VR environment Full Instructions

1) Overview

The VR environment was designed in the Unity Engine based on our Real-life study site at the Civil and Electrical Engineering School, Nanyang Technological University (N1.1-B5M-02).
Dimensions as well as visual textures of the venue were recorded from real life and translated into a 3D simulation of the environment. This includes lighting, texture, the visual design of fixtures, and furniture within the environment. Within the VR simulated environment, a computerized Go-No-Go task is displayed on a computer monitor for participants to perform. Input from Participants would be obtained through a standard “Xbox 360” controller that participants hold with both hands. They are instructed to respond as quickly as possible and to pull either the left or right trigger on the controller to indicate a corresponding response.

2) Hardware Requirements

VR Workstation Specification
Intel Core i7-6950X;
Asus X99-E WS M/B;
Kingston 4x16GB (KVR21N15D8/16);
Samsung 850 EVO 1TB 2.5”;
Asus 24X DVDRW;
Gigabyte GTX 1080 Ti Auros 11GB;
Seasonic Prime Gold 750W Modular PSU;
Corsair Obsidian 750D AF FT Chassis;
Win10 Pro 64bit OS
Logitech MK120 Desktop Combo (bundled)

VR Hardware
VIVE VR System Includes
Headset
2 face cushions
1 nose rest
2 wireless controllers
2 base stations
3-in-1 cable
Link box
Earbuds
Cables, chargers and accessories

VIVE Specs
Headset Specs
Screen: Dual AMOLED 3.6’’ diagonal
Resolution: 1080 x 1200 pixels per eye (2160 x 1200 pixels combined)
Refresh rate: 90 Hz
Field of view: 110 degrees
Safety features: Chaperone play area boundaries and front-facing camera
Sensors: SteamVR Tracking, G-sensor, gyroscope, proximity
Connections: HDMI, USB 2.0, stereo 3.5 mm headphone jack, Power, Bluetooth
Input: Integrated microphone
Eye Relief: Interpupillary distance and lens distance adjustment

Controller specs
Sensors: SteamVR Tracking
Input: Multifunction trackpad, Grip buttons, dual-stage trigger, System button, Menu button
Use per charge: Approx. 6 hours
Connections: Micro-USB charging port

Xbox360 controller specs
Input: Right stick, Directional pad, Back button, Left bumper, Left trigger, Guide button, Start button, Right trigger, Right bumper, A button, B button, X button, Y button.
Connections: USB

Tracked Area Requirements
Standing / seated: No min. space requirements
Room-scale: 6’6’’ x 5’ min. room size, 16’4’’ max. between base stations

3) Software Installation

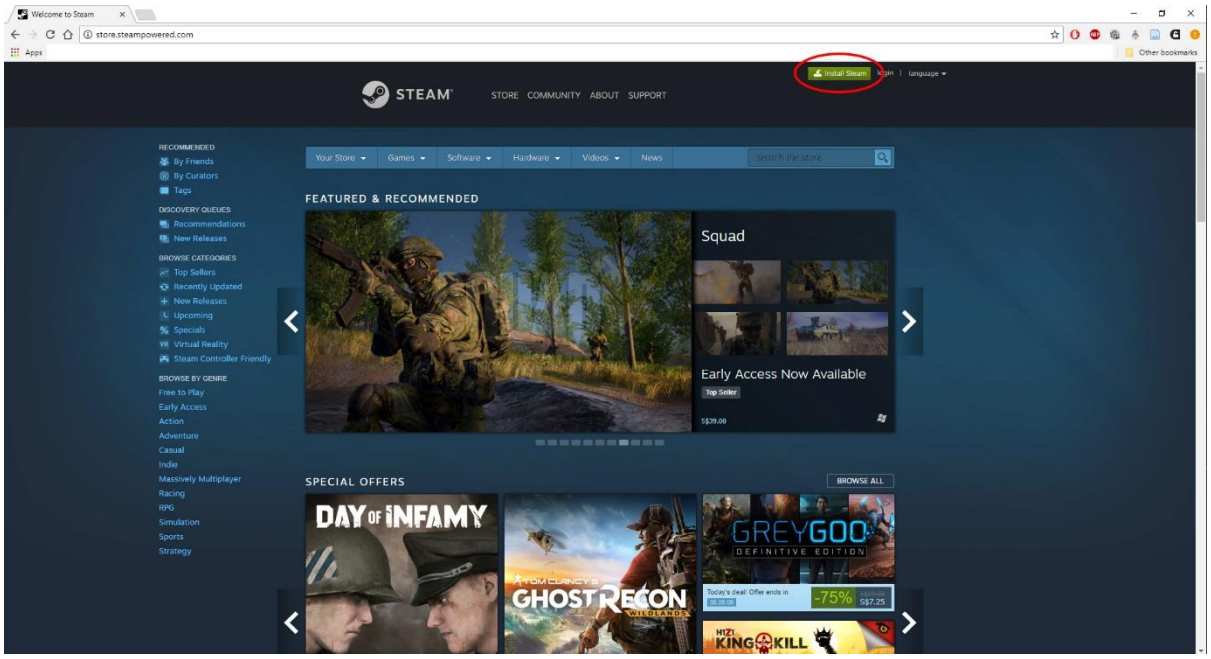
The UGlab VR environment is based in Unity's 3d Environment engine. It requires Steam's VR software platform to connect to the VR hardware and so both SteamVR and Unity need to be installed before the VR environment program can be run.

1) Install Steam VR

a. Install Steam software platform

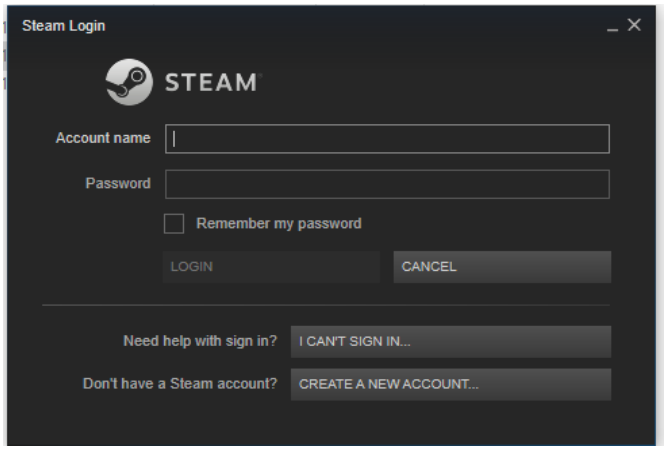
To install Steam VR, Visit the following web address: http://store.steampowered.com/

And Click the green "Install Steam" button at the top of the website.



b. Login/create Steam Account

i. If you do not have a steam Account, follow website instructions to create a steam account. Else once Steam has been installed, login.

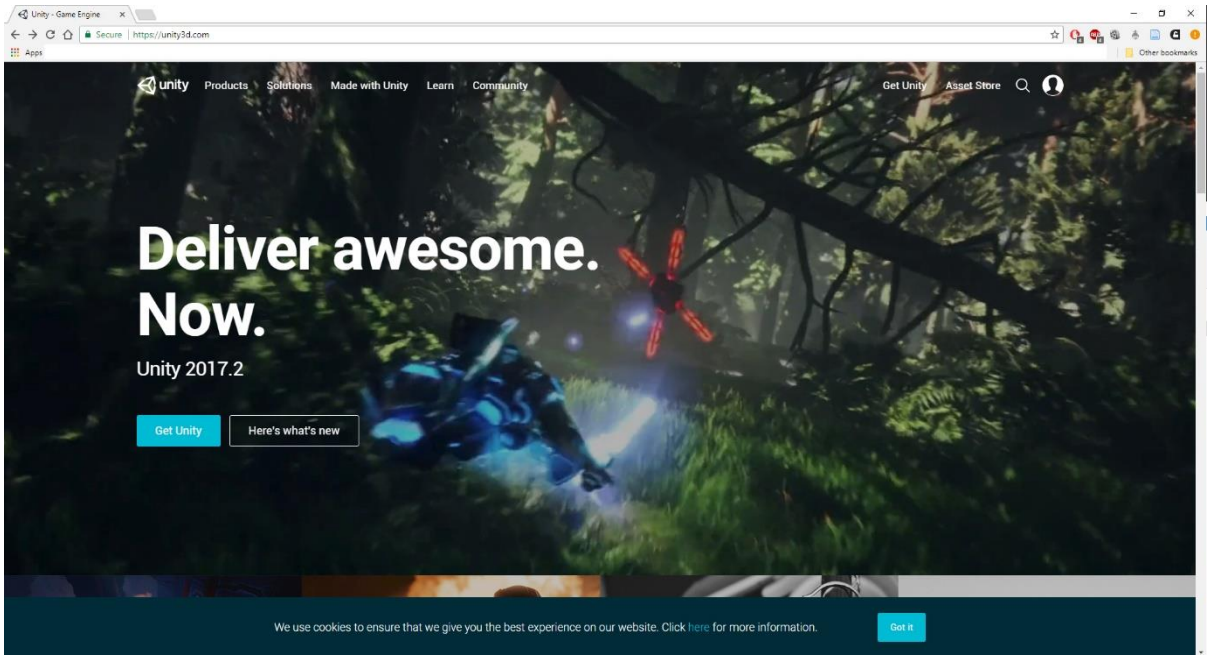


c. Install Steam VR

While on the Steam software platform, Select and install SteamVR from software list (Type "steamVR" in the search box)

2) **Download and Install Unity 3D environment engine (ver.)**

a. Download the Unity Installer from the following website: https://unity3d.com/



3) **Unpackage <UdgLab-CSI> folder to the desktop**

To Unpackage <UdgLab-CSI> to the desktop, simply unzip the folder on to the computer's desktop.

Once SteamVR and Unity have been installed; and the <UdgLab-CSI> folder has been placed on the desktop, the software required to run VR environment is ready. Next the VR hardware will need to be setup.

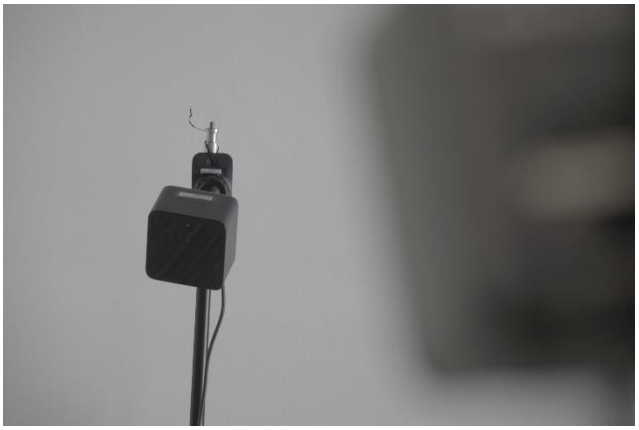
4) Hardware Setup

The VR Hardware consists of 1 Windows based Workstation computer; 1 set of HTC Vive goggles; 2 HTC wireless controllers; and 2 base-station position sensors. After the software has been installed onto the Workstation, the VR equipment would need to be setup prior to usage.

