing or for adjusting its placement.
- **Proceed <Right arrow>** – moves to the next term.
- **Edit <E>** – adjusts the position of an already placed concept.
- **Screenshot <Space>** – takes a screenshot of the screen and saves it inside the application folder.

3.1.2. Options

In the “*Options*” section, you can adjust the application’s behavior and appearance.

Currently, the following settings are available:

- **Pointing hand** – the hand (or specifically the index finger), that the user will use to determine the placement position of a term.
- **Object spawning** – choose whether already placed terms completely disappear from the scene or remain with increased transparency.
- **Terms randomized** – toggle the randomization of the terms on or off (the output file also shows a line indicating the order in which the terms were displayed).
- **Environment** – select from preset environments for allocation (either a room or a green-to-blue gradient simulating grass and sky).
- **Change camera position** – adjust the camera’s position from which the user views the entire cube (see Figure 4).

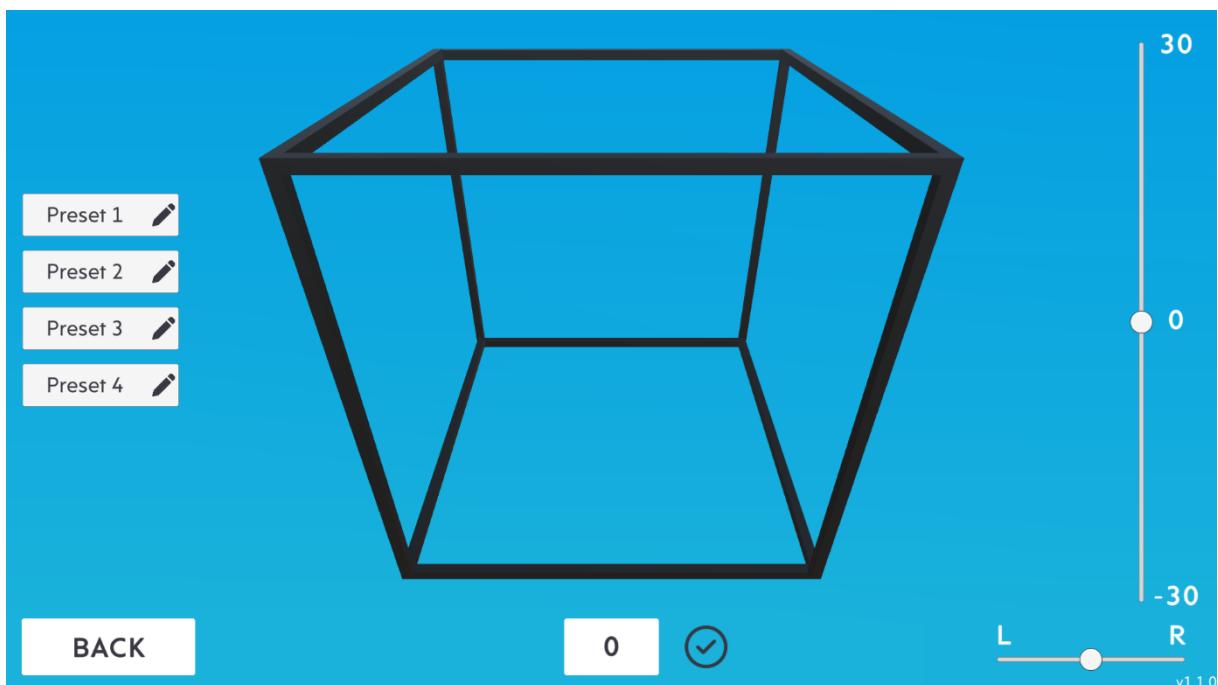


Figure 4: Change camera position.

You can then test your selected settings using the example scenarios. By clicking the “**Demo**” button, you enter the demonstration version of the application, where you can try placing three sample terms, navigate to the next or previous term, edit them, and generally see how the application works.

To return to the main menu, simply click the “**Exit**” button, press **Escape** on the keyboard and select “**Exit**”, or place all three test terms and press the assigned placement button (by default, **Enter**).

3.2. Reaction time

In the reaction time part, the application offers similar “**Settings**”, which you can see in Figure 5.

