



User manual for LINAC training environment in virtual and augmented reality

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1. Introduction

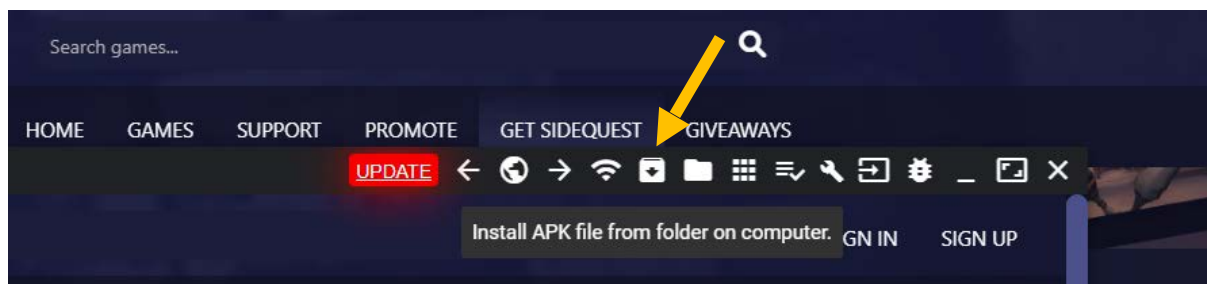
This document describes the functionality of LINAC training environment in virtual and augmented reality. Both systems were developed at Virtual Reality Technologies laboratory at Vidzeme University of Applied Sciences (ViA VR-Lab) during project's REEB activities (2021.-2023.). The ViA VR-Lab was established in 2009 in cooperation with the Fraunhofer Institute Virtual Reality Training and Development Centre (Magdeburg, Germany) and the University of Agder (Kristiansand, Norway), pointing to its long history and years of experience. ViA VR-Lab specializes in virtual and augmented reality system design and development for various fields (industry, medicine, safety training, education, tourism etc.) by developing technological innovations in multi user environments, large scale position tracking, simulation visualization, content management, evaluation and assignments, cloud-based rendering, sensors, IoT and digital twins, wearable sensors and training therapy, artificial intelligence.

2. Devices and installation

LINAC training environment in virtual reality is developed and tested for Meta Quest 2 virtual reality headsets and latest "REEB_ViA_VR-Lab_Linac_Quest2_v4_29062023.apk" installation file is used to deploy the system on headset. LINAC training environment in augmented reality is developed and tested for MS Hololens 2 augmented reality headset and latest "REEB_ViA_VR-Lab_Linac_HL2_v3_11072023.appx" installation file is used to deploy the system on headset.

2.1. Installation on Meta Quest 2

- Download *SideQuest Advanced Installer* from <https://sidequestvr.com/setup-howto> and install on your PC.
- Connect Quest 2 headset to your PC with USB cable
- Open *SideQuest* application on PC and choose *Install APK file from folder on computer*



- Select installation file, for example ““REEB_ViA_VR-Lab_Linac_Quest2_v4_29062023.apk”
- When installation is finished put on your Quest2 headset and look for the LINAC application in *Library* → *Unknown Sources*.

2.2. Installation on MS Hololens 2

This section provides step by step instructions how to install application on Hololens 2 headset via Device Portal. To achieve this, you will need the *app installer* file of your application and a Hololens 2 device with enabled *Developer mode* and access to *Device Portal*. If your Hololens 2 device already has *Developer mode* enabled and you can access Device Portal skip to step Nr.3.

Step Nr. 1 – Enable developer mode on Hololens 2.

1. Power on your Hololens 2.
2. Go to the Main Menu.
3. Go to the settings.
4. Select the Update menu item.
5. Select For developer’s menu item.
6. Enable Developer mode.
7. Scroll down and enable Device Portal.

If you are in multi-user and not an admin, the ability to enter Developer Mode may be greyed out. Please ensure that you are an admin on the device.

Step Nr. 2 – Access Device Portal on your computer.

1. Find your Hololens 2 IP address. There are three possible ways on how to do this:
 - a) Going to Settings > Network & Internet > Wi-Fi > Advanced Options.
 - b) Going to Settings > Network & Internet and selecting Hardware properties.
 - c) Using the "What's my IP address?" voice command.
2. From a web browser on your PC, go to https://<YOUR_HOLOLENS_IP_ADDRESS>

The browser will warn you either about security certificate or your connection not being private. For now, you can ignore those and proceed to the page by choosing *Advanced* in Chrome, Edge or Firefox, *Help me understand* in Opera GX (see fig. 1).

