

# VR SafeScaff

## User manual

Virtual Reality training platform for safety education of personnel in the construction industry 'SafeScaff'

NACIONĀLAIS  
ATTĪSTĪBAS  
PLĀNS 2020



EIROPAS SAVIENĪBA  
Kohēzijas fonds



VIDZEME UNIVERSITY  
OF APPLIED SCIENCES

IEGULDĪJUMS TAVĀ NĀKOTNĒ

2022

## Contents

▶ Controls.....	3
• General movement.....	3
• Interacting with objects.....	4
• User interface.....	4
• General interaction.....	4
• Opening HUD menu.....	4
• Opening tablet menu.....	4
• Keyboard.....	5
▶ HUD Menu.....	6
▶ Settings.....	6
▶ Main Menu.....	7
▶ Training scenario.....	12
• Getting ready.....	12
• Building.....	13
• Safety.....	16
• Securing scaffolding.....	16
• Safety harness and straps.....	16
• Injuries.....	17
• Finishing the scenario.....	18
• Single User mode specific functionality.....	19
• Multi User mode specific functionality.....	20
• Nametags.....	20
• Voice chat.....	21
• User to user interaction.....	21
▶ Tablet.....	22
• Grading.....	22
• Forklift.....	23

## ► Controls

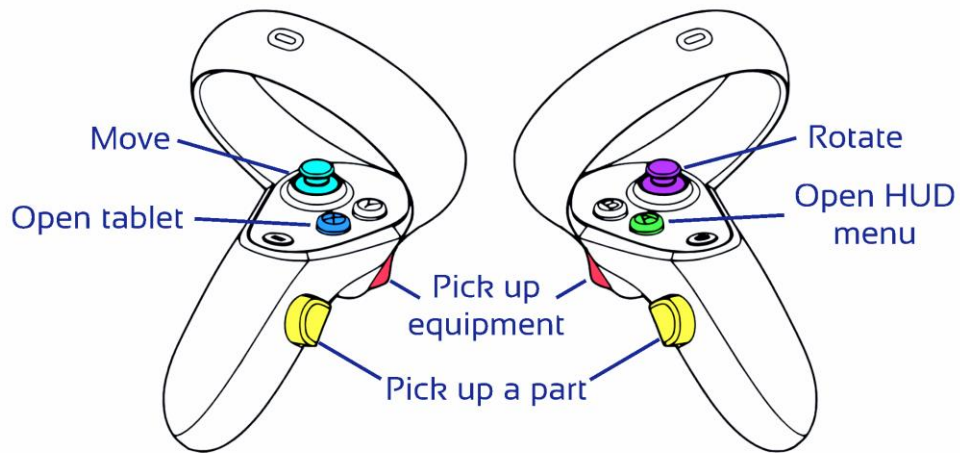


Figure 1. Control layout for Oculus Quest controllers

### • General movement

There are two movement types in this experience – smooth movement and teleportation. Smooth movement is the default type, but it can be switched to teleportation in the settings menu.

To use the smooth movement type, move the left thumbstick (shown in Figure 1 above) in any direction.

To use the teleportation movement type, first it must be enabled in the settings. After that, to move, user must move the left thumbstick in any direction and aim with the teleportation graphics to the position they want to move to. To finish teleportation, the thumbstick must be released and moved back to starting position.



Figure 2. Using teleportation and aiming to destination position

To turn, move the right thumbstick (shown in Figure 1 above) to the left or right. Users' view and virtual avatar will be rotated 45° in the respective direction.

Users' physical movement is also taken in account and translated to the virtual world, so, with a big enough play-space, controller input might not be necessary.

- **Interacting with objects**

During the experience various objects are needed to be picked up and interacted with. These are safety equipment and scaffolding parts.

To interact with these objects, move hands towards the object and when they are touching the object, press the buttons described further. For safety equipment objects, the trigger button must be used. For scaffolding parts, grip button must be used. These buttons are shown in Figure 1 above.

- **User interface**

### General interaction

To interact with the user interface, user must use their hand to control the ray position (see Figure 3). When the ray is over an interactable UI element, that element will become active. To activate or click this element, user must press the trigger button on the right controller (shown in Figure 1 as 'Pick up equipment').



Figure 3. UI hand ray visible

### Opening HUD menu

To toggle the state of the HUD menu, the user must press the 'A' button on the controller as shown in Figure 1.

Further functionality of this menu is described in 'HUD Menu' chapter further in this document.

### Opening tablet menu

The tablet menu is only available in a training scenario scene (single user or multi user).

To toggle the state of this menu, the user must press the 'X' button on the controller as shown in Figure 1.

Further functionality of this menu is described in 'Tablet' chapter further in this document.

## Keyboard

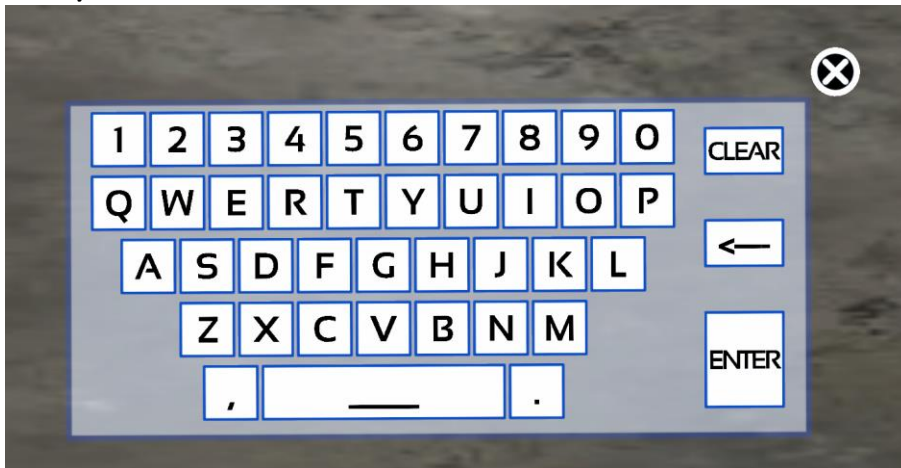


Figure 4. Keyboard UI

The keyboard UI appears when a text input field is selected. To write any text, the user must click each letter button.

There are a few special buttons: 'Clear', "←" as backspace, 'Enter' and 'X'.