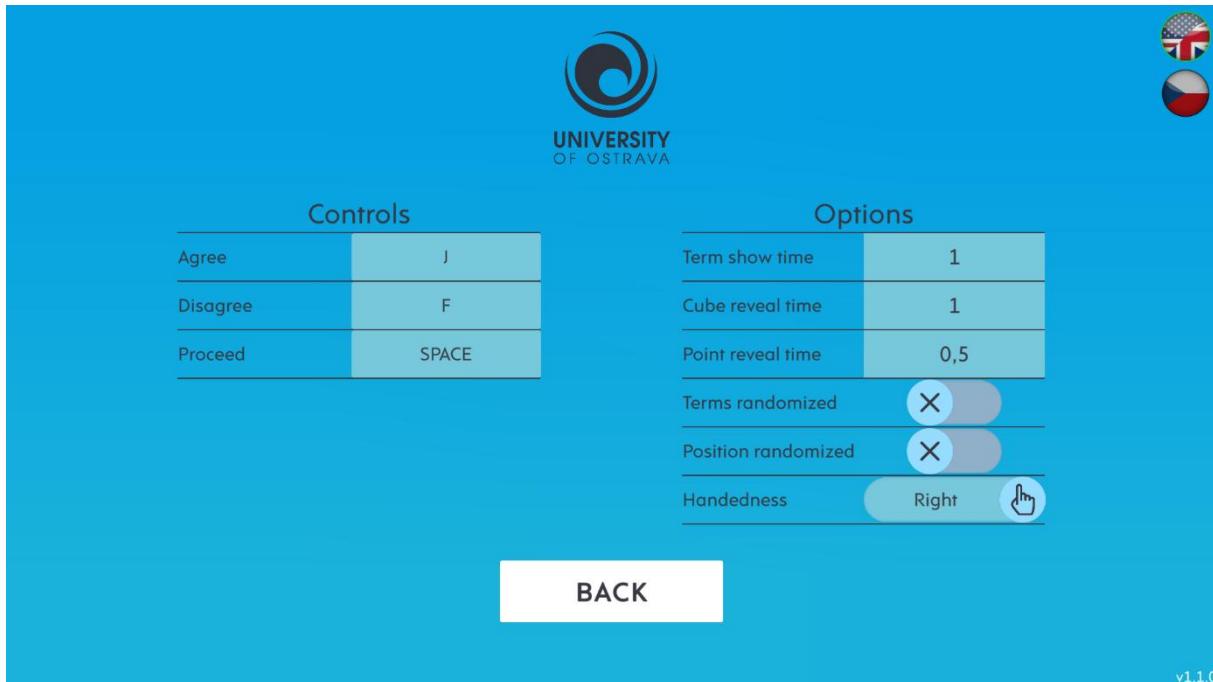


Figure 5: View of the **Settings** section in the Reaction time mode.

3.2.1. Controls

In the “*Controls*” section, you can reassign buttons for three actions:

- **Agree <J>** – user agrees with the placement of the given term.
- **Disagree <F>** – user disagrees with the placement of the given term.
- **Proceed <Space>** – moves to the next term.

3.2.2. Options

In the “*Options*” section, you can adjust mostly time related behavior. The following options are available:

- **Term show time** – how long the term is displayed to the user.
- **Cube reveal time** – how long the empty cube is shown on the screen.
- **Point reveal time** – how long the placed point (term) is visible; after this time, a screen with accept or reject icon appears.
- **Terms randomized** – toggle the randomization of the terms on or off.
- **Position randomized** – toggle the randomization of the position of the terms on or off (either up close, up far, down close or down far).
- **Handedness** – determines whether the accept icon is displayed on the right or left side of the screen (you must also change the agree and disagree bindings).

4. User manual

Using the application is generally intuitive. From the main menu, in addition to the previously mentioned **Settings**, you can navigate to the following sections:

- **Load** – to load terms either manually (individual terms) or from a file.
- **Export** – to save the recorded values to a file.
- **Start** – to start the object allocation process.

4.1. Loading terms

In the “Load” section of the **Allocation** mode, you can add terms individually using the text field and the “Add Term” button, or upload them from a file by clicking the “Browse” button (see Figure 7 *Figure 6: Example input file in a) .csv format and b) .txt format.*)

When importing from a file, make sure that the file is in **.csv** or **.txt** format, with each term on a separate line. Figure 6 shows:

- a .csv file displayed in Microsoft Excel, and
- b) a .txt file displayed inTextEdit on a macOS device.