1) Charge wireless VR Controllers via micro-USB

<image of wireless controllers>

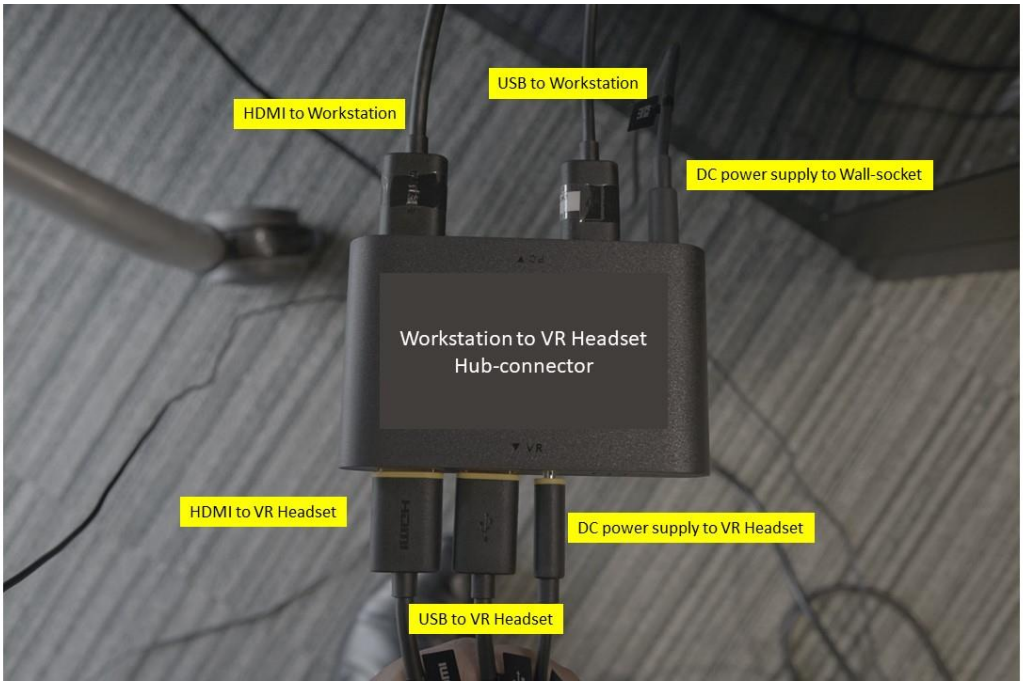
2) Position and Connect VR base-station position sensors
   The 2 Base-stations need to be above head height and pointed towards each other in a manner that allows the two base-stations to see each other as well as the user while he is within VR usage region. (additional instructions available during VR room calibration setup)



<image of base stations>

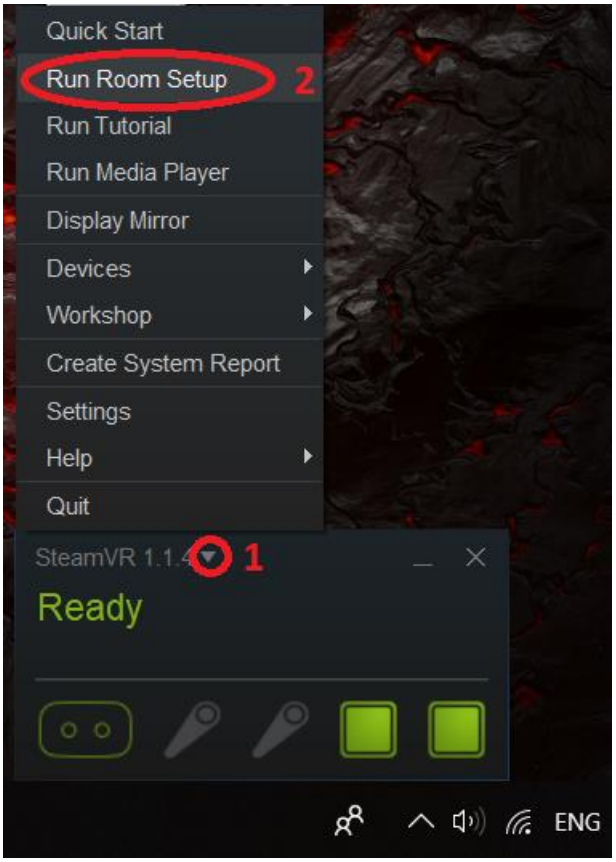
3) Plug in HTC Vive VR goggles to the VR PC

<image of HTC Vive>

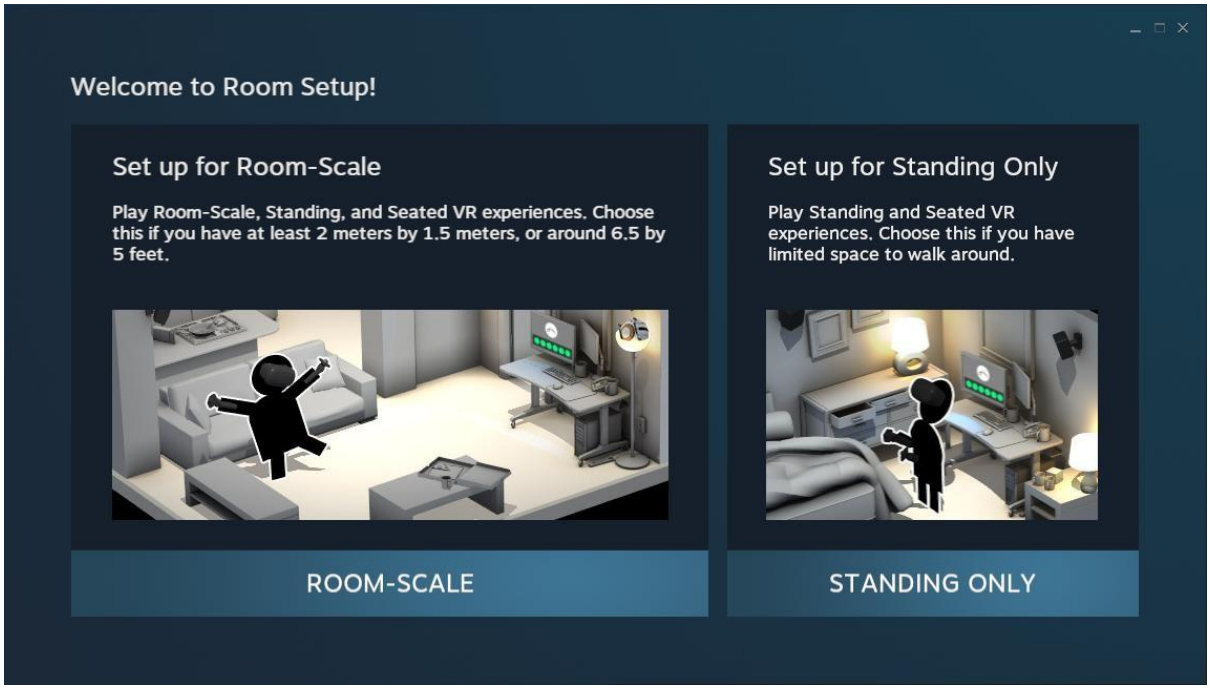


<Image of HTC Hub connector aka “Link-Box”>

4) Run through VR Room calibration instructions within Steam VR



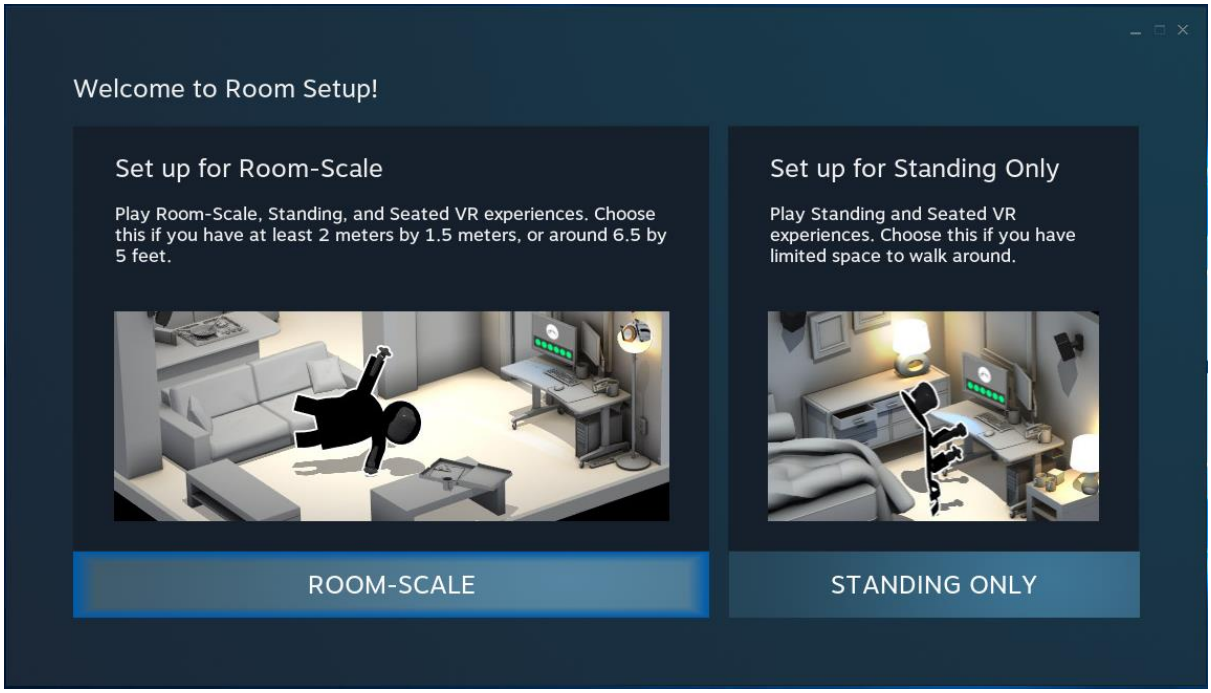
<Room setup located at bottom SteamVR widget>