Button	Description
Clear	Clears the active input field
←	Deletes the last character in the active input field
Enter	Accepts the text entered in the input field and closes the keyboard UI
X	Closes the keyboard UI

## ► HUD Menu

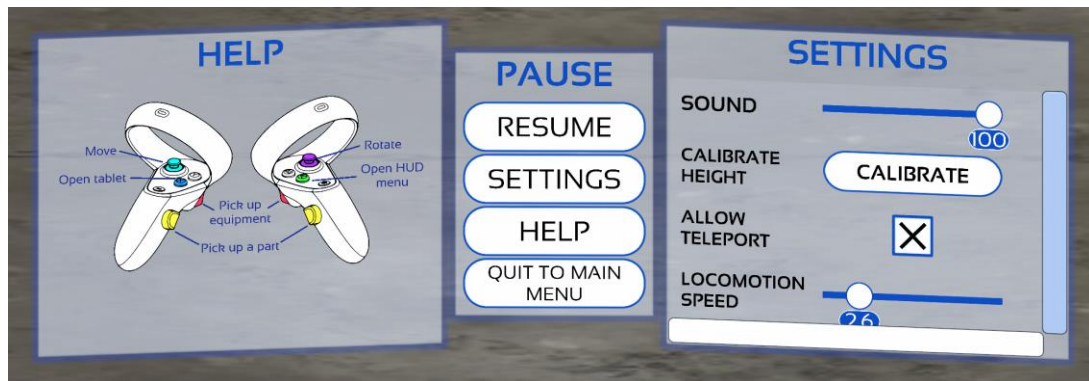


Figure 5. HUD menu and its sub-menus

This menu can be activated at any point in the experience. From this menu, the user can adjust the settings and view the controls. While the user is in a training scenario, the 'Quit to main menu' button is active, which brings the user back to the main menu scene and ends the scenario.

## ► Settings

Available in Main Menu scene and in the HUD menu.

There are four available settings to adjust:

Setting	Description
Sound	Adjusts the sound volume for the application
Calibrate height	Adjusts the virtual avatar height and proportions to match the users' height (based on headset height)
Allow teleportation	Enables or disables the teleportation movement type
Locomotion speed	Adjusts the smooth movement speed

## ► Main Menu

After starting the application, the first scene loaded is the Main Menu. This allows the user to select the training mode, as well as change settings to adjust the experience.



Figure 6. Main menu screen

As seen in Figure 6, the user can choose between viewing control instructions, settings and choosing between single user and multi user modes. This screen also allows the user to close the application by clicking on the 'X' button seen in the upper left corner.

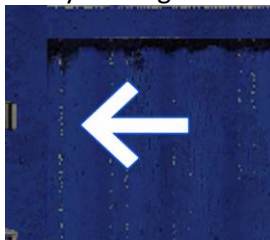


Figure 7. Menu back button

Each Main Menu screen has a back button (see Figure 7) in the upper left corner. Clicking this button will return to the previous screen in the menu.

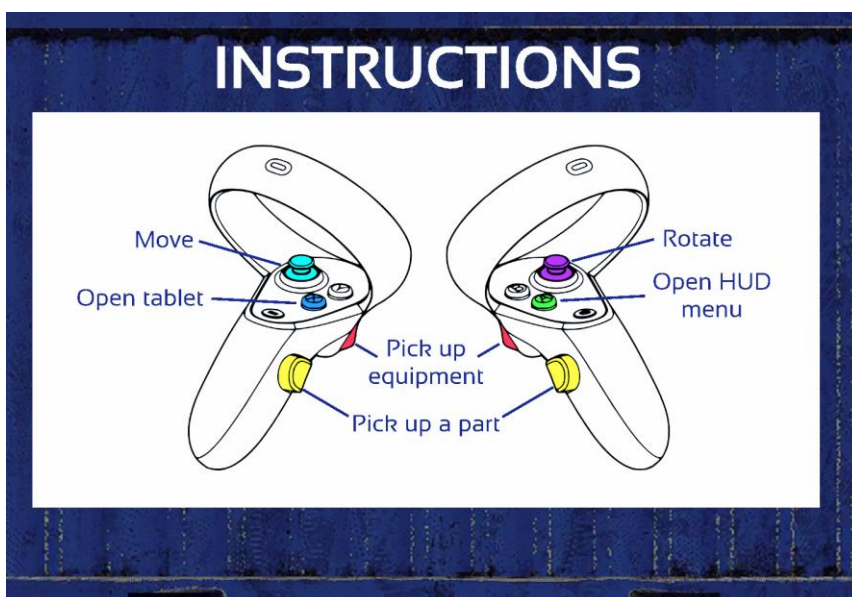


Figure 8. Instructions screen

Clicking the 'Instructions' button, shows the controller button layout for various actions.

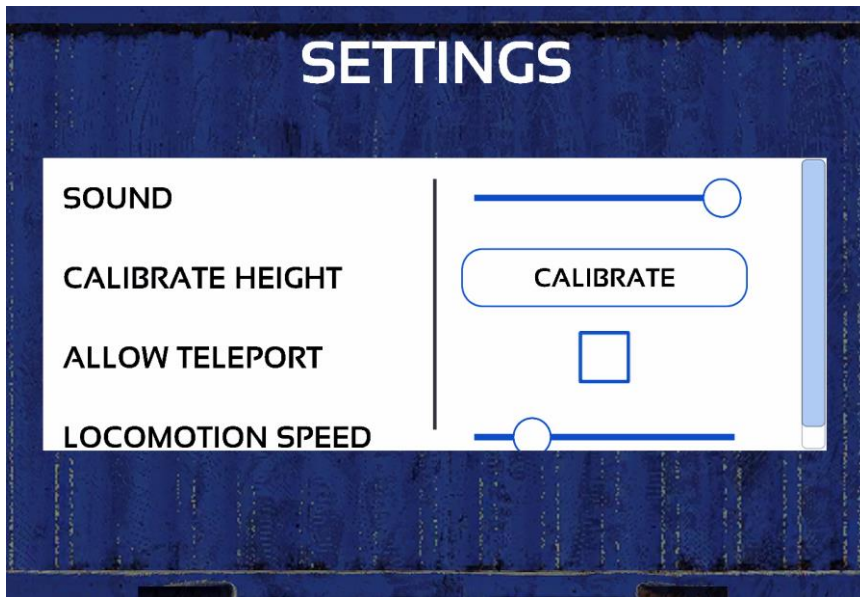


Figure 9. Settings screen

Clicking the 'Settings' button, shows the settings available to adjust. These settings are described in the 'Settings' chapter in this document.

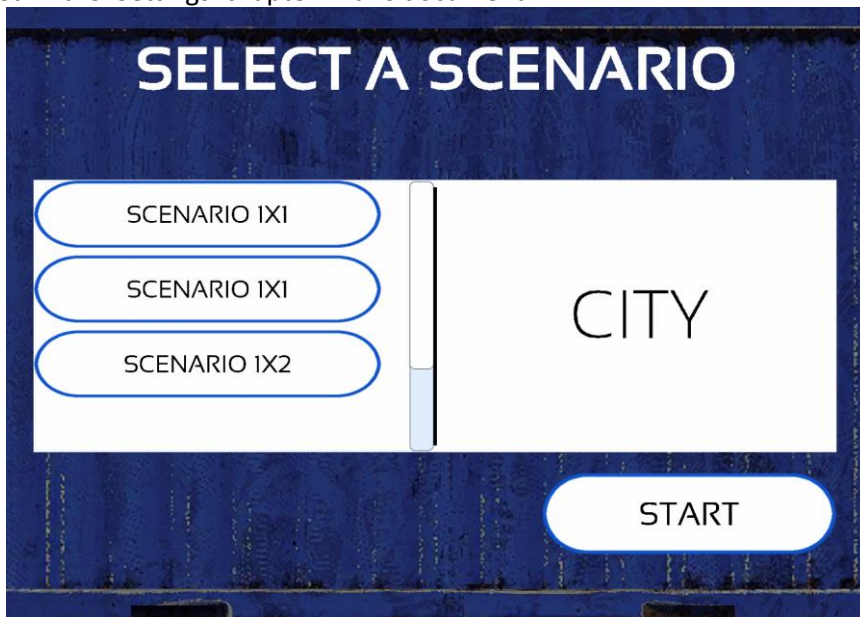


Figure 10. Single user scenario screen

Clicking the 'Single player' button, shows and allows the user to start a single user training scenario. In this screen all available scenarios are shown on the left. Clicking a scenario will set it as active and show its description on the right. After a scenario is selected, clicking the 'Start' button, will start the scenario, and load its scene.