Please note that uploading terms from a file will **erase all previously added terms**.

Recommendation: To ensure correct display of Czech characters, save files using **UTF-8 encoding**.

	A
1	První
2	Druhý
3	Třetí

a) b)

Figure 6: Example input file in a) .csv format and b) .txt format.

After successfully adding terms, you should see the uploaded terms in the middle section of the screen, as shown in Figure 7.

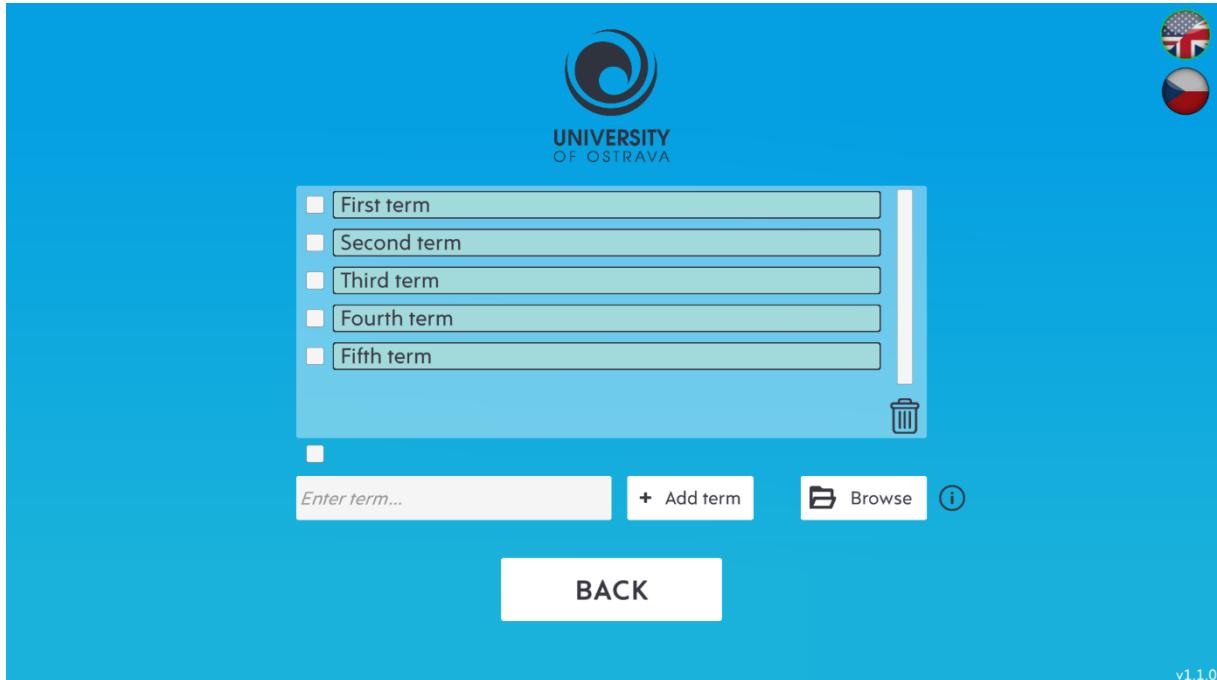


Figure 7: Term input section for the Allocation mode.

In the **Reaction time** mode, you can also import the terms either manually or from a file, but it is a little different, as you can see in Figure 8. If you want to add terms manually, you

simply enter the text and select arousal and valency (high or low) and a position from 4 options: UC (Up Close), DC (Down Close), UF (Up Far), DF (Down Far).

Figure 8: Term input section for the Reaction time mode.

When importing from a file, the file also must be in **.csv** or **.txt** format and each term must be on a separate line. The other values (arousal, valency, height and distance) must be on the same line as the term either separated by a semicolon (txt file) or in the next column (csv file), see Figure 9.

A	B	C	D	E
First term	H	H	U	C
Second term	H	L	U	F
Third term	L	L	D	C

Figure 9: Example input file in a **.csv** format for the Reaction time mode.