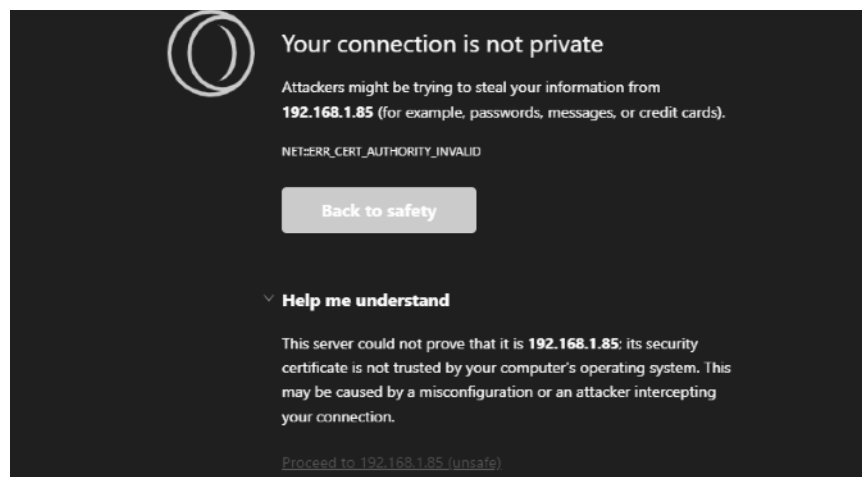


Figure 1. Warning before accessing the Device Portal in Opera GX browser.

The first time you connect to the Device Portal on your HoloLens, you will need to create a username and password (see fig. 2).

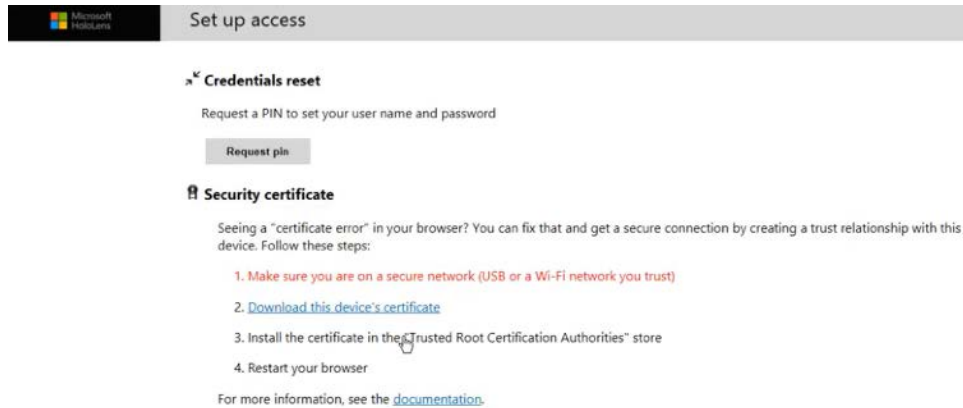


Figure 2. First time setup for Device Portal.

3. Select or tap Request pin and look at the HoloLens display to get the generated PIN.
4. Enter the PIN in the PIN displayed on your device textbox.
5. Enter the username you will use to connect to the Device Portal. It does not need to be a Microsoft Account (MSA) name or a domain name.
6. Enter a password and confirm it. The password must be at least seven characters in length. It does not need to be an MSA or domain password.
7. Click Pair to connect to Windows Device Portal on the HoloLens.

Step 3 – Install your application via Device Portal

1. In Device Portal go to Views > Apps.



Figure 3. Device Portal.

2. If you already have the app installed with the same version number uninstall it by selecting the app in the Installed apps dropdown and clicking Remove.
3. Then select the application package by clicking browse and searching for your installation folder `reeb_urp_1.0.0.0_ARM64_Test` on your computer.
4. Select `*.appx` installation file, for example `“REEB_ViA_VR-Lab_Linac_HL2_v3_11072023.appx”`.

5. If you have not installed the application, previously check *Allow me to select optional packages*
6. Click *Next*
7. Click *Browse* button again and go to Dependencies>ARM64 and select the appx inside it. Click *Install* and wait for the installation to complete. The app is now on your Hololens 2 device.