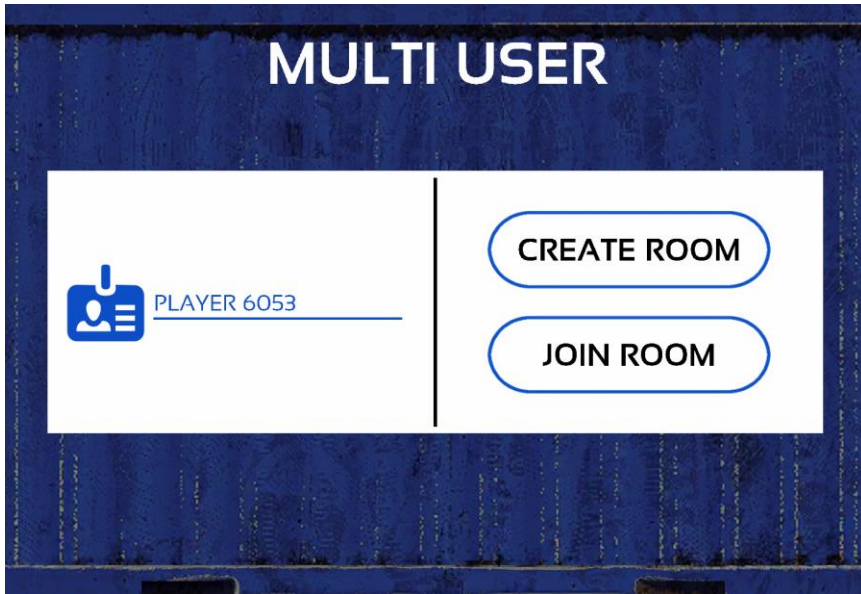


Figure 11. Multi user mode user setup

Clicking on the 'Multi User' button, allows the user to create or join a network training scenario. In this screen, the user can change their name by clicking on the input field on the left. Then the user chooses to create or join a room. After clicking either button, the screen will change accordingly.

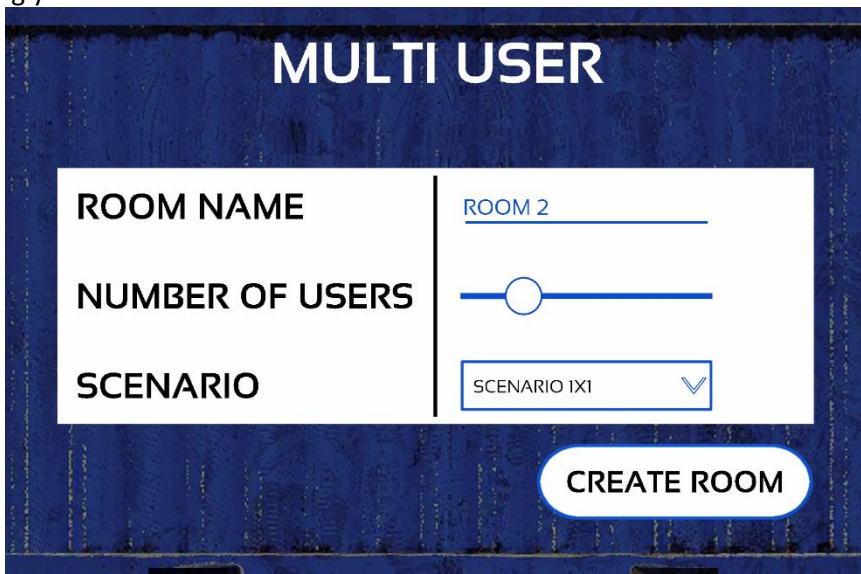


Figure 12. Room creation screen

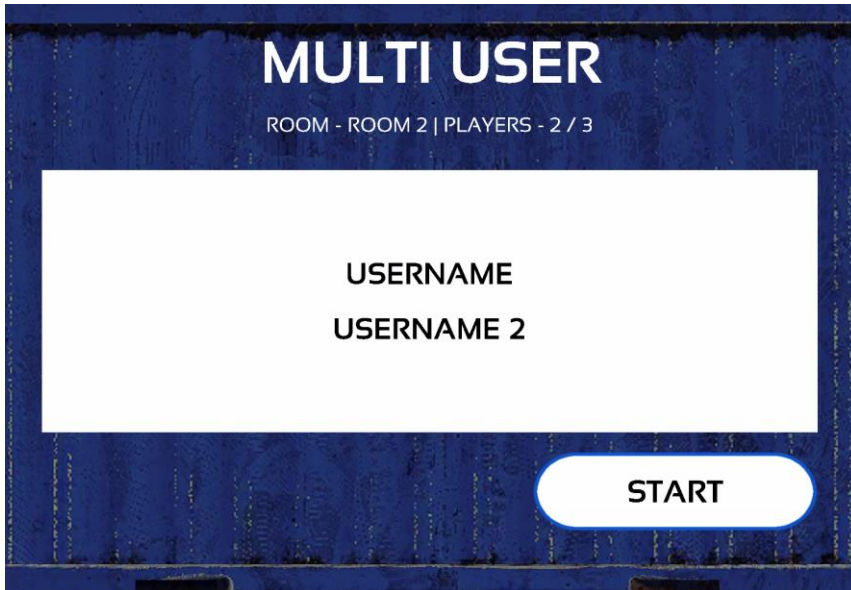


Figure 13. Room view (from creator perspective)

Clicking the 'Create Room' button allows the user to create a new network training scenario. Here they must define the room name by which others can find it, the maximum number of users and the scenario to load. After these parameters are defined, the user must click the 'Create Room' button. This will create the room and make it available to see and join for other users.

After creating the room, the screen will change to the room view (see Figure 13). Here the creator can start the scenario after all necessary users have connected and are visible in the user list.