4.2. Saving output values

The “**Export**” section allows you to save the recorded values from individual users into a **.csv** file, which can then be further analyzed using external tools. To create and save this file, at least one measurement must be completed. All current measurements (or their IDs) are displayed in the middle section of the screen (see Figure 10 **Figure 10: Output values section (with two measurements)**).

To save the data, simply click the “**Save**” button, choose the target location, and enter a file name (the default name is set to ObjectAllocation).

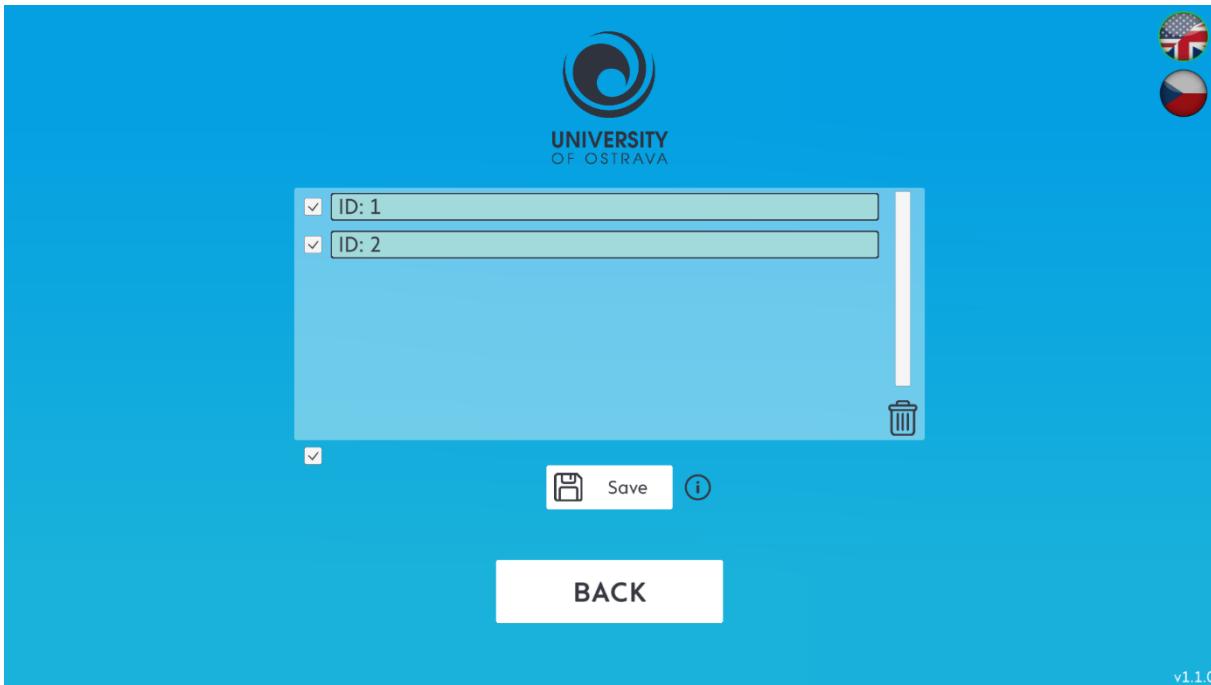


Figure 10: Output values section (with two measurements).

4.2.1. Output values format

Each measurement produces 9 values, defined in the file header (first row). These are: **ID, Term, Order, Pos X, Pos Y, Pos Z, First reaction time, Number of edits, Total reaction time**.

ID is any text identifying the user. Each ID must be unique, meaning the same ID cannot be used again if it has already been used and is still stored in the application's memory (listed among completed measurements). Deleting recorded values also frees up all IDs.

Order mainly relates to the term randomization setting. When randomization is enabled, this shows the order in which terms were presented to the user.

Position is displayed on three axes, each ranging from -0.2 to 0.2 meters. This corresponds to a cube with 40 cm edges, where the center of the cube is at position (0, 0, 0).

First reaction time is the time from when a term is shown until it is first placed. Each subsequent adjustment to that term adds to the Total reaction time, and the Number of edits is also recorded (if no adjustments are made, this is 0, and the total reaction time equals to the first reaction time).

An example of the output file can be seen in Figure 11.