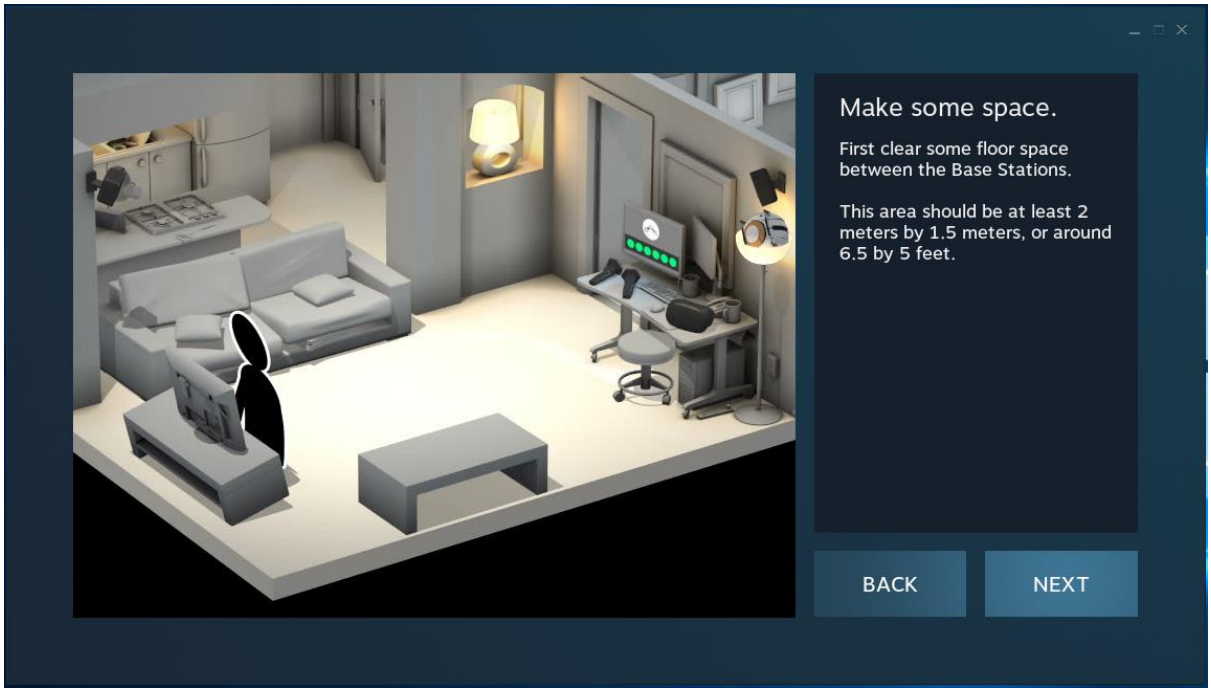
<image of SteamVR room calibration setup>

Once all the Hardware is plugged in and ready, Follow the step-by-step instructions on Steam to calibrate the VR hardware to SteamVR. Once that is done, the VR setup is ready for use. (refer to Annex A)

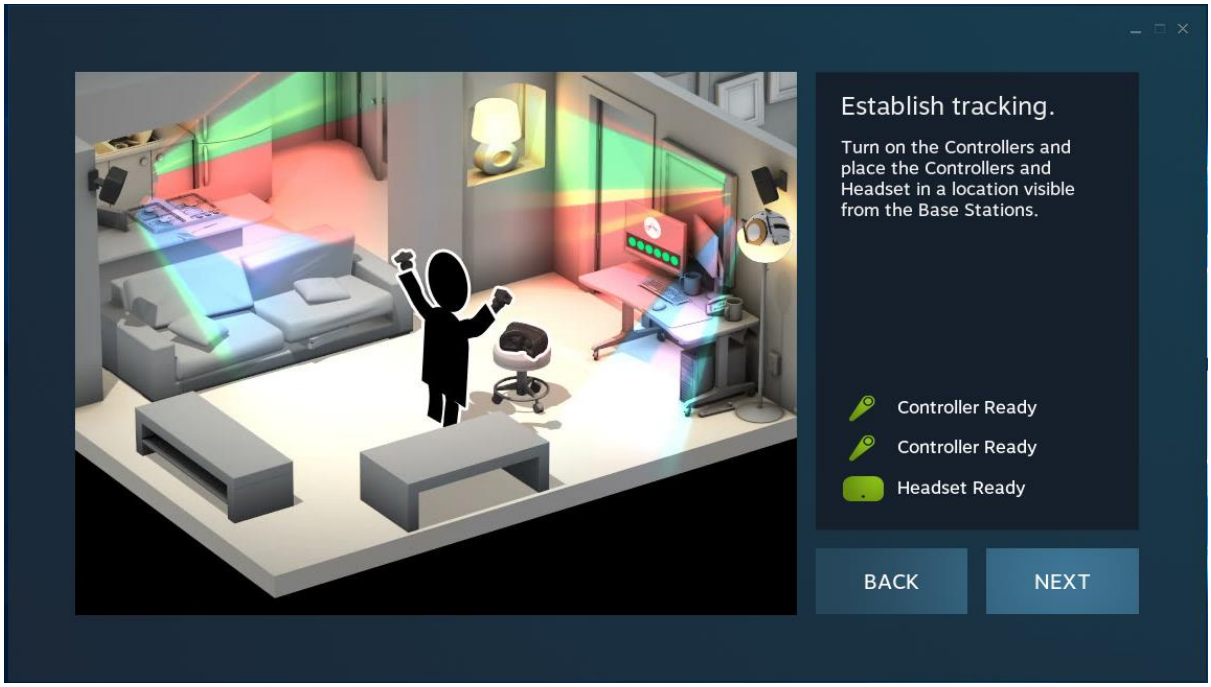
<Annex A: Steam VR - Room Setup Process>