3. General functionality

During training process the participant should carry out three tasks which involves the correct positioning of table, patient and treatment area. All three tasks are predefined by instructor in *Settings panel* and can be changed for each training/evaluation session.

User experience is different in VR and AR, as interaction techniques are different. In VR environment participant uses controllers and buttons on virtual tablet for positioning (see fig. 4), but in AR environment participant uses hand gestures and fingers to press buttons which are much larger (see fig. 5), however the logics of both systems are based on the same rules.

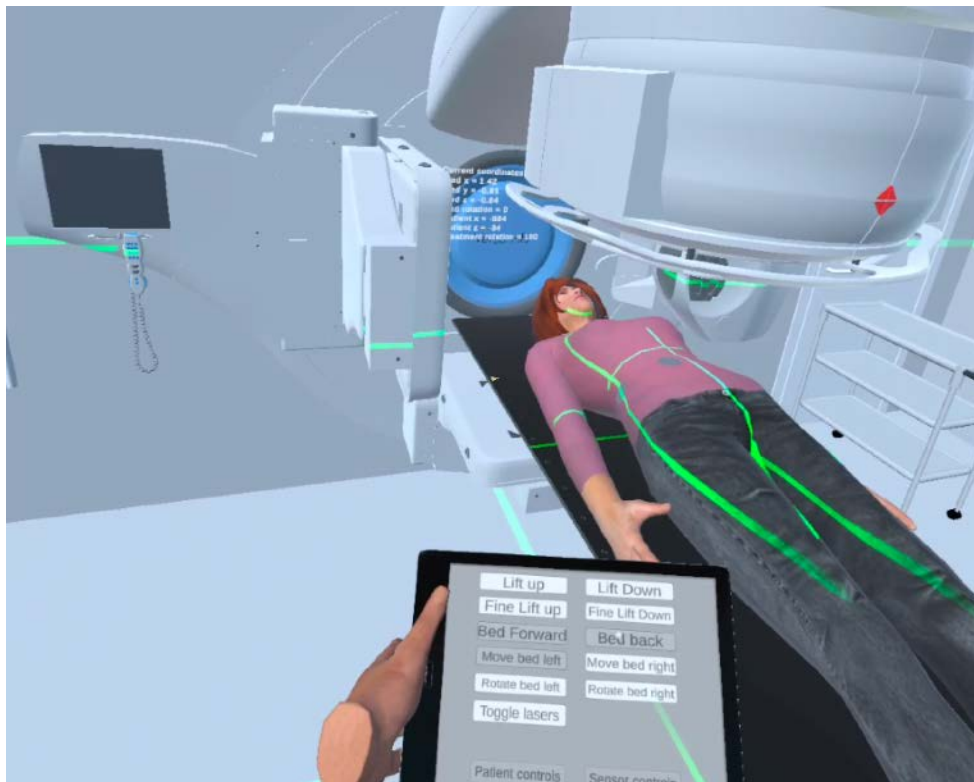


Figure 4. LINAC training environment in virtual reality and interaction with virtual tablet



Figure 5. LINAC training environment in augmented reality and interaction with hands

Both systems provide feedback on separate *whiteboard* located in the virtual environment near the LINAC device and the patient (see fig. 6).