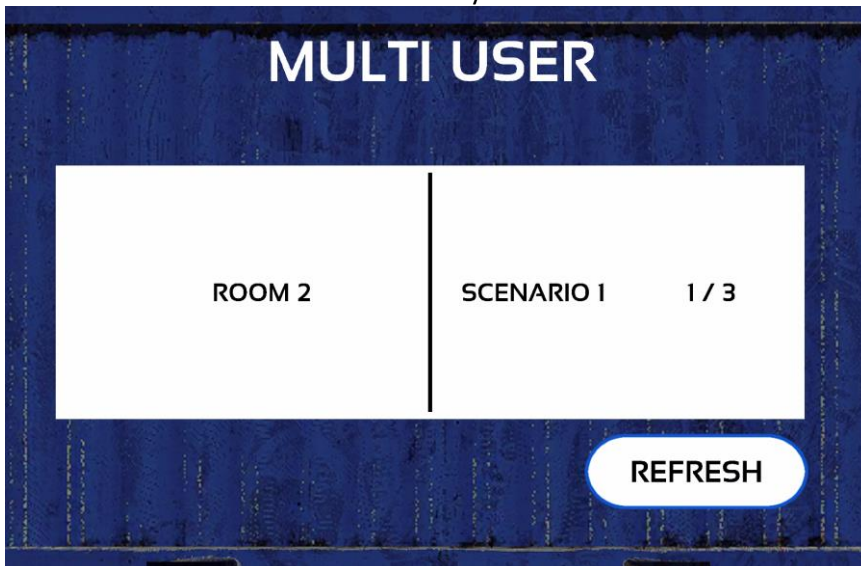
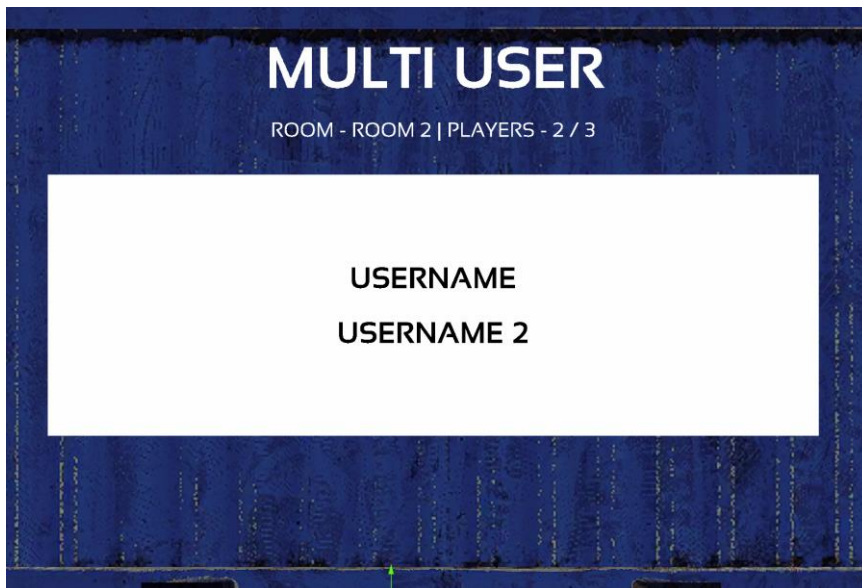


Figure 14. Created room list



*Figure 15. Room view (from regular user perspective)*

Clicking the 'Join Room' button allows the user to join an existing network training scenario. In this screen a list of available rooms is shown (see Figure 14), the user must click on the necessary room, and they will join it. After that, the room view is shown (see Figure 15), and the user must wait for the room creator to start the scenario.

## ► Training scenario

After loading a training scenario, the user is transferred to a scenario starting room within a chosen environment (a port or a city). Here the user must make sure they are ready to start building – they must put on the necessary safety equipment. And then they must build the scaffolding.

From the beginning of the scenario, the user is being evaluated – do they perform the correct actions regarding to safety and building the scaffolding. Throughout this chapter there are notes regarding what actions counts as a mistake.

### ● Getting ready



Figure 16. Starting room with safety equipment

To equip the safety equipment, the user must pick it up with the controller button and move it to the appropriate place on their body. For example, the helmet must be moved to the head, gloves to hands, harness to the body.

When picking up an equipment piece, there is a possibility for it to be broken (torn gloves or vest, broken helmet, etc). The user must check if it's good to use, if it is not, that piece of equipment must be thrown out using the waste container next to the table.

If the user tries to equip broken equipment, it's counted as a mistake. If some equipment is missing when user leaves the room, that is also counted as a mistake.

The user can visually check if they have equipped everything in the mirror.

One additional equipment that has a specific position to place – the hammer. This object must be placed in the toolbelt slots around player's waist. They are represented as white circles (see Figure 17). When placing the hammer in the toolbelt, one of the circles expands, indicating that the object is ready to be placed in it. To place it, the user must release the equipment pickup button.

To take the hammer out of the toolbelt, move the hand to the hammer and press the respective controller button. The hammer will be placed in the user's hand.



Figure 17. Toolbelt slots

After equipping the safety harness, two extra objects are placed in the toolbelt – safety strap carabines that are used while working on the scaffolding. They can be interacted with in the same way as the hammer. Further functionality is described further in the document.

- **Building**

Before placing any scaffolding parts, the user must place the scaffolding progress sign that indicates that the scaffolding is being worked on. To do this, the user must click on the blank sign as shown in Figure 18.



Figure 18. Scaffolding progress sign. Building activation (left). Building in progress (right)

After the sign has been placed, user grading and timers will start, and the user can start placing scaffolding in the correct places.

The user can see a semi-transparent blueprint of the finished scaffolding (see Figure 19) and must fill it with the actual scaffolding parts in a correct order. Next to the blueprint are boxes of sorted scaffolding parts (see Figure 20).

