This document contains information about the VastWaste installation, its various features and projection systems, and how to set them up. Code documentation is forthcoming, but much of it is explained in code comments.

Projection system modes

This installation is designed to be run as a standalone program that is projected from a computer to multiple displays or projectors in a venue. As a result, we have implemented various ways to experience and project the installation based on the desired experience and available equipment. There are three primary ways to run this installation:

- As a VR piece, with no projection (this is the default when you start it for the first time)
- As a flat projection onto one wall, with the option to also use VR
- As a room-scale projection with projectors running on each wall, including the option to also use VR

Note: If you only have one display, you cannot use both a projection mode and VR at the same time due to technical limitations. You can instead switch between VR and projection in the settings menu detailed below. If you have 2 or more displays, then it is possible to run projection and VR at the same time.

Hardware requirements

Since this installation is a software program using the Unity engine and VR, there are certain hardware requirements that should be met in order for it to run properly. These include:

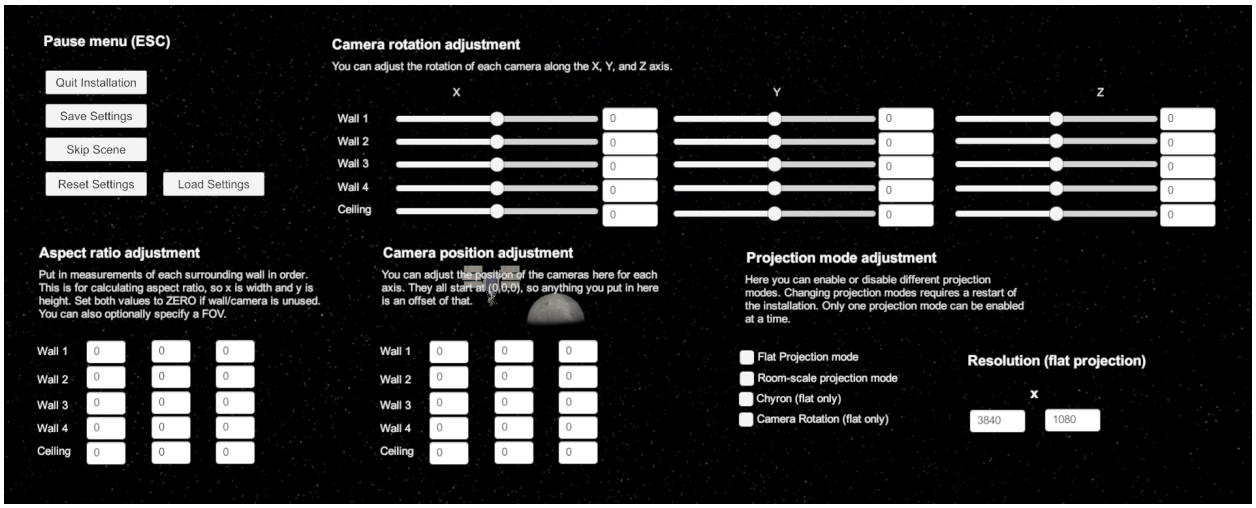
- A computer with a dedicated GPU, laptop or desktop.
    - This computer should have the ports to output to as many displays as required for the venue.
    - The computer should have a VR-compatible GPU (A GTX 1070 or better is recommended).
    - If running on a laptop, the laptop should be set to its highest performance mode and connected to power at all times.
    - Windows 10 (recommended) and 11 are both compatible with this installation.
- A SteamVR compatible virtual reality headset, if VR is being used.
    - HTC Vive is preferred and is the headset the installation is designed for, but any should work.
    - If base stations or any other equipment are required to run the headset, they should be set up as well.
    - Controllers are not necessary and **should not be used**.
- Displays or projectors for running the projection on.
    - These displays should optimally be of the same size, resolution, and aspect ratio.
    - If using flat projection, the projectors should be lined up horizontally with no seams, creating the appearance of one large screen.

    - If using room projection, the projectors should be displaying to one wall each and would be lined up at the corners of each wall.
- As the installation contains sound and music, speakers can be connected if available

NOTE FOR ISEA2022/UPC – Do not worry about doing the setup below for the piece. The creators of the installation will set it up upon their arrival, assuming the above hardware requirements are met.

The settings menu

Most tools necessary for setting up projection are available through a settings menu. Once the installation is run, you can press the Escape key to open and close this menu. Here is an image of the menu and a description of each option:



Pause menu buttons:

- Quit installation - closes the program, saving settings in the process.
- Save settings - saves settings.
- Skip scene - skips from the space scene to the ocean scene. Only recommended for testing purposes.
- Reset settings - resets most settings to their defaults.
- Loads settings - loads last saved settings.

Camera rotation adjustment (**room projection only**):

- Allows users to control the rotation of each camera on each axis in order to make them align with one another in the desired way. This is necessary as the layout from venue to venue can vary and the cameras will require adjustments.

Aspect ratio adjustments (**room projection only**):

- Allows users to enable or disable certain cameras or adjust their aspect ratios and FOV based on the venue and projectors. By default, both fields of the aspect ratio are set to 0

which disables the camera. To enable specific cameras, assign them an aspect ratio (commonly 16:9) and they will turn on automatically. To disable them, set those values to 0.

Camera position adjustment (**room projection only**):

- **This should be avoided as much as possible**, as it can cause some visual changes from the intended experience, but it is there if moving the cameras in the virtual space is necessary for proper alignment.