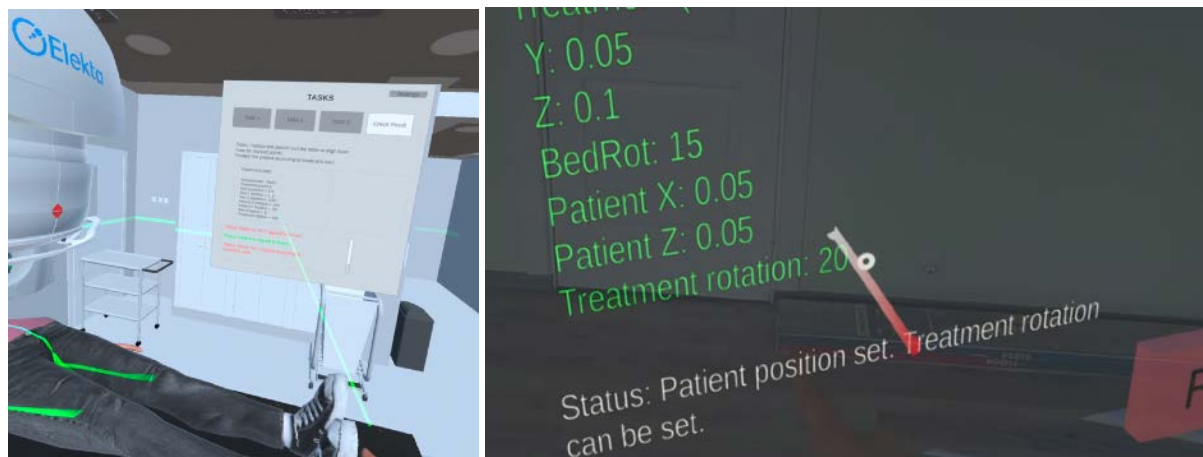


Figure 6. Selected task and feedback in VR and AR environments

4. Table and patient position

Each task starts with setting a correct position of the patient. There are three marked dots on patient skin which should align the laser lines. To achieve this, trainee can adjust separately the position of the table and the position of the patient (see fig. 7).

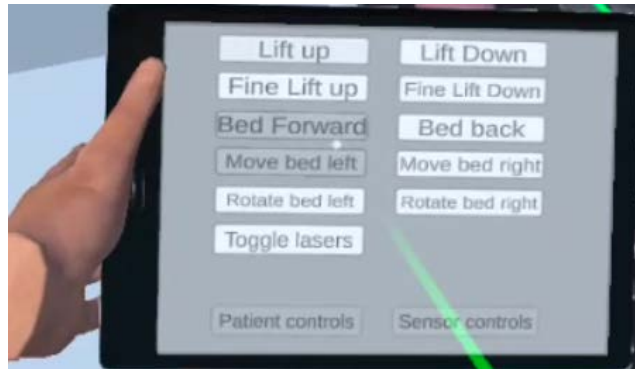


Figure 7. patient and table position adjustment (X, Y, Z, Y rotation)

Following status messages on tablet and whiteboard informs about position (see fig. 8):

- Status: Patient is not aligned to laser lines.
- Status: Patient aligned. Treatment is not possible. Collision problem.
- Status: Patient aligned. Treatment position can be set.

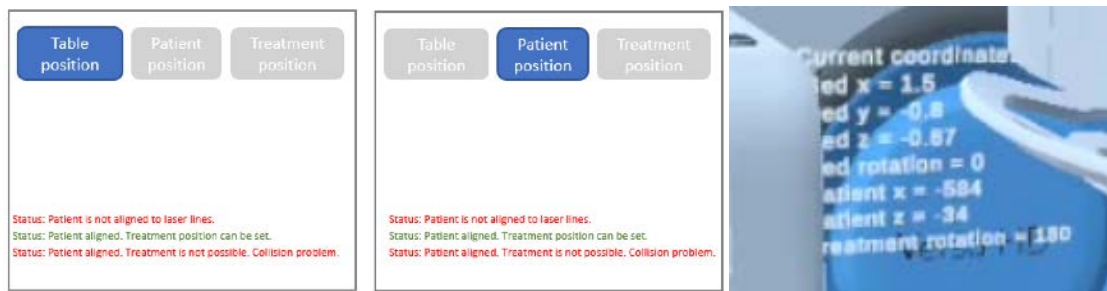


Figure 8. Status messages and live data for initial position

You can continue to treatment position and it is enabled only then, when status message “Patient aligned. Treatment position can be set.” is displayed.

5. Treatment position

When the patient is adjusted to initial position (isocenter) it can be adjusted now to treatment position according the data on treatment card prepared by instructor.

Following status messages on tablet and whiteboard informs about position (see fig. 9):

- Status: Task is not completed. Wrong treatment position
- Status: Task completed. Correct treatment position.

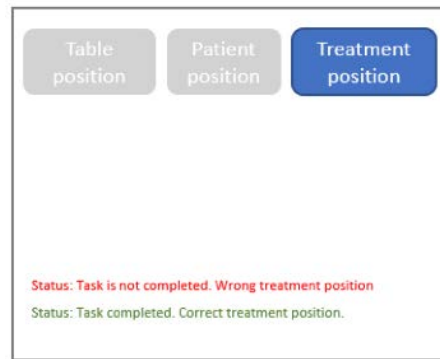


Figure 9. Status messages and live data for treatment position

When “Task completed. Correct treatment position” message appears; it means that current task is completed and participant can proceed to the next task or finish the session if it was the last task. To reset session for additional practise or for the next user, press Restart button (see fig. 10).