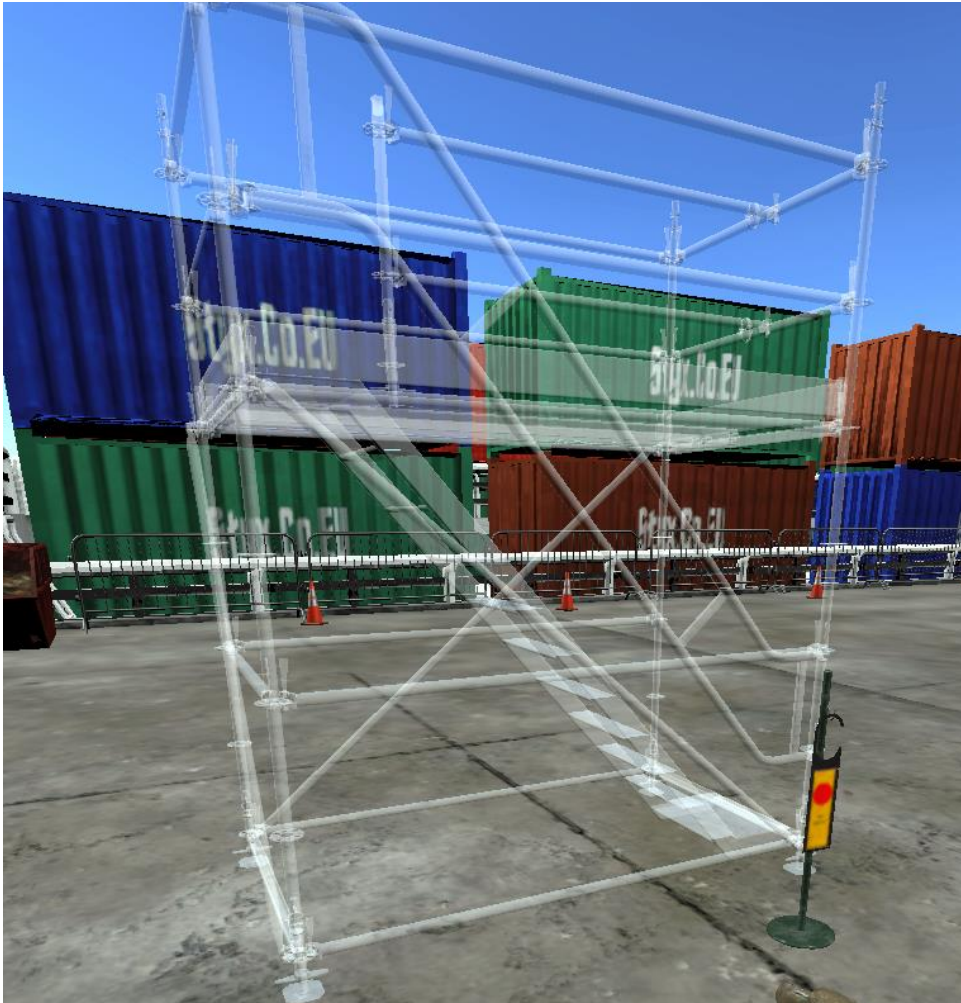


Figure 19. Scaffolding blueprint

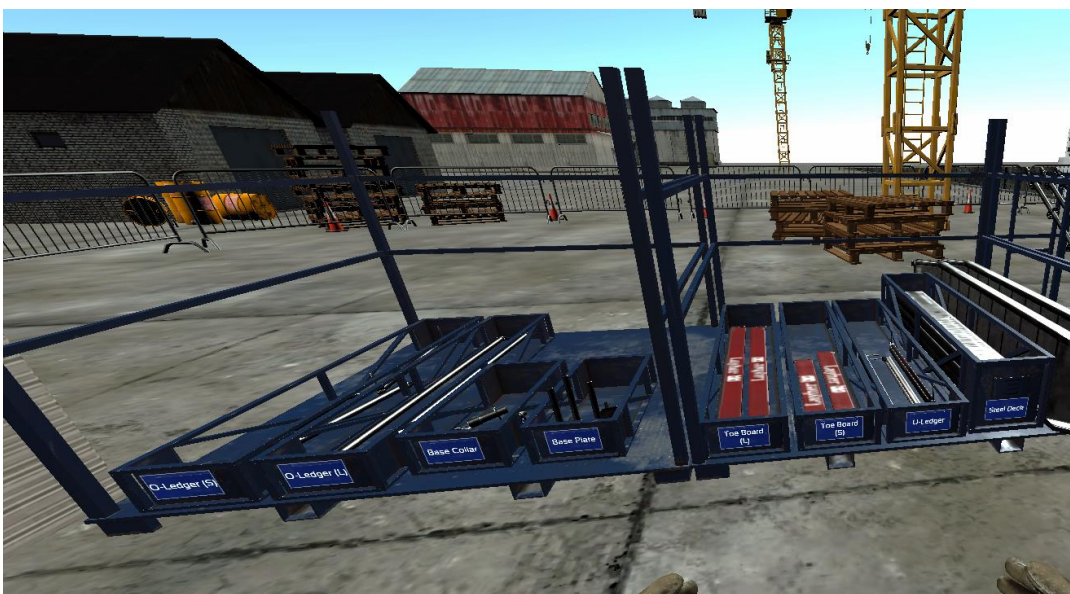


Figure 20. Scaffolding part boxes

The user must pick up the parts from the boxes, bring them to the blueprint and place them in the correct place and order. When placing a part in a blueprint correctly, the blueprint part will change its color to green (see Figure 21). When that happens, the user can let go of the button used to pick up/hold the part and the part will be placed. The rotation of the parts must also be taken in account – incorrectly rotated parts can not be placed in the blueprint.

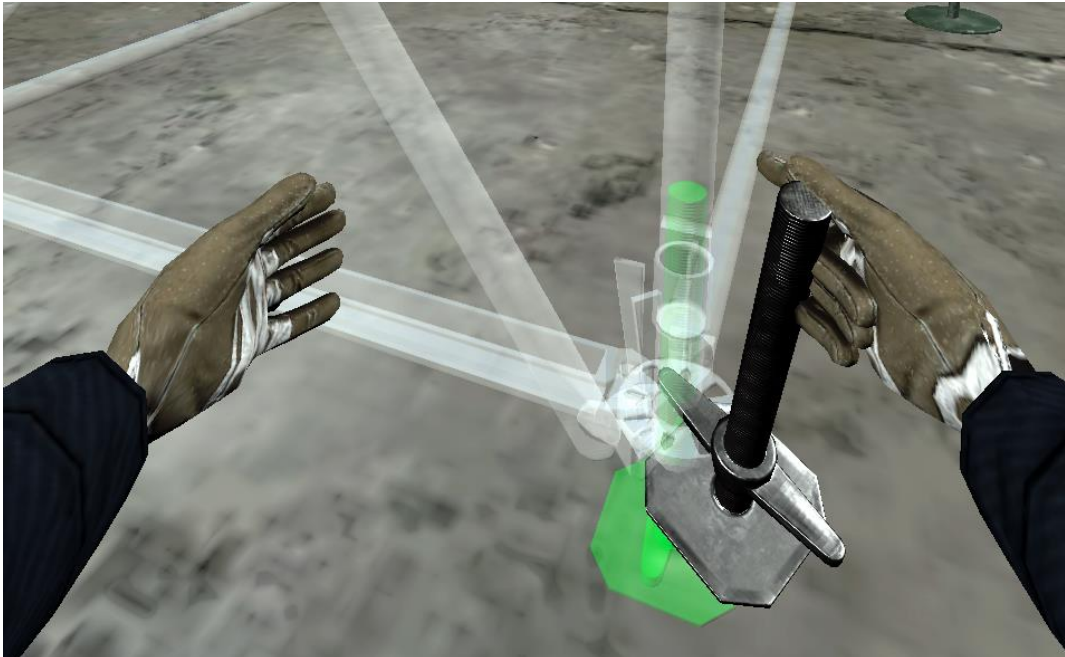


Figure 21. Placing the correct scaffolding part

The order in which the parts must be placed is the same as in real life. For example, the base plate part must be placed to be able to place the base collar, and the standards must be placed to be able to place the ledger parts between them.

When picking up scaffolding parts from the boxes, some of them can be broken (see Figure 22). The user must check each part for damages and if found, the part must be disposed of using the nearby waste container.

If the user attempts to place a broken part, it is removed from user's hands with a sound effect and a text pop-up notifying the player that something was not done correctly. This is counted as a mistake and reflected in the grading.