Projection mode adjustment:

- The first two checkboxes will toggle the selected projection mode (turning on or off either flat or room projection). Both cannot be selected at the same time; if this happens the program will spit out an error and revert to VR-only mode. Once a mode is selected or deselected, **you must press the quit button and restart the installation for it to take effect**!
- Chyron (**flat projection only**) - enables or disables the chyron, a bar on the bottom of the installation which gives a live feed of some of the data that powers what's going on in the scene.
- Camera rotation (**flat projection only**) - enables or disables camera rotation around the scene to give viewers a glimpse into things happening in every part of the scene. This setting is toggleable by scene.

Resolution adjustment (**flat projection only**):

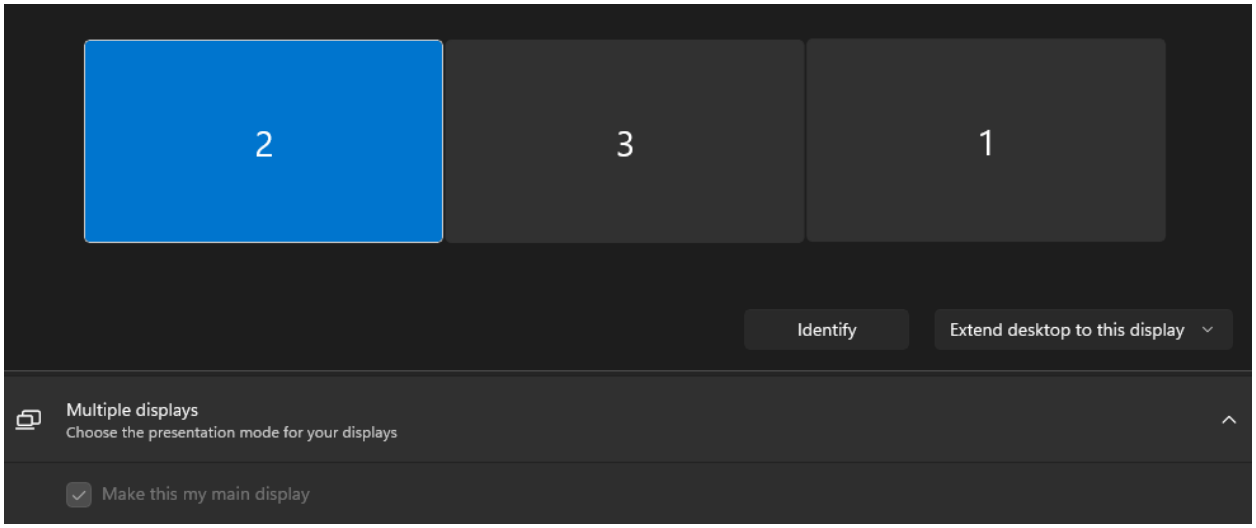
- Allows users to set a resolution for the flat projection to run on. This is explained further below, but is typically the combined horizontal resolution of the projection displays and their height. Changes to this will require a restart of the installation to take effect.

Configuring the projection

This part assumes you have read the two above sections on the settings menu and hardware requirements.

Setting up flat projection:

1. If your computer is only connected to the projection displays and not to **any other display** (such as a monitor or built-in laptop display), **skip to step 4**.
2. Connect all of your projectors/displays to the computer. Open Windows Display Settings and drag your displays around so that the first display comes after the others and so that the order starts with the second display and continues onward. For example, if you have 4 screens (including a built-in laptop display or monitor), you would go from having them ordered as (1,2,3,4) to (2,3,4,1). If the remaining monitors are out of order, for example (2,4,3) instead of (2,3,4), you will likely need to swap the order of the cables plugged into your computer or the projectors (this is a side effect of how Windows handles display identities). Here's a picture using 3 displays, 1 main monitor and 2 projectors:



3. Select the second display (now the first in the order), and set it as the main display in the settings options down the page. This is all necessary because of the way Unity and Windows handle multi-display; the installation will only run on the “main display”, so the “main display” will be the first display in the projection itself. Your monitor, now the last one in the order, will be the VR preview screen.
4. Optionally, connect your VR setup to your computer and make sure SteamVR detects your headset.
5. Now start the installation. Open the settings menu with Escape. Tick the flat projection box (and chyron or rotation, if desired). Then input the **combined resolution** of the projection displays into the resolution field. For example, if I have three 1920x1080 screens side by side that I am using for the projections, I will add the widths together (1920x3 = 5760) and put that in the width field then put 1080 as the height (since all displays are the same height).
6. Now **restart the installation**, using the Quit button to shut the program down and save your settings. The flat projection should now be working.

Setting up room projection:

1. Connect all of your projectors to your computer. Depending on the order of your projectors in the room space, you may have to go into Windows Display Settings and re-order the displays or swap some cables in order to get the desired order. If you have a built-in laptop display or monitor, make sure that is first in the display order as that is where the VR preview will run and it will not count as a projection display.
2. Optionally, connect your VR setup to your computer and make sure SteamVR detects your headset.
3. Now start the installation. Open the settings menu with Escape. Turn on the checkbox for room projection. Now **restart the installation**, using the Quit button to shut the program down and save your settings. The room projection should now be working.
4. Open the settings menu with Escape. Enable some of the cameras depending on how many projection displays you have connected. Adjust FOV, aspect ratio, and camera

rotation as necessary. Instructions on how to do all of these things are in the settings section above. You are done!

More information

This documentation is written and maintained by Jack Burkhardt, a student at Northwestern University who helped work on this piece and implemented most of the projection system. If you have any questions, notice any issues, or just need more information, feel free to contact me at jackburkhardt@u.northwestern.edu.