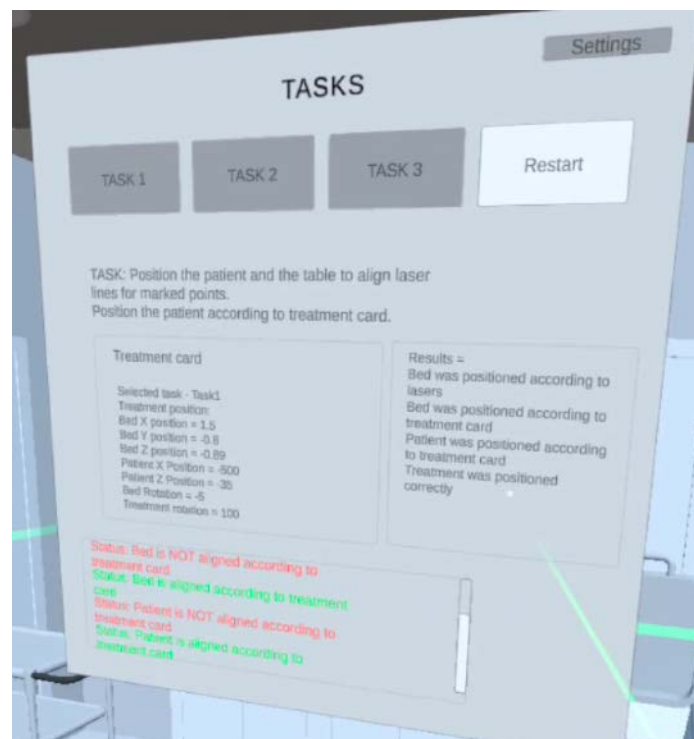


Figure 10. Whitebord with status on completed tasks and Restart button

6. Task management

Task management functionality is integrated in the system to provide possibility for the instructor to adjust and specify different tasks to avoid the situation that the same task is offered for next

examination or practise. It means that tasks are not hardcoded in the system and for task correctness instructor is responsible. To prepare tasks Settings button should be pressed and dialog window with all the settings should be filled or corrected for each task. The values which should be pointed out are treatment position (X, Y, Z and Y rotation), patient position (Z and Y rotation) and name of treatment organ (see fig. 11).

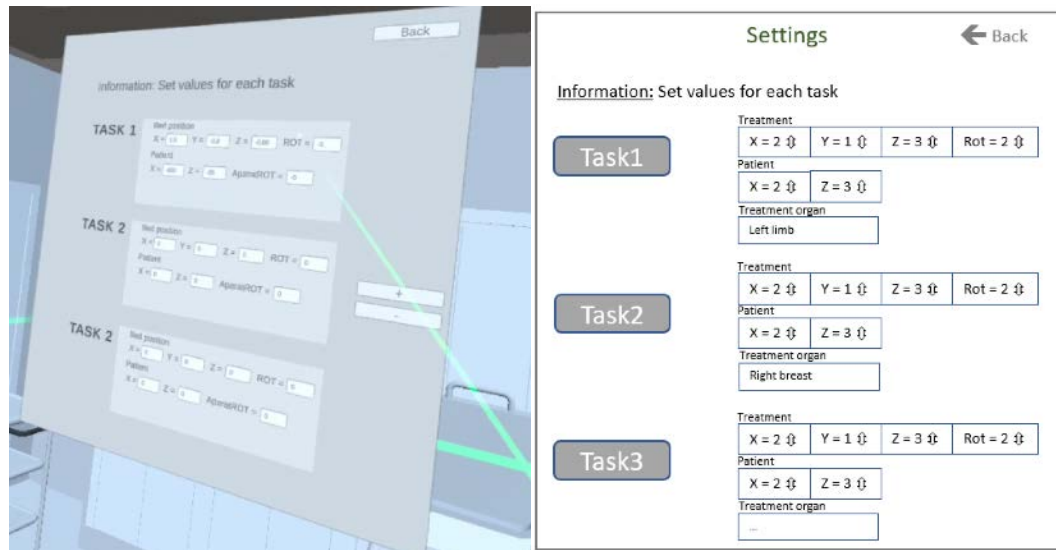


Figure 11. Adjustable values for each task by instructor