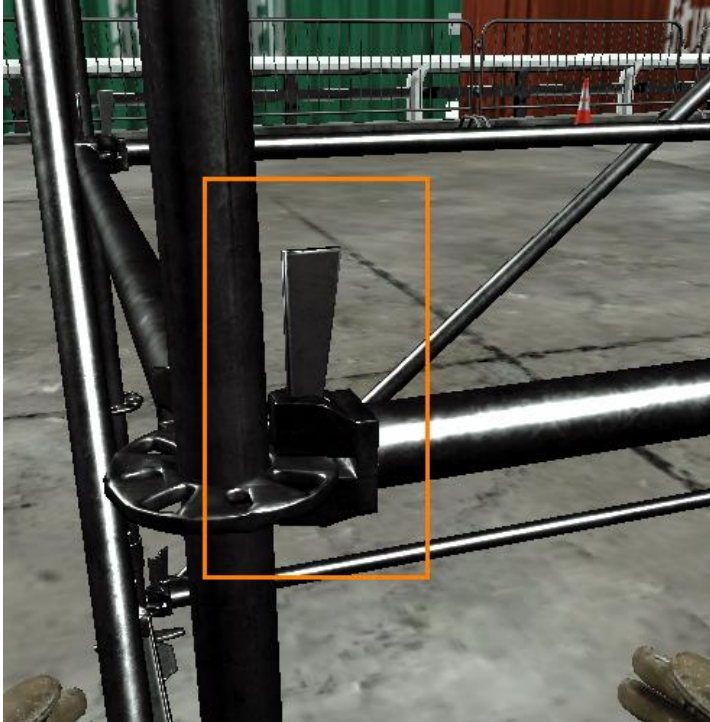


Figure 22. Broken base plate object

- **Safety**

### **Securing scaffolding**

Some scaffolding parts need to be secured after placing them. These are mostly various types of ledgers with ringlocks (see Figure 23). To secure them, the hammer must be used. The user must strike the ringlock pins with the hammer twice to fully secure them. The state of security can also be determined by the sound when the pin is struck.



*Figure 23. Scaffolding ledger ringlock*

### **Safety harness and straps**

When moving onto building the second and higher floors, the safety straps must be used. They are located in the toolbelt on both sides after the safety harness is equipped.

The safety carabines can be attached to O-ledgers. To attach one, the user must pick up a carabine from the toolbelt and move it to a ledger. Once the carabine turns bright green, controller button can be let go and the carabine will attach to the ledger (see Figure 24 and Figure 25).





Figure 24. Safety strap carabine ready to be attached

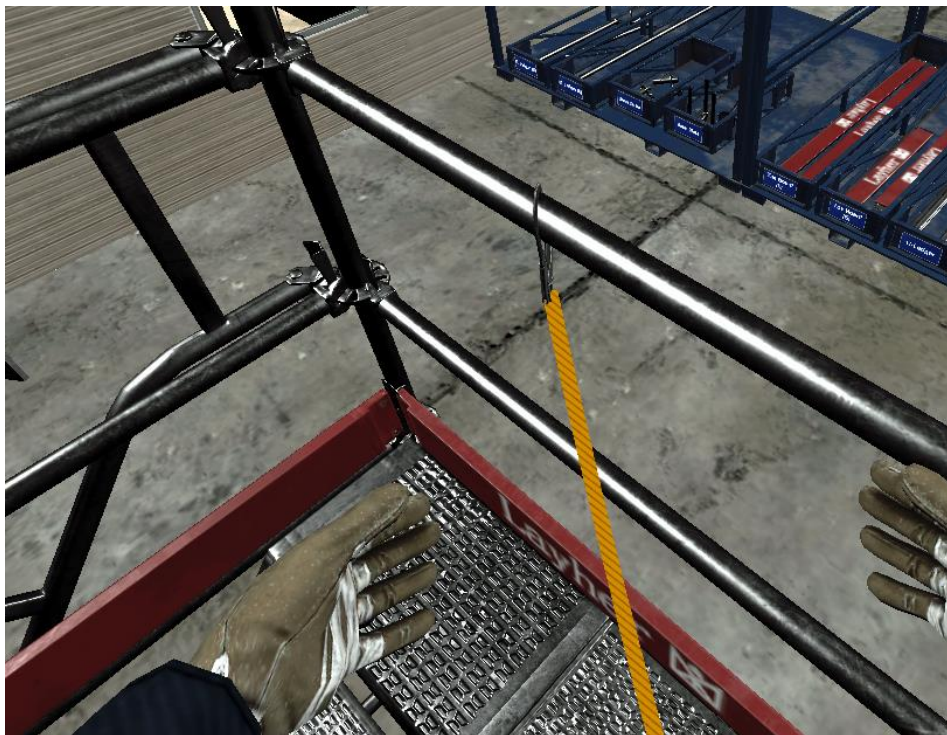


Figure 25. Safety strap carabine attached to ledger

When the carabine is attached, the user can only move a certain distance away from it. If the user falls off the scaffolding while attached, they will not fall to the ground but hang above the ground. In case the user is not attached to the scaffolding with the carabine, they will fall to the ground. In both cases, user falling off the scaffolding is considered as a major mistake.

If the user drops the carabine, it will move back to the toolbelt when the user gets too far from it.

## Injuries

While building the scaffolding, the events when user receives a hit to the head with a scaffolding part are also recorded and registered in grading. This counts as a safety mistake in both cases – when a helmet is and is not worn. However, in the case without a helmet, the mistake is bigger.

When a user receives a hit to the head, their view will be adjusted. If no helmet is worn the view turns red (see Figure 26). If a helmet is worn, the view gets slightly blurry, and the helmet is knocked down in front of users' eyes (see Figure 27). To push back the helmet, the user must move his hand to the head, as if pushing the helmet physically.



Figure 26. Head injury visuals without helmet



Figure 27. Head injury visuals with helmet

- **Finishing the scenario**

After the scaffolding has been completed, the user must update the scaffolding progress sign. To do that, the user must click on the red and yellow 'No Entry' sign and it will change to the completed graphics (see Figure 28).

When this is done, previously mentioned timers and grading will stop, and no new changes made to the scaffolding will be taken into account.

