BINOCULAR TENSION

BY RAFAEL LOZANO-HEMMER

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GENERAL IMPORTANT INFORMATION

This short section must be read for proper operation.

BINOCULAR TENSION (2024)

BY RAFAEL LOZANO-HEMMER

Technique

Flat display, 3D sensor, computer, wooden frame, custom-made software.

Description

"Binocular Tension" is a stretched horizontal display with the image of two large human eyes that track and follow the observer with a built-in computerized tracking system. When a public member is detected, their presence triggers the eyes to wake up, looking at the visitor directly, creating an uncanny experience that questions who is the observer and who is the observed. The piece is part of a series of surveillance pieces that started in 1992 with the interactive installation "Surface Tension," where an image of a giant human eye follows the observer with Orwellian precision. In this series of works, the artist creates a tangible manifestation of observation itself as the subject of the work of art. Here eye contact is presented as a technological mechanism of sentience, seduction, policing, and control.

Operation

Please refer to Appendix I - Installation for detailed system information and wiring diagram.

1. Connect all the elements to a power source as shown in the installation's wiring diagram.

2. To turn the piece **ON**, press the power button of the computer for a second then release it. Important note: Please do not push the button again as this will shut down the piece. Wait at least 2 minutes before pressing it again as the computer might take that long to boot. After 2 minutes, you should see the piece.

3. To turn the piece **OFF**, press the computer's button all the way down until you've seen the "Shutting down..." screen appearing and fading to a black screen (shouldn't take more than 2 seconds).

4. If the piece doesn't start within 2 minutes, try to turn on the piece again. If it still doesn't turn on, then hold the power button on the computer all the way down for 10 seconds. Then, wait at least 3 seconds and press the power button all the way down for 1 second and you should be up and running again.

General Artwork Behaviors

The display shows the eyes of a person and tracks the movement of viewers near the piece. If no one is near the artwork the eyes are normally closed and have minimal movement. Depending on how the software is configured the eyes can periodically open temporarily even if no one is nearby.

Interacting with the Artwork

As a viewer walks in front of the piece the eyes will begin to track and follow them, adjusting their positioning based on their height. If a person steps in closer to the display than the tracked person, the eye will start tracking this closer person. If the only people in front of the artwork stop moving, the piece will behave the same way it does when no one is in front of the piece, i.e., looking in the last “active” direction and eventually going to sleep. The eyeballs look up, down, and straight depending on where the “highest” position of the closest, moving person/object is.

Maintenance

Please do not clean the depth sensor or the display surfaces with Windex or soap. Use a lint-free cloth and LCD screen liquid cleaner, such as Kensington Screen Guardian found in most computer stores.

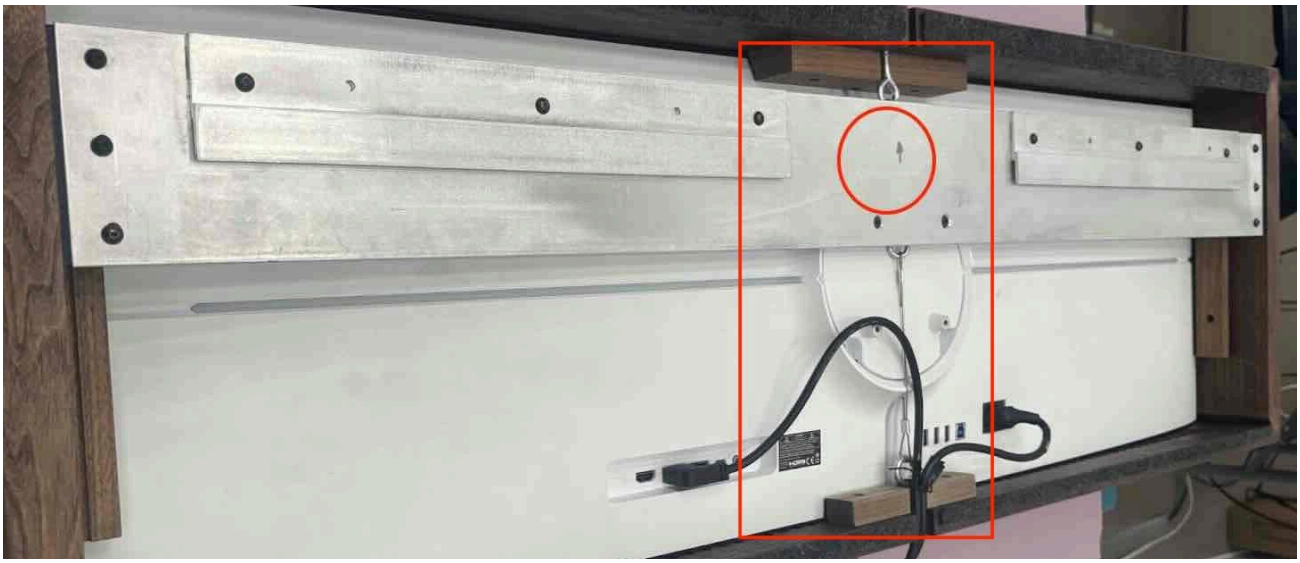
While cleaning the depth sensor, avoid applying too much pressure onto its surface, otherwise the sensor could swivel and it will mess up the alignment of the artwork.

The wood frame should simply get dusted using a clean feather duster, such as those produced by Swiffer. Do not use harsh cleaners or rough sponges.

We recommend cleaning the piece at least every two months.

Placement Instructions