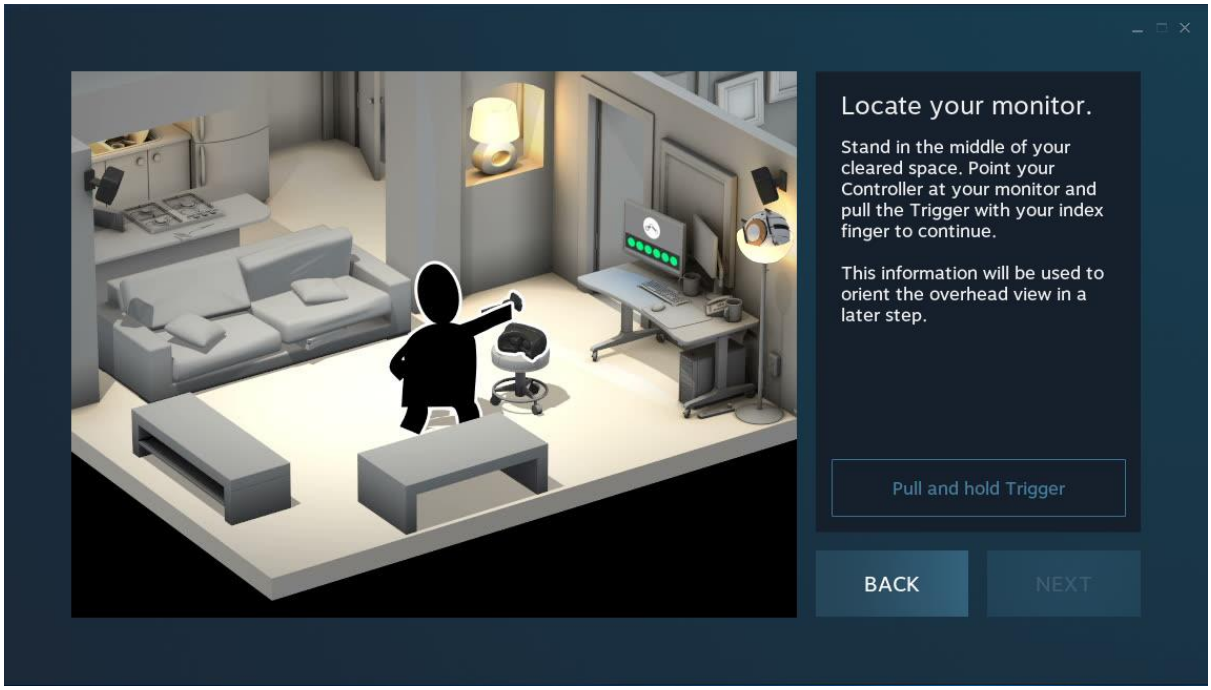
(1) Select Room Scale Setup



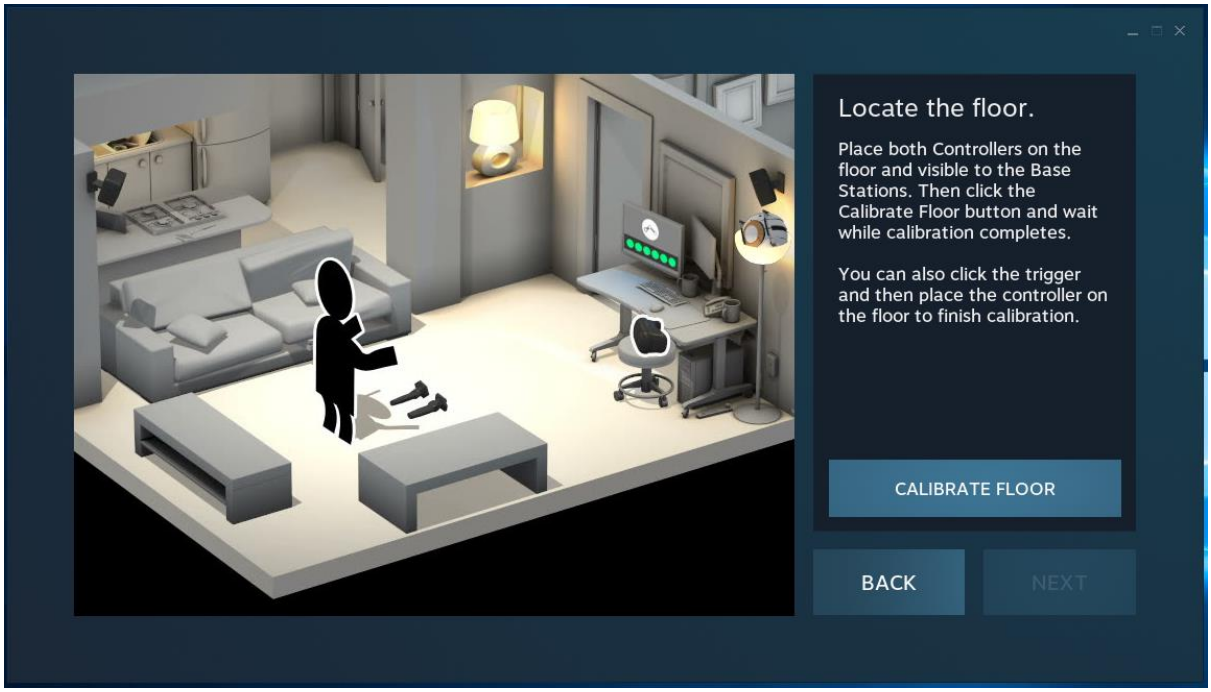
(2) Clear the area of obstacles



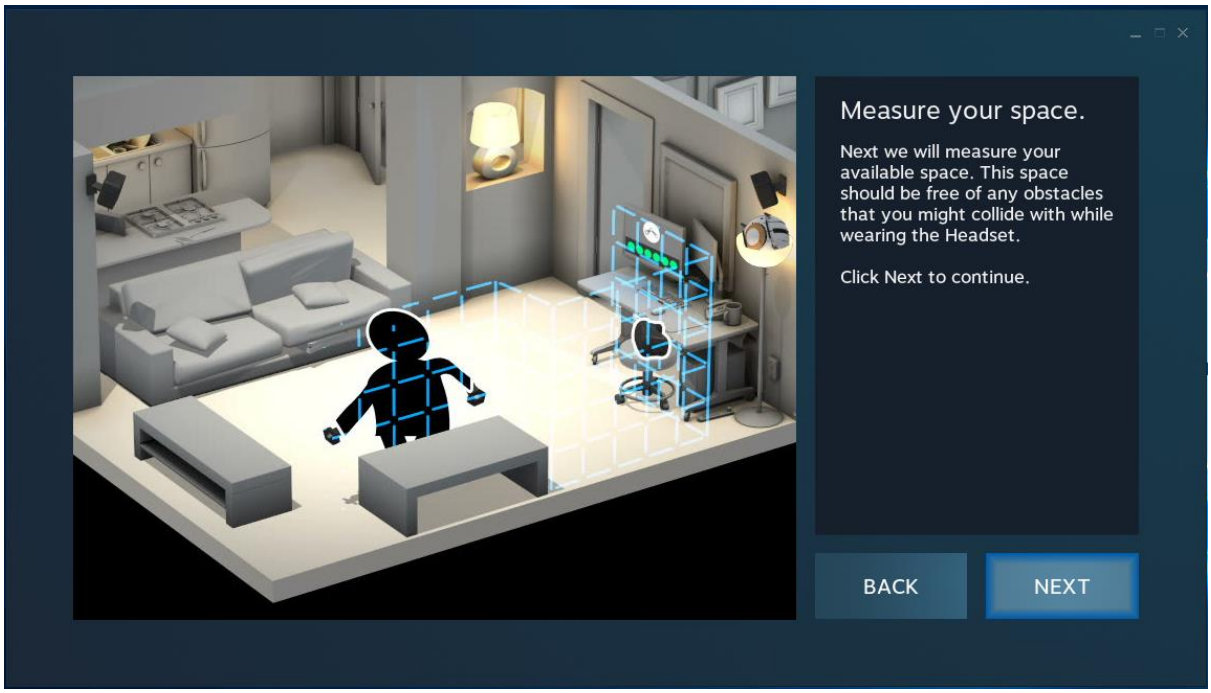
(3) Turn-on VR equipment and position within range of the Base stations



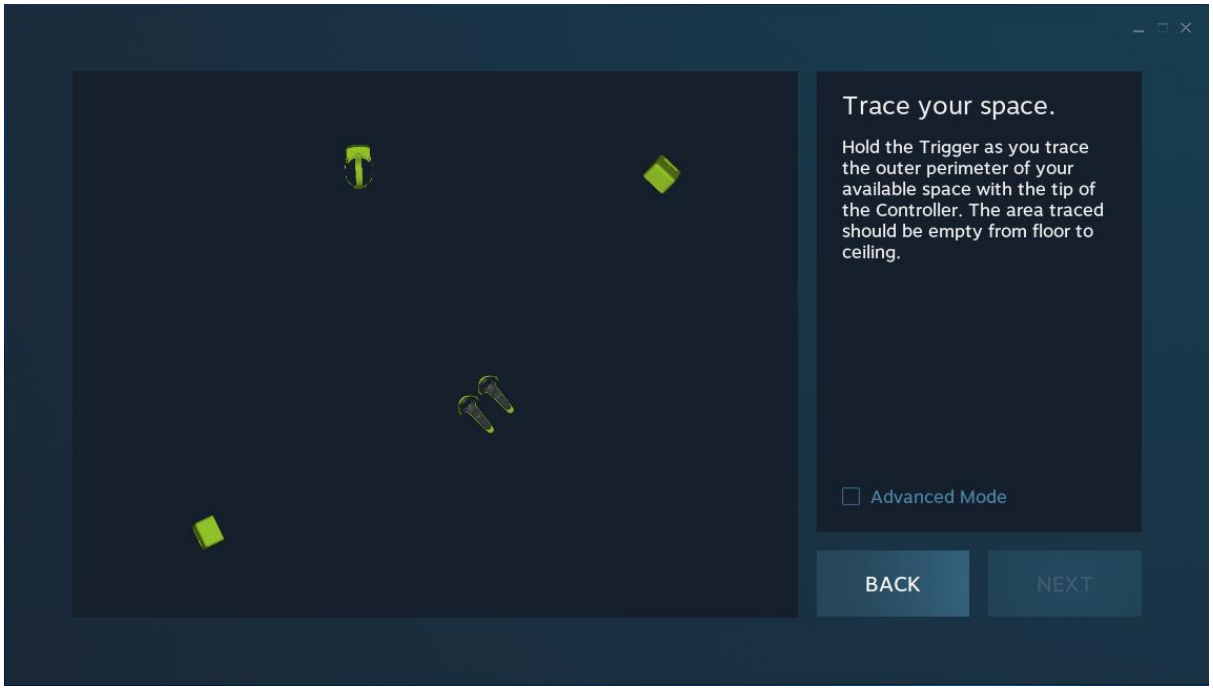
(4) Locate monitor by pointing at it using a VR controller from within play area



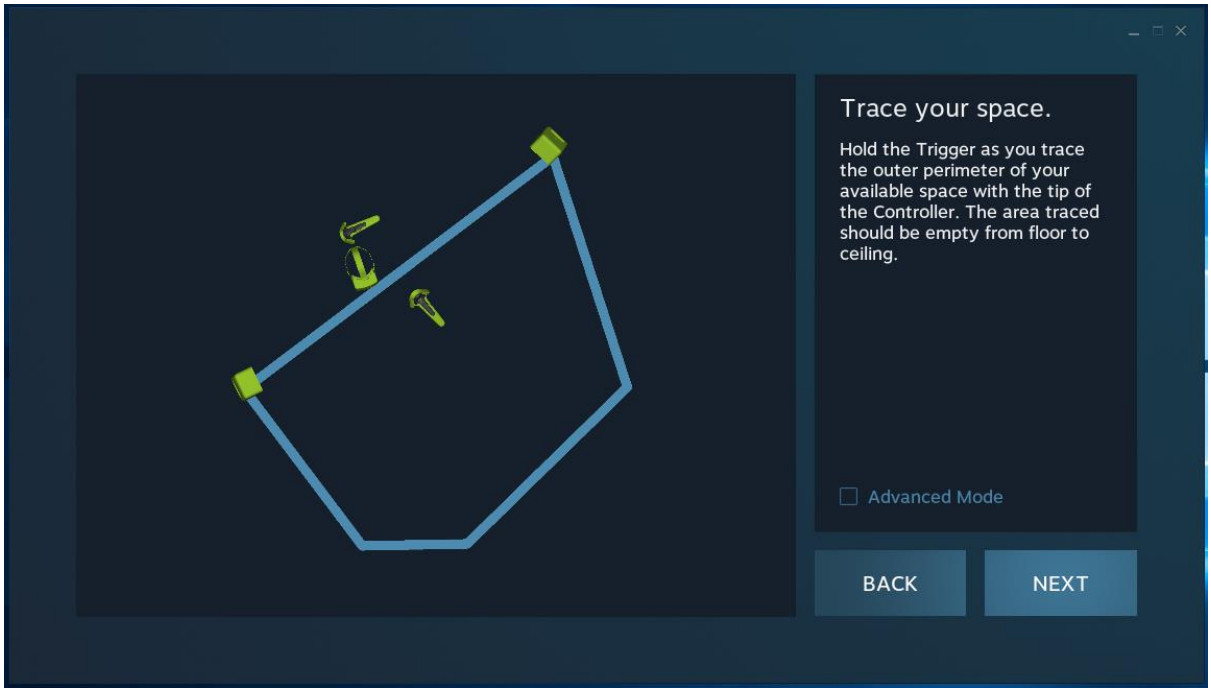
(5) Place VR Controllers on the floor to calibrate floor height