ID	Term	Order	Pos X	Pos Y	Pos Z	First reaction time	Number of edits	Total reaction time
1	First term	1	-0,060896	-0,077635	-0,05037	2,008667	0	2,008667
1	Second term	2	0,0766807	0,0284973	-0,0242	1,094408	0	1,094408
1	Third term	3	-0,130396	0,104131	0,112648	1,361361	0	1,361361
1	Fourth term	4	0,1502218	-0,164389	-0,14171	1,975302	0	1,975302
1	Fifth term	5	0,1677721	-0,021996	0,185023	2,295624	0	2,295624
2	First term	1	0,0054594	0,117104	-0,07013	3,076424	0	3,076424
2	Second term	2	-0,143577	-0,111128	-0,14488	1,414734	0	1,414734
2	Third term	3	-0,160033	0,059452	-0,17341	1,468136	0	1,468136
2	Fourth term	4	0,1057028	0,1149642	-0,09329	1,855202	0	1,855202
2	Fifth term	5	-0,050288	-0,128739	0,155157	2,228878	0	2,228878

Figure 11: Example output file with two measurements of five terms each.

4.3. Starting the allocation

We now come to starting the allocation process, for which **at least one term must be loaded**. Once this condition is met, clicking the "Start" button will take you to the final part of the menu, which includes a text field for entering the user ID (see Figure 12).

As described in Section Output values format, this ID cannot be empty and must be unique. After entering a valid ID, you can proceed to start the allocation process.

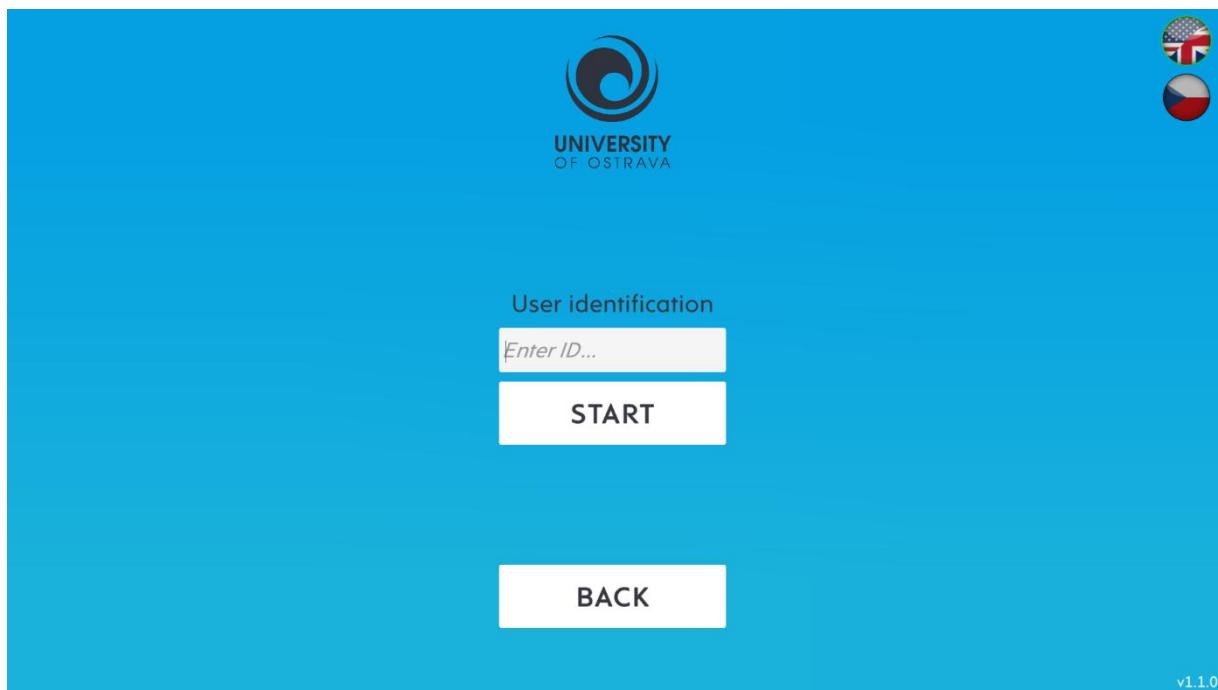


Figure 12: User ID entry section of the menu.