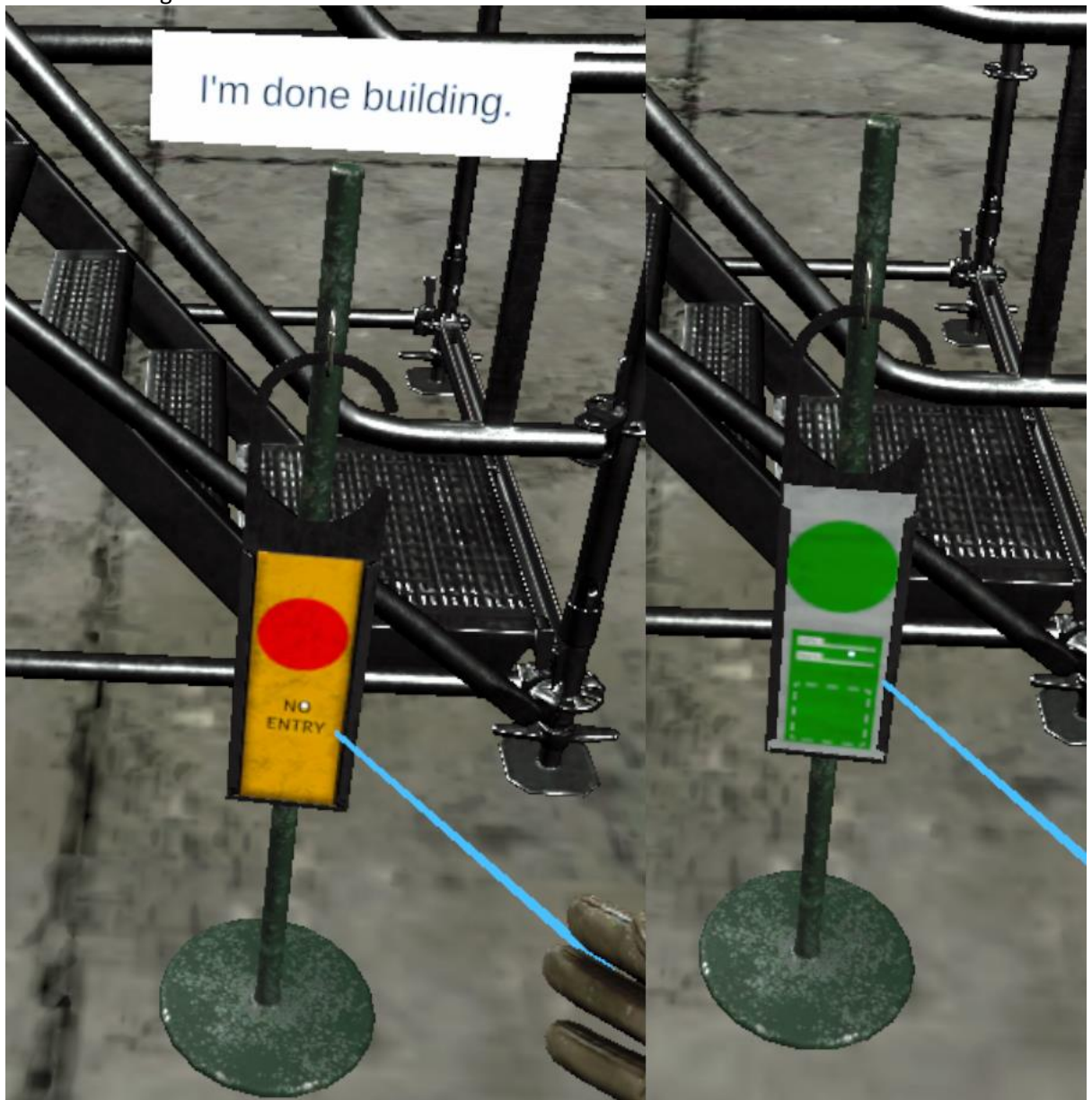


Figure 28. Scaffolding progress sign. Building still in progress (left). Building completed (right)

- **Single User mode specific functionality**

In single user scenarios, to build the second and higher floors, the user would need to repeatedly climb up and down to gather the necessary scaffolding parts. To solve this issue, a forklift object can be used to bring necessary parts to the floor where user is located.

The user can select four different parts at a time and have them lifted to them. They can, of course, be changed at any time.

Further instructions on how to operate the forklift are described in 'Tablet' chapter further in the document.

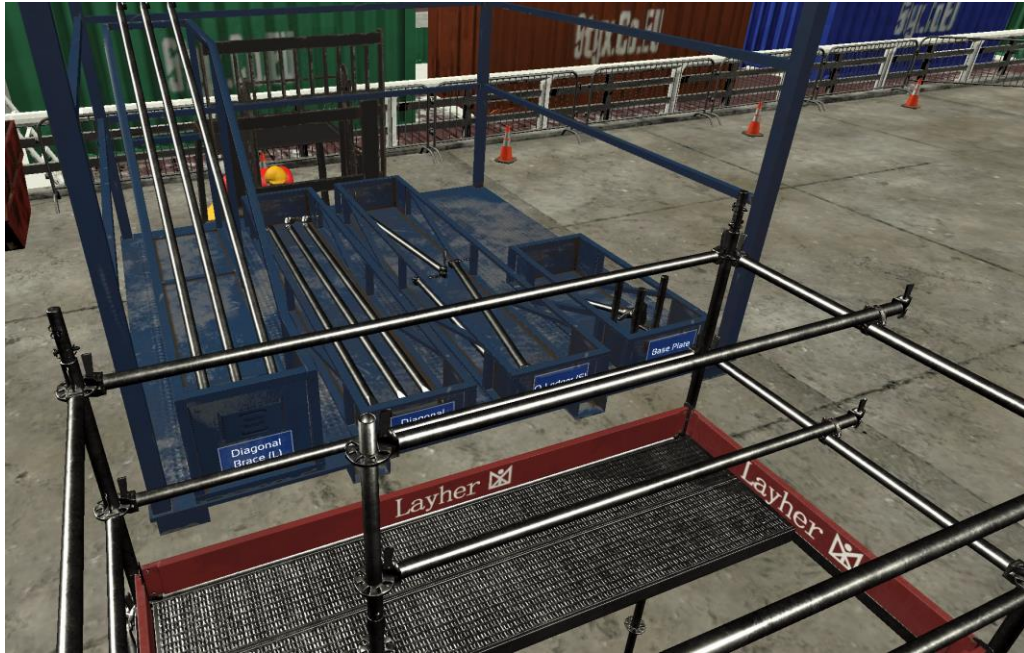


Figure 29. Scaffolding parts on a forklift

- Multi User mode specific functionality

- Nametags

- To be able to differentiate between users, each user has a nametag above their virtual character. This name is the same as what was entered when entering multi user scenario.



Figure 30. Nametag above users' virtual character

## Voice chat

To make communicating easier when users are not near each other, voice chat functionality has been implemented in multi user training scenarios. It is enabled by default and other users should hear one another.

To disable voice chat, the user must open the HUD menu and click on the 'Mute Voice' button. Then to re-enable voice chat, button 'Unmute' must be clicked.



Figure 31. Voice chat entry in multiuser HUD menu

To see which user is and is not muted, there is a visual indicator next to their nametag that shows a different icon depending on the voice chat state (see Figure 32 and Figure 33).

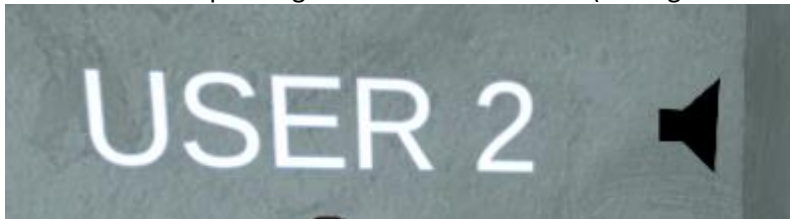


Figure 32. User not muted

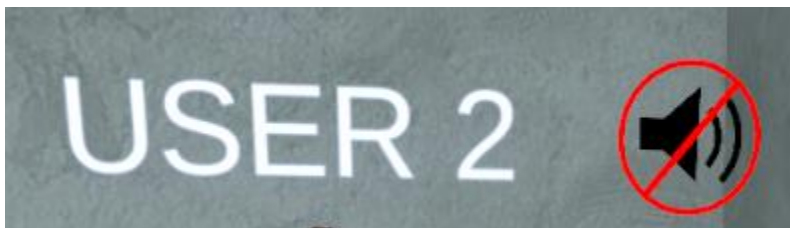


Figure 33. User muted

## User to user interaction

Multi user scenarios are made to simulate real world where users can help each other and pass necessary scaffolding parts. Passing objects is done by one user having an object in their hand and the other user trying to pick up the object by pressing the appropriate controller button.