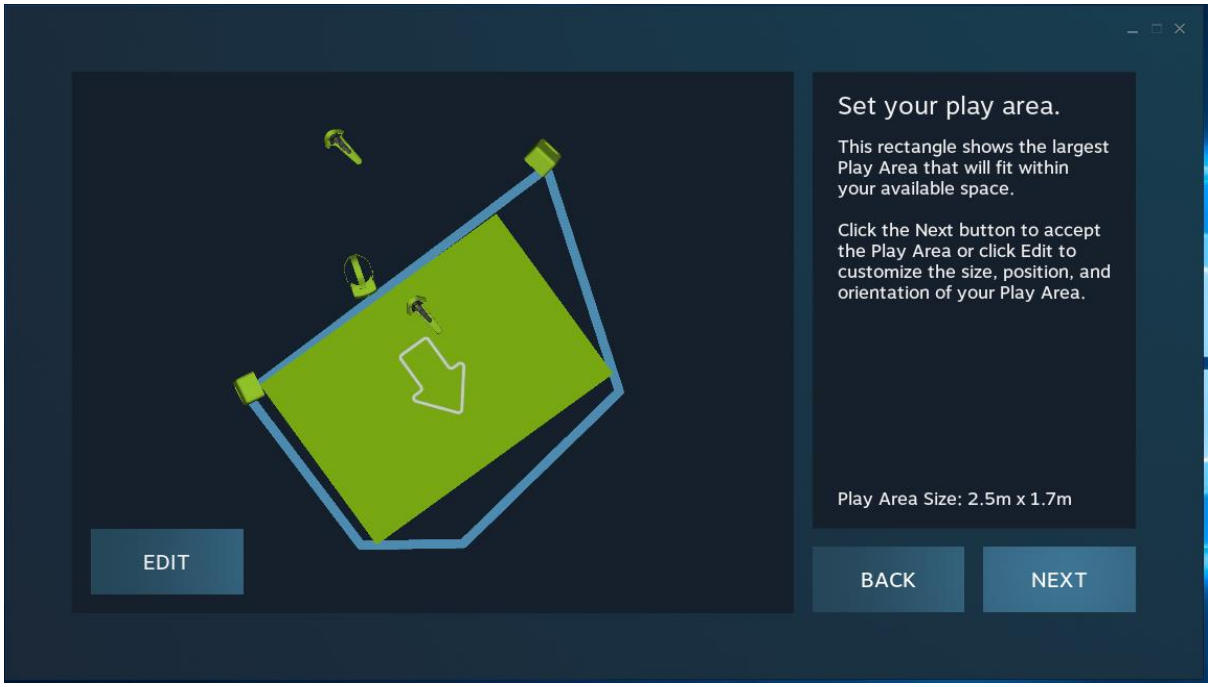
(6) Use VR Controller to outline parameter of floor space



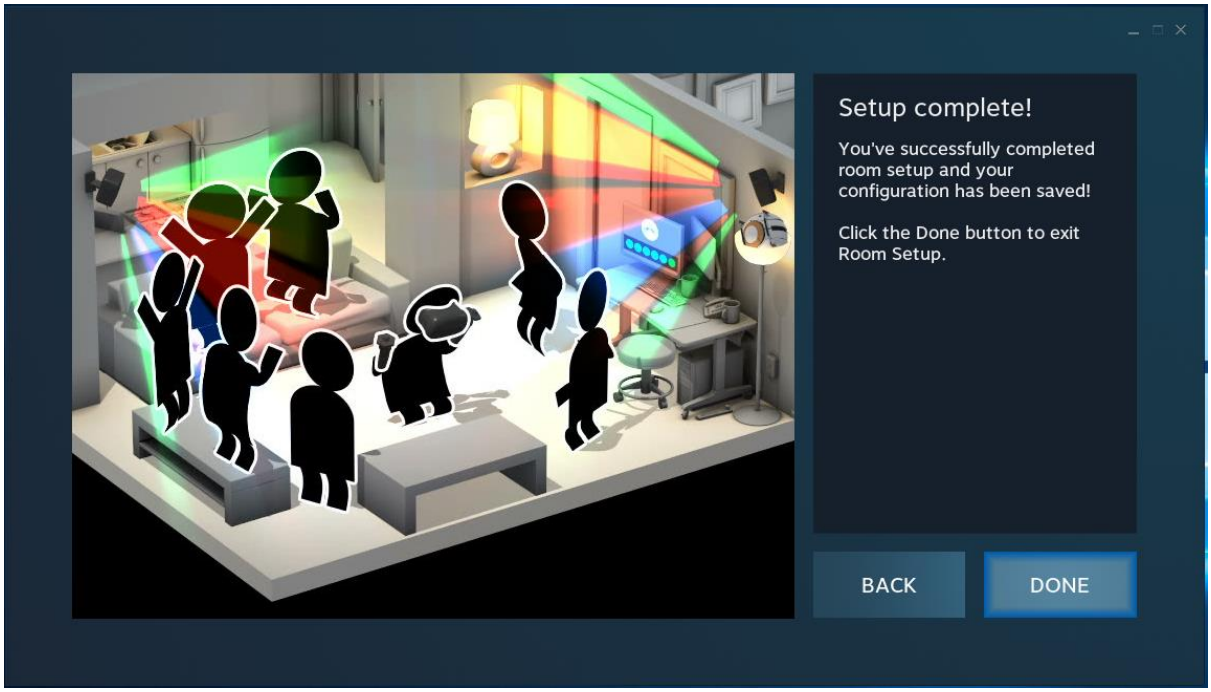
(6a) Map view of tracked objects



(6b) After tracing available space



(6c) Setting play area within available space

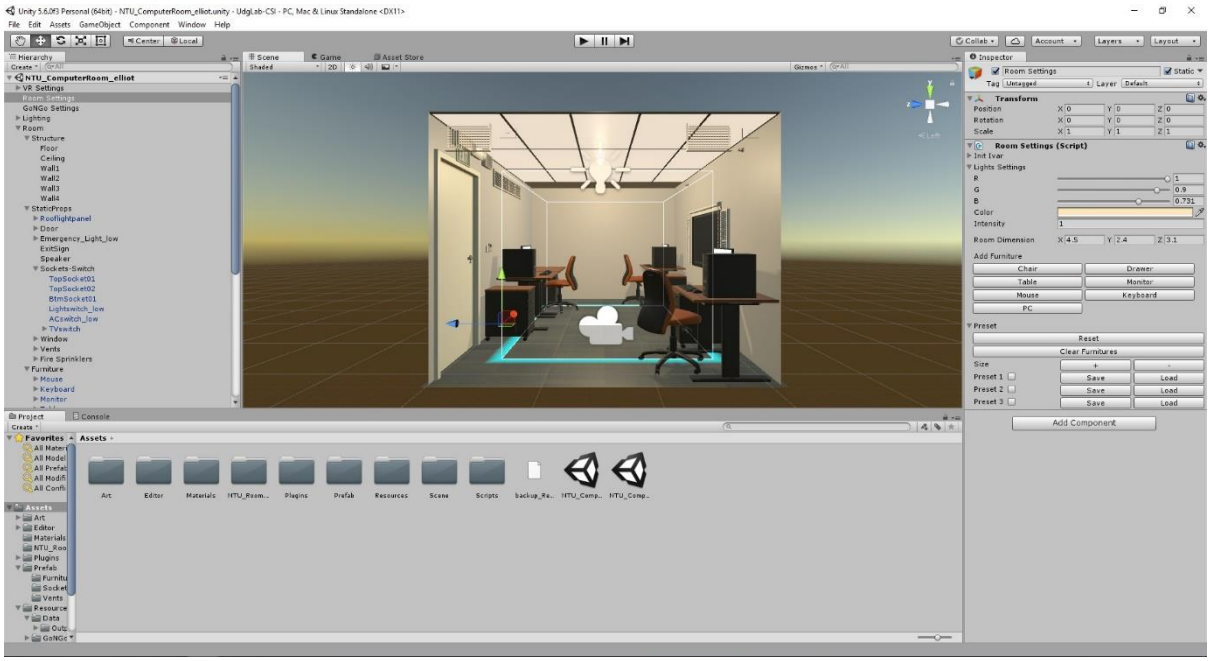


(7) Setup Completion page

5) VR Environment Configuration Instructions

Unity: Basic Navigation Instructions

The Psy-VR Platform was created using the Unity 3D Game Engine. To make adjustments to the Psy-VR Platform, it may be necessary to navigate the Unity interface.



Unity Environment window in Scene view

While in Scene View, users are able to view and modify the 3D environment. It is possible to adjust your view of the 3D environment by using a combination of Mouse and Keyboard inputs.

Scroll up/down = Zoom in/out

Middle click + drag = Translate Position Along Vertical Face

Up/down/left/right arrow keys = Translate Position Along Horizontal Face

Right click + drag = Pan/Tilt Axis change

Left click = select object

Left click + drag = Highlight multiple objects

When an object is selected, Axis controls will appear over the object. To manipulate the object, click and drag the corresponding axis arrows and the object will translate along said axis.

Note: Changes to the 3D environment (eg. furniture positions and room size adjustments…etc.) can be saved as presets in the Graphic User Interface Panel to the right of the Unity window. To do So, click one of the 3 “Save” buttons for the preset and the current setup will be saved as that preset. Once saved, the environment configuration can be simply recalled later by clicking the Load button for the corresponding preset.

For additional instructions on using Unity, please refer to:-

Unity’s website: https://www.unity.com/learn

The VR Environment can be configured on a number of variables. It is possible to adjust the Dimensions of the room; Lighting position, intensity and color; Furniture type and Position, as well as run the Go-No-Go task on Computer Monitors within the VR Environment.

1) **Configuring Room Dimensions**
    a. Height, Width, Depth
    b. Lighting
        i. Color
        ii. Intensity
2) **Inserting and Positioning Furniture**
    a. Inserting from Library
    b. Position & configuration
3) **Psychological Computerized Task**
    a. Applying Task to a Computer Monitor
    b. Customizing Task Variables
    c. Retrieving response Data

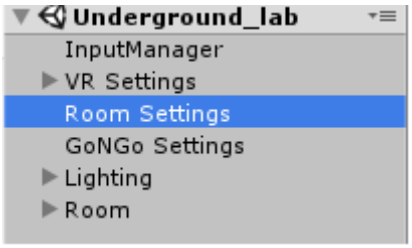


Figure 1.1

Figure 1.1 can be found on the left hand side of unity. Select “Room Settings” and check on the inspector. You should be able to see Figure 1.2