4.4. Object Allocation

During object allocation, the user uses the pointing hand to locate points within the cube and the assigned spawn key – or a double-pinch gesture with the opposite hand – to place objects (see Figure 13).

At each step, the user can navigate to previous or next term. However, to move to the next term, the currently displayed concept must first be placed.

To adjust an already placed term, simply navigate to it, press the **Edit** key, and place it again. Once all terms have been placed, a message appears with a thank-you note and instructions to complete the allocation process (by pressing the **Spawn** key).

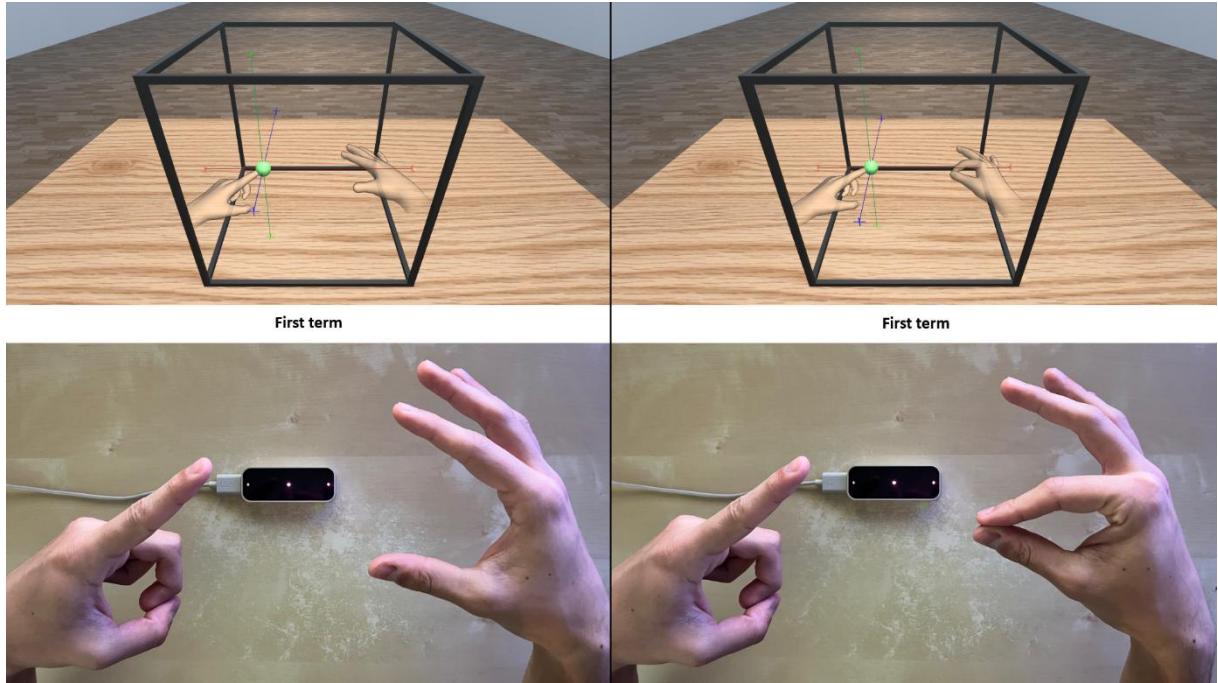


Figure 13: Example of object allocation using the pinch gesture.

5. Updates and Maintenance

The application is currently regularly updated and improved. We recommend checking for new versions of the application, as they may include important bug fixes, security updates, and new features.

5.1. How to update to a newer version

New application versions are released at our GitHub repository mentioned in Section TODO. Updating is the same as the initial installation: simply replace the existing folder (Windows) or file (macOS). All previous settings will be preserved, as the application stores these values outside the current version folder.

For each new version, release notes will be provided detailing what has been changed or added.

5.2. Application maintenance

This section is optional. However, we recommend performing maintenance occasionally. Currently, no specific maintenance procedure is prepared, but it may be added in the future.

5.3. Support contact

If you encounter any issues that cannot be resolved on your own, contact the application developer – send an email describing the issue to radim.pesa@osu.cz.

6. FAQ and troubleshooting

Under preparation