## ► Tablet

### • Grading

Main functionality of the tablet is to view the users' grading information. It shows a summary view ('Summary') of the current grade points, mistakes, elapsed scaffolding build time and walked distance. It also has a more detailed view ('Log') where each graded action is logged and can be viewed.

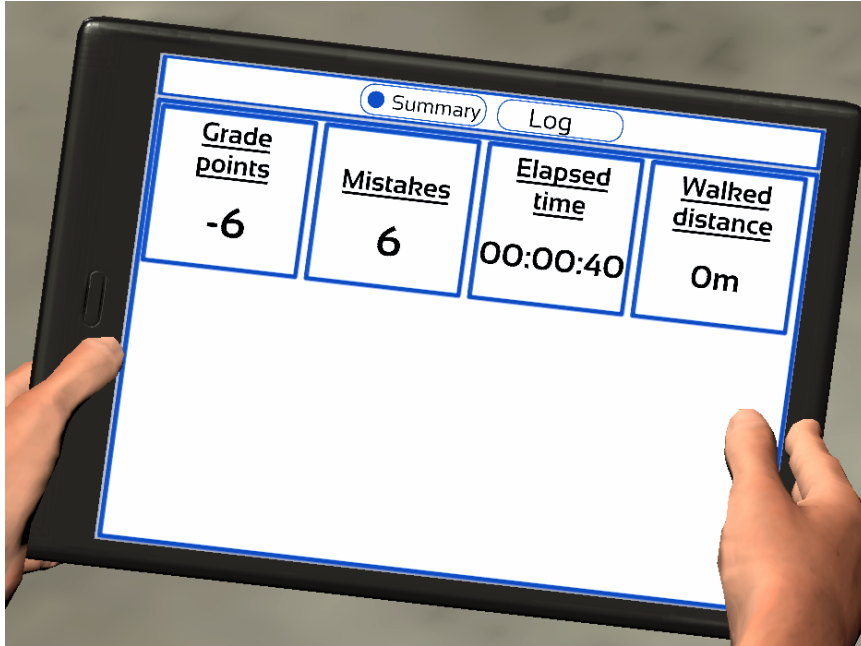


Figure 34. Tablet grading summary view

In the 'Log' view, the user can view their mistakes and other graded actions. It shows when and what actions was performed and how many grade points were adjusted. If all actions are not shown, the 'Refresh' button can be pressed to refresh the UI and show all logs.

To make it easier to navigate through all the logs, a filter can be applied to show only selected types of actions. To remove all applied filters at once, the 'Clear' button can be pressed.

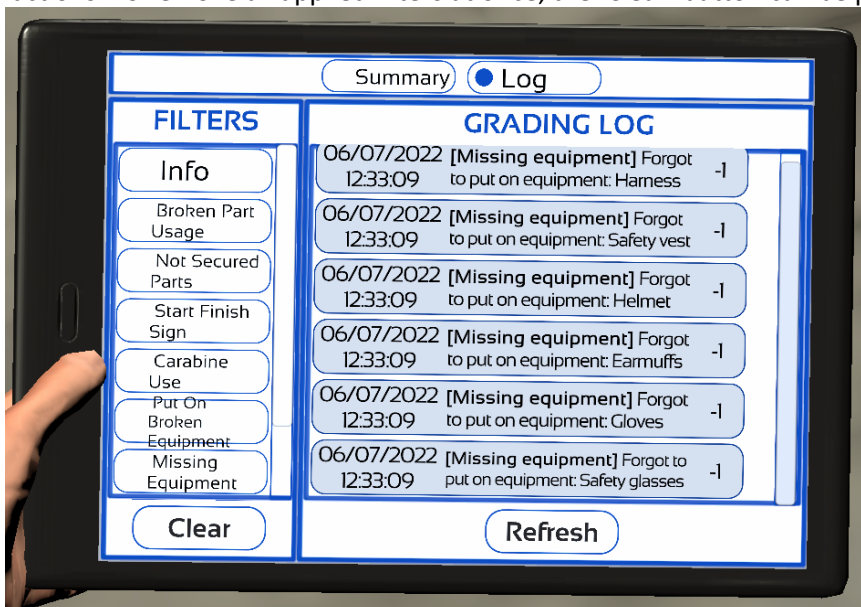


Figure 35. Detailed view of users' actions

- Forklift

The tablet is also responsible for controlling the forklift object in single user mode. To use the forklift controls, the 'Parts' tab must be selected in the tablet (see Figure 36).

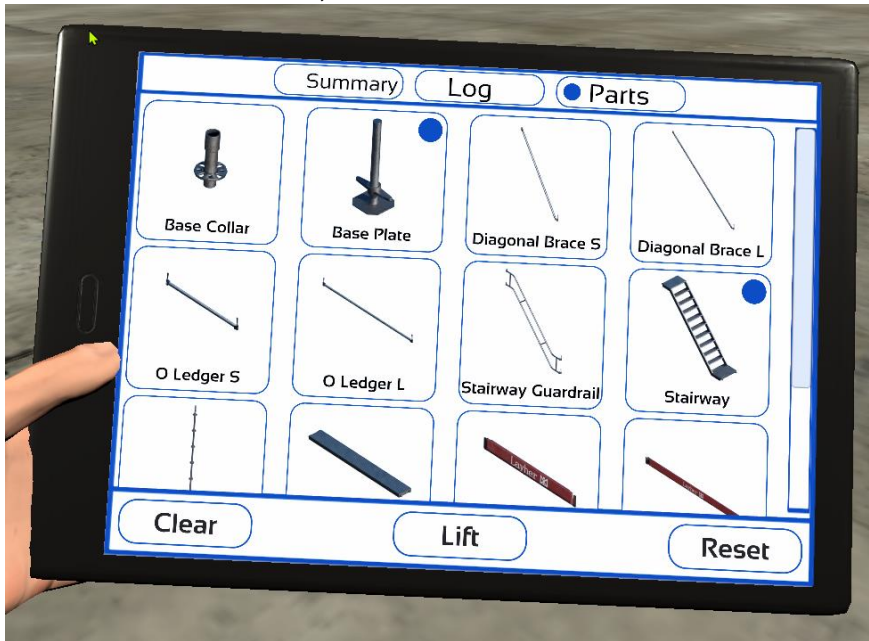
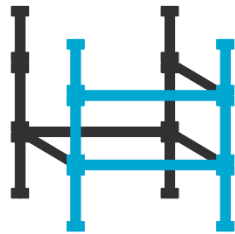


Figure 36. 'Parts' tab selected in tablet

To choose the necessary parts, user must click on them, and they will become selected. After that, pressing the 'Lift' button, the forklift will begin lifting the parts to the users' position.

Only four parts can be selected at a time. To select different parts, user must clear the selection using the 'Clear' button, which will remove selection from the tablet. Or the 'Reset' button can be used to remove the selection from the tablet and remove existing scaffolding parts from the forklifts' pallet.



# VR SafeScaff

NACIONĀLAIS  
ATTĪSTĪBAS  
PLĀNS 2020



EIROPAS SAVIENĪBA  
Kohēzijas fonds



VIDZEME UNIVERSITY  
OF APPLIED SCIENCES

IEGULDĪJUMS TAVĀ NĀKOTNĒ

2022