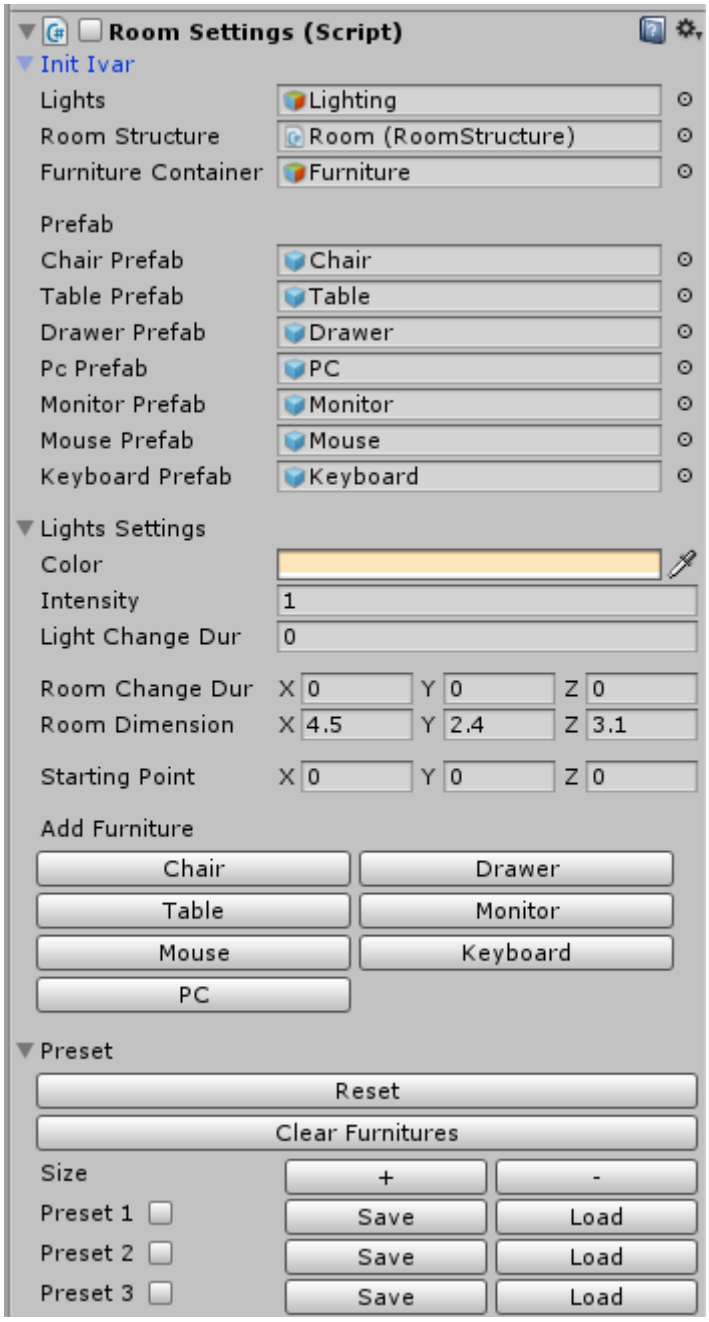


Figure 1.2

Functions of every field on figure 1.2

Lights, Room structure, furniture are predetermined objects that should not be changed unless you understand what you are doing.

Prefab: This are the prefab that will be created when “Add Furniture” buttons are pressed. Currently, there are no way to add in new furniture.

Light Settings:
- Color: Color of the lighting in the room.
- Intensity: Intensity of the lighting.
- Light Change Dur: The duration it takes for the changes to happen.

Room Change Dur: The duration it takes for the room dimension to change to the assigned value.
Room Dimension: The dimension of the room based on the 3 dimension (X, Y, Z).

Starting Point: The starting position of player.

Add Furniture: Add furniture to the room. The model is added based on the prefab variables above.

Preset: These are used to store the room data. Room dimension, furniture position will be saved to the array for a quicker setup in the future.
- Reset: Reset the dimension of the room to the default.
- Clear furniture: Remove all the furniture in the room.
- Size: “+”, “-“ increase or decreases the size of the preset.
- Save/Load: Save or load the room data from or to the array.
- The checkbox can be ticked to prevent any overwrite on the data.

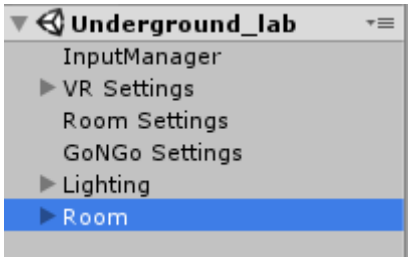


Figure 2.1

Select “Room” as shown in figure 2.1 on the left on Unity for advance setup on the room.

Figure 2.2 will be displayed on the inspector after selecting “Room”.

*Note: Only add permanents object to this field. At the current version, it is not able to setup dynamic object like the furniture created from the “Room Settings”. Adding any furniture from the prefab created will break the system.

Do not change any of these if you do not understand.

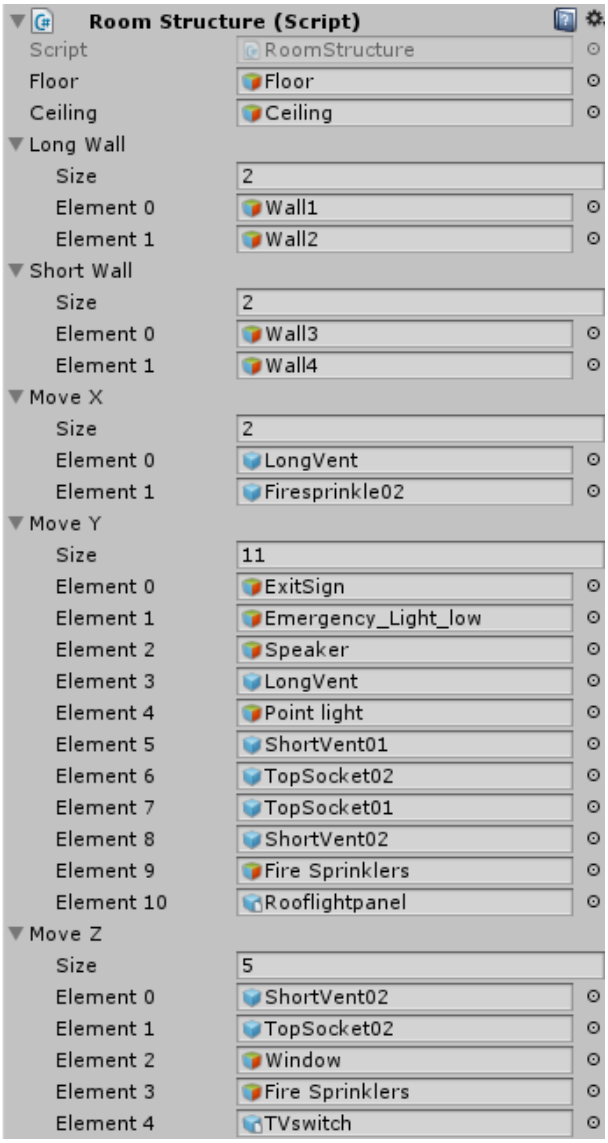


Figure 2.2

Floor, Ceiling: The floor and ceiling of the room. Their width and depth will be stretch or shrink when the X or Z dimension of the room is changed.
When Y is changed, the ceiling will move accordingly as well.

Long wall: The walls which the door is on and the wall opposite to it.
The width and height of these objects will change accordingly when the Y and X room dimension is altered.

Short wall: The other 2 walls in the room.
The width and height of these objects will change accordingly when the Y and Z room dimension is altered.

Move X: All object(s) in the array will change their X position when X dimension of the room is changed.

Move Y: All object(s) in the array will change their Y position when Y dimension (height of the room) of the room is changed.

Move Z: All object(s) in the array will change their Z position when Z dimension of the room is changed.

Furniture

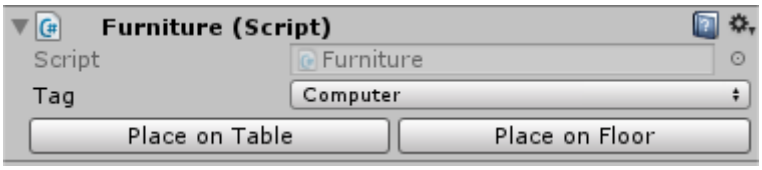


Figure 3.1

Figure 3.1 will be displayed on the inspector when any furniture (except for chair) is created/selected.

Tag: Do not change this.

Place on Table: The furniture will have its Y position increase to the height of the table. The furniture can then be place on the table accurately.

Place on Floor: Have the furniture's height be place on the floor.

Figure 3.2

Figure 3.2 will be found in the inspector of "Drawer" and "Chair". This script helps to rotate each individual wheel on the furniture for realism.

The angle is between -180 degrees to 180 degrees.

Figure 3.3

Figure 3.3 can only be found in the inspector of a "Chair". This script helps to change the rotation of the chair base on its upper half and lower half (Check out figure 3.4 and figure 3.5).

Figure 3.4 Upper half of chair

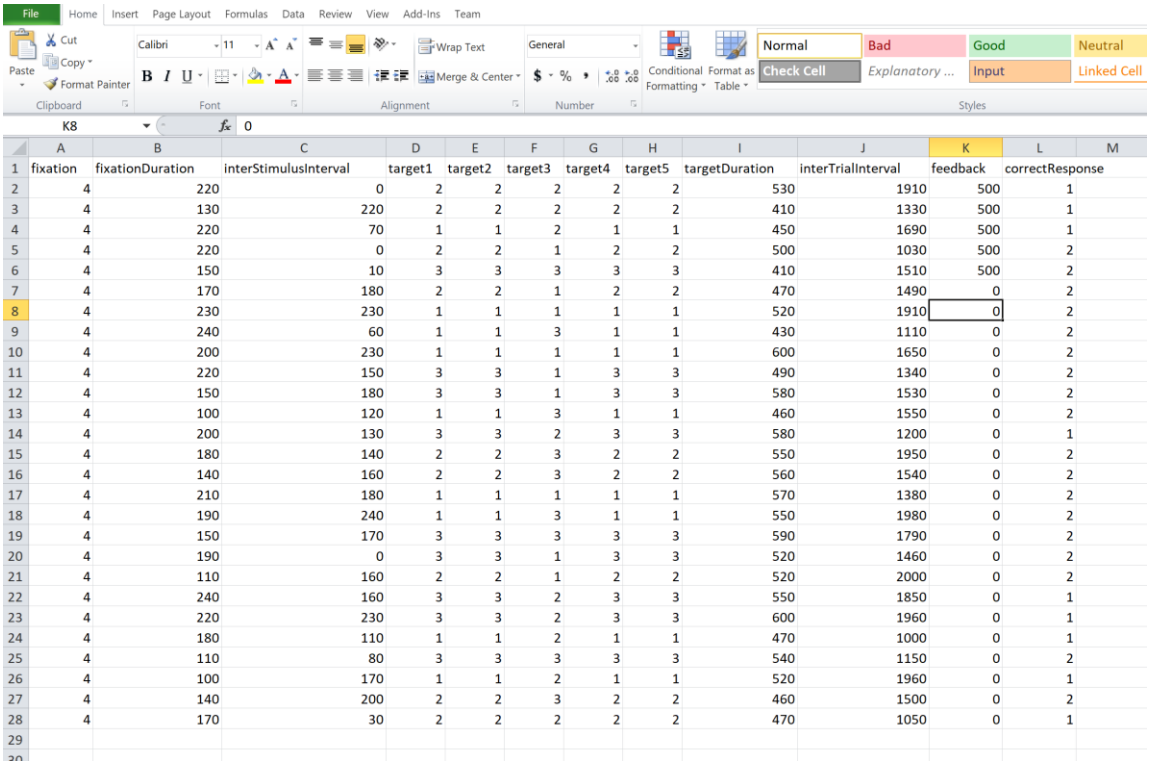
Figure 3.5 Lower half of chair

5) Psychological Task Setup

Introduction to the Psychological (Flanker) Task
The Psychological (Flanker) Task can be presented on any computer screen placed within the Virtual Environment and participants respond through trigger buttons on an Xbox360 controller plugged into the PC via USB.

For each trial, participants would be presented with a fixation cross, followed by the stimulus which are a set of 5 sprites that are arrows either pointed to the left or to the right.
Participants would be instructed to focus on the middle arrow and responded by pulling the trigger that corresponded with the direction the middle arrow was pointed. The other arrows could be pointing in the same direction as the middle arrow (congruent trials) or they could point in the opposite direction (incongruent trials) predetermined by the researcher via modifying the condition variables within a .XML sheet.

1) Open Psychological Task Condition Variable sheet



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	fixation	fixationDuration	interStimulusInterval	target1	target2	target3	target4	target5	targetDuration	interTrialInterval	feedback	correctResponse	
2	4	220	0	2	2	2	2	2	530	1910	500	1	
3	4	130	220	2	2	2	2	2	410	1330	500	1	
4	4	220	70	1	1	2	1	1	450	1690	500	1	
5	4	220	0	2	2	1	2	2	500	1030	500	2	
6	4	150	10	3	3	3	3	3	410	1510	500	2	
7	4	170	180	2	2	1	2	2	470	1490	0	2	
8	4	230	230	1	1	1	1	1	520	1910	0	2	
9	4	240	60	1	1	3	1	1	430	1110	0	2	
10	4	200	230	1	1	1	1	1	600	1650	0	2	
11	4	220	150	3	3	1	3	3	490	1340	0	2	
12	4	150	180	3	3	1	3	3	580	1530	0	2	
13	4	100	120	1	1	3	1	1	460	1550	0	2	
14	4	200	130	3	3	2	3	3	580	1200	0	1	
15	4	180	140	2	2	3	2	2	550	1950	0	2	
16	4	140	160	2	2	3	2	2	560	1540	0	2	
17	4	210	180	1	1	1	1	1	570	1380	0	2	
18	4	190	240	1	1	3	1	1	550	1980	0	2	
19	4	150	170	3	3	3	3	3	590	1790	0	2	
20	4	190	0	3	3	1	3	3	520	1460	0	2	
21	4	110	160	2	2	1	2	2	520	2000	0	2	
22	4	240	160	3	3	2	3	3	550	1850	0	1	
23	4	220	230	3	3	2	3	3	600	1960	0	1	
24	4	180	110	1	1	2	1	1	470	1000	0	1	
25	4	110	80	3	3	3	3	3	540	1150	0	2	
26	4	100	170	1	1	2	1	1	520	1960	0	1	
27	4	140	200	2	2	3	2	2	460	1500	0	2	
28	4	170	30	2	2	2	2	2	470	1050	0	1	

<IMG psychological task condition variables>

2) Modify Variables & Save

Each trial's variables can be customized within the Example.xml sheet.
Each variable for each trial is labelled across the first row and can be modified by simply changing the variables.

Each Variable is described as follows: -

Fixation – indicates which sprite will be displayed (default fixation cross is labelled as "4.png" but can be modified or replaced by any other .PNG file of the same dimensions)

fixationDuration – Determines how long the fixation cross will be displayed for (in milliseconds).

interStimulusIntervel – Determines the time between fixation cross and display of the trial stimulus.

Target1 to Target5 – denotes the 5 images that will appear as trial stimulus for the specific trial period. (can be modified or replaced by any other .PNG file of the same dimensions)

targetDuration – Determines the time in milliseconds that the Target stimulus are presented.

InterTrialInterval – Determines the time in milliseconds between end of target stimulus and feedback display.

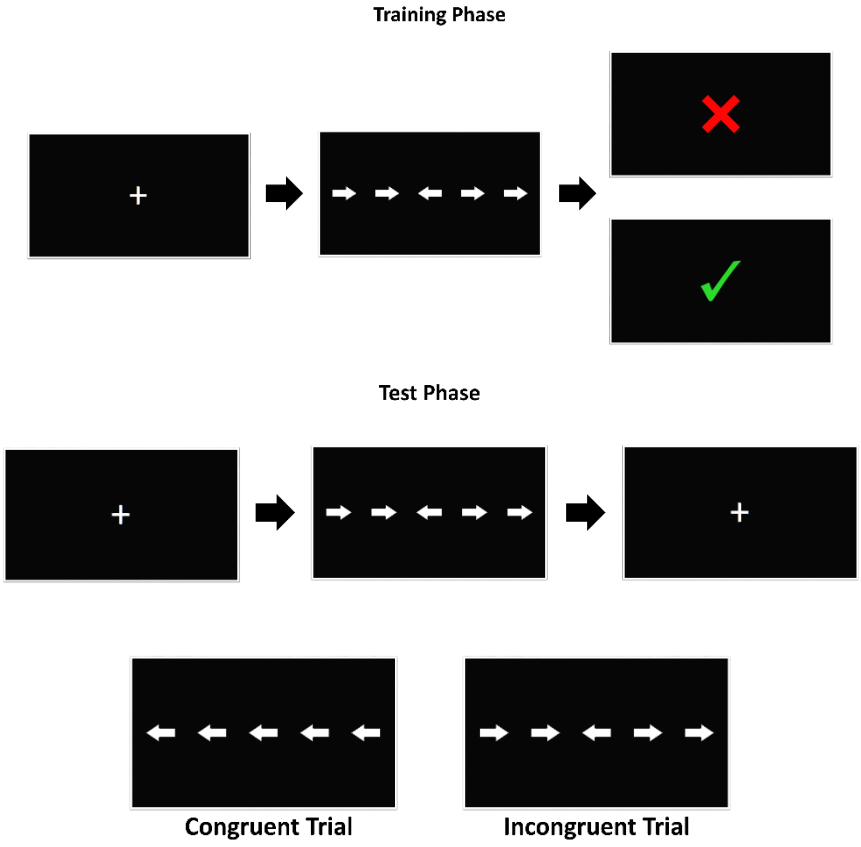
feedback – Determines the time in milliseconds that feedback is displayed. (can be set to "0" if no feedback is required)

correctResponse – Indicates which response for specific trial should be considered correct or incorrect. Will determine whether response feedback displayed is a "tick" or a "cross".

(Note: Breaks are inserted as trials simply with no response and longer target duration. Any sprite can be inserted in place of the target trial to indicate a break and will be displayed to the participant accordingly. By default, a sprite displaying "30 Second Break" was used. Labelled as "5.PNG")

All Sprites for the Psychological Task are located and can be modified in the GoNGo folder: -

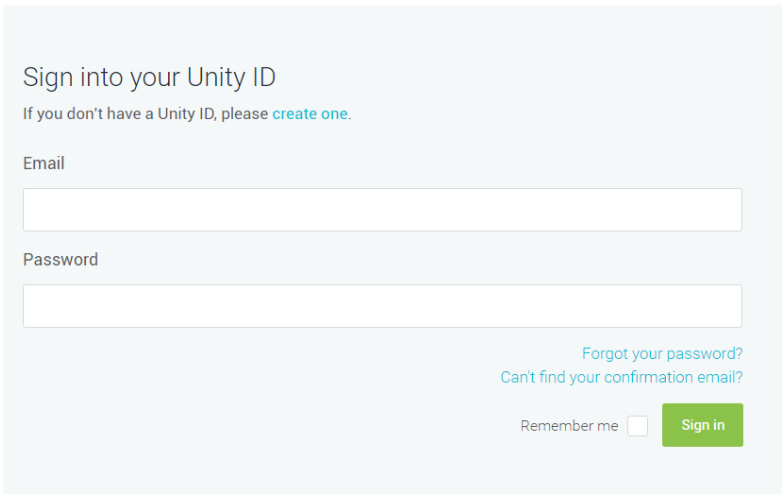
..\Desktop\UdgLab-CSI\Assets\Resources\GoNGo



<Examples of the Psychological task stimulus presented on monitors within VR environment>

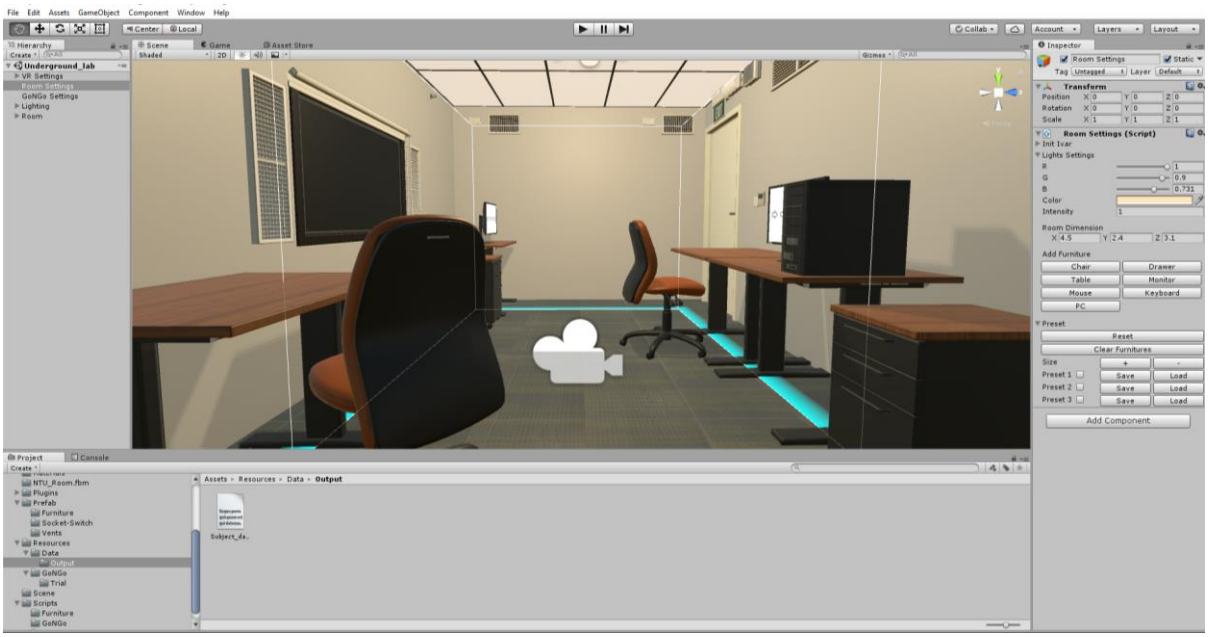
6) Usage Instructions (During Experiment)

1) Login/Create Unity Account



(Unity will automatically prompt you to input your Login credentials prior to accessing their interface.)

2) Select <UdgLab-CSI>
3) Sit the participant in the middle of the Virtual area
4) Plug the Xbox360 controller into the Desktop PC's USB port
5) Participant wears the VR headset and holds on to the Xbox360 controller.
6) Click the Play button above the preview window (within Unity) to **Run** environment program.



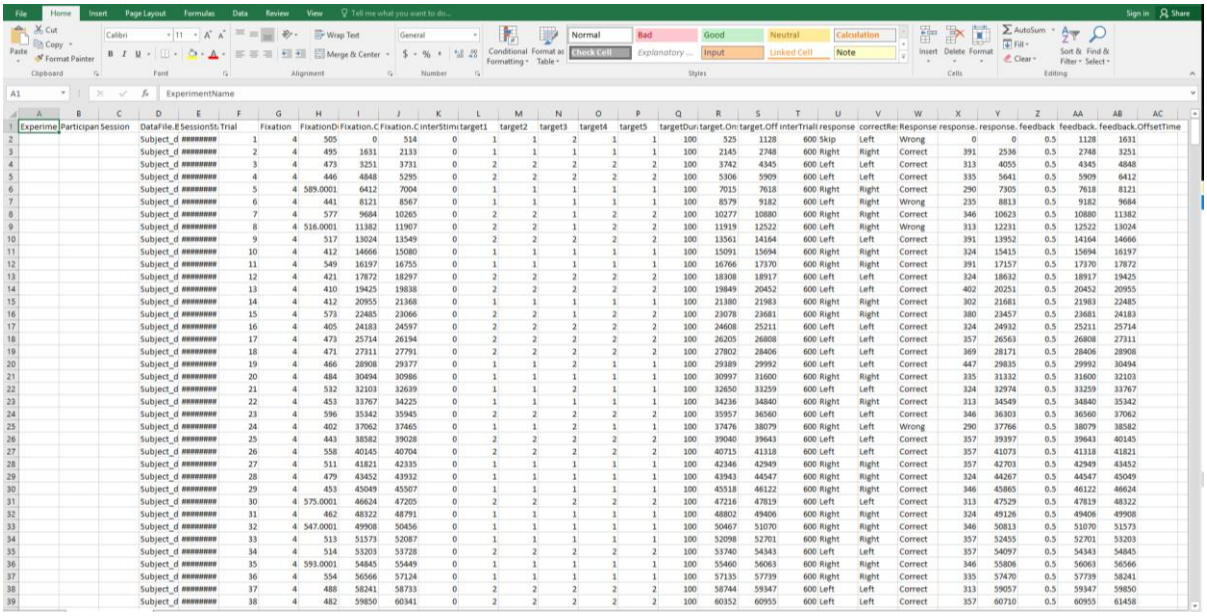
<IMG unity interface>

Once the <UdgLab-CSI> Folder has been selected and the play button within Unity has been clicked, SteamVR will automatically activate and display the VR environment through the VR goggles. Participant within the VR environment will be able to perform the Psychological task displayed on the computer monitor within VR using the trigger buttons on the Xbox controller.

7) After Experiment (Managing Output Data)

After the Experiment has completed, the data is automatically saved in the data folder: -

…\Desktop\UdgLab-CSI\Assets\Resources\Data



Experime	Participan	Session	DataFile.E	SessionSt	Trial	Fixation	FixationDi	Fixation.C	Fixation.C	InterStimi	target1	target2	target3	target4	target5	targetDur	target.On	target.Off	interTriall	response	correctRe	Response	response.	response.	feedback	feedback.	feedback.	OffsetTime
			Subject_d	########	1	4	505	0	514	0	1	1	2	1	1	100	525	1128	600	Skip	Left	Wrong	0	0	0.5	1128	1631		
			Subject_d	########	2	4	495	1631	2133	0	1	1	1	1	1	100	2145	2748	600	Right	Right	Correct	391	2536	0.5	2748	3251		
			Subject_d	########	3	4	473	3251	3731	0	2	2	2	2	2	100	3742	4345	600	Left	Left	Correct	313	4055	0.5	4345	4848		
			Subject_d	########	4	4	446	4848	5295	0	2	2	2	2	2	100	5306	5909	600	Left	Left	Correct	335	5641	0.5	5909	6412		
			Subject_d	########	5	4	589.0001	6412	7004	0	1	1	1	1	1	100	7015	7618	600	Right	Right	Correct	290	7305	0.5	7618	8121		
			Subject_d	########	6	4	441	8121	8567	0	1	1	1	1	1	100	8579	9182	600	Left	Right	Wrong	235	8813	0.5	9182	9684		
			Subject_d	########	7	4	577	9684	10265	0	2	2	1	2	2	100	10277	10880	600	Right	Right	Correct	346	10623	0.5	10880	11382		
			Subject_d	########	8	4	516.0001	11382	11907	0	2	2	1	2	2	100	11919	12522	600	Left	Right	Wrong	313	12231	0.5	12522	13024		
			Subject_d	########	9	4	517	13024	13549	0	2	2	2	2	2	100	13561	14164	600	Left	Left	Correct	391	13952	0.5	14164	14666		
			Subject_d	########	10	4	412	14666	15080	0	1	1	1	1	1	100	15091	15694	600	Right	Right	Correct	324	15415	0.5	15694	16197		
			Subject_d	########	11	4	549	16197	16755	0	1	1	1	1	1	100	16766	17370	600	Right	Right	Correct	391	17157	0.5	17370	17872		
			Subject_d	########	12	4	421	17872	18297	0	2	2	2	2	2	100	18308	18917	600	Left	Left	Correct	324	18632	0.5	18917	19425		
			Subject_d	########	13	4	410	19425	19838	0	2	2	2	2	2	100	19849	20452	600	Left	Left	Correct	402	20251	0.5	20452	20955		
			Subject_d	########	14	4	412	20955	21368	0	1	1	1	1	1	100	21380	21983	600	Right	Right	Correct	302	21681	0.5	21983	22485		
			Subject_d	########	15	4	573	22485	23066	0	2	2	1	2	2	100	23078	23681	600	Right	Right	Correct	380	23457	0.5	23681	24183		
			Subject_d	########	16	4	405	24183	24597	0	2	2	2	2	2	100	24608	25211	600	Left	Left	Correct	324	24932	0.5	25211	25714		
			Subject_d	########	17	4	473	25714	26194	0	2	2	2	2	2	100	26205	26808	600	Left	Left	Correct	357	26563	0.5	26808	27311		
			Subject_d	########	18	4	471	27311	27791	0	2	2	2	2	2	100	27802	28406	600	Left	Left	Correct	369	28171	0.5	28406	28908		
			Subject_d	########	19	4	466	28908	29377	0	1	1	2	1	1	100	29389	29992	600	Left	Left	Correct	447	29835	0.5	29992	30494		
			Subject_d	########	20	4	484	30494	30986	0	1	1	1	1	1	100	30997	31600	600	Right	Right	Correct	335	31332	0.5	31600	32103		
			Subject_d	########	21	4	532	32103	32639	0	1	1	2	1	1	100	32650	33259	600	Left	Left	Correct	324	32974	0.5	33259	33767		
			Subject_d	########	22	4	453	33767	34225	0	1	1	1	1	1	100	34236	34840	600	Right	Right	Correct	313	34549	0.5	34840	35342		
			Subject_d	########	23	4	596	35342	35945	0	2	2	2	2	2	100	35957	36560	600	Left	Left	Correct	346	36303	0.5	36560	37062		
			Subject_d	########	24	4	402	37062	37465	0	1	1	2	1	1	100	37476	38079	600	Right	Left	Wrong	290	37766	0.5	38079	38582		
			Subject_d	########	25	4	443	38582	39028	0	2	2	2	2	2	100	39040	39643	600	Left	Left	Correct	357	39397	0.5	39643	40145		
			Subject_d	########	26	4	558	40145	40704	0	2	2	2	2	2	100	40715	41318	600	Left	Left	Correct	357	41073	0.5	41318	41821		
			Subject_d	########	27	4	511	41821	42335	0	1	1	1	1	1	100	42346	42949	600	Right	Right	Correct	357	42703	0.5	42949	43452		
			Subject_d	########	28	4	479	43452	43932	0	1	1	1	1	1	100	43943	44547	600	Right	Right	Correct	324	44267	0.5	44547	45049		
			Subject_d	########	29	4	453	45049	45507	0	1	1	1	1	1	100	45518	46122	600	Right	Right	Correct	346	45865	0.5	46122	46624		
			Subject_d	########	30	4	575.0001	46624	47205	0	2	2	2	2	2	100	47216	47819	600	Left	Left	Correct	313	47529	0.5	47819	48322		
			Subject_d	########	31	4	462	48322	48791	0	1	1	1	1	1	100	48802	49406	600	Right	Right	Correct	324	49128	0.5	49406	49908		
			Subject_d	########	32	4	547.0001	49908	50456	0	1	1	1	1	1	100	50467	51070	600	Right	Right	Correct	346	50813	0.5	51070	51573		
			Subject_d	########	33	4	513	51573	52087	0	1	1	1	1	1	100	52098	52701	600	Right	Right	Correct	357	52455	0.5	52701	53203		
			Subject_d	########	34	4	514	53203	53728	0	2	2	2	2	2	100	53740	54343	600	Left	Left	Correct	357	54097	0.5	54343	54845		
			Subject_d	########	35	4	593.0001	54845	55449	0	1	1	1	1	1	100	55460	56063	600	Right	Right	Correct	346	55806	0.5	56063	56566		
			Subject_d	########	36	4	554	56566	57124	0	1	1	1	1	1	100	57135	57739	600	Right	Right	Correct	335	57470	0.5	57739	58241		
			Subject_d	########	37	4	488	58241	58733	0	2	2	2	2	2	100	58744	59347	600	Left	Left	Correct	313	59057	0.5	59347	59850		
			Subject_d	########	38	4	482	59850	60341	0	2	2	2	2	2	100	60352	60955	600	Left	Left	Correct	357	60710	0.5	60955	61458		

<IMG of output data sheet>

(Note: If the data file is not renamed or saved out of the data folder before the next time the task is run, each instance of running the task will override the previous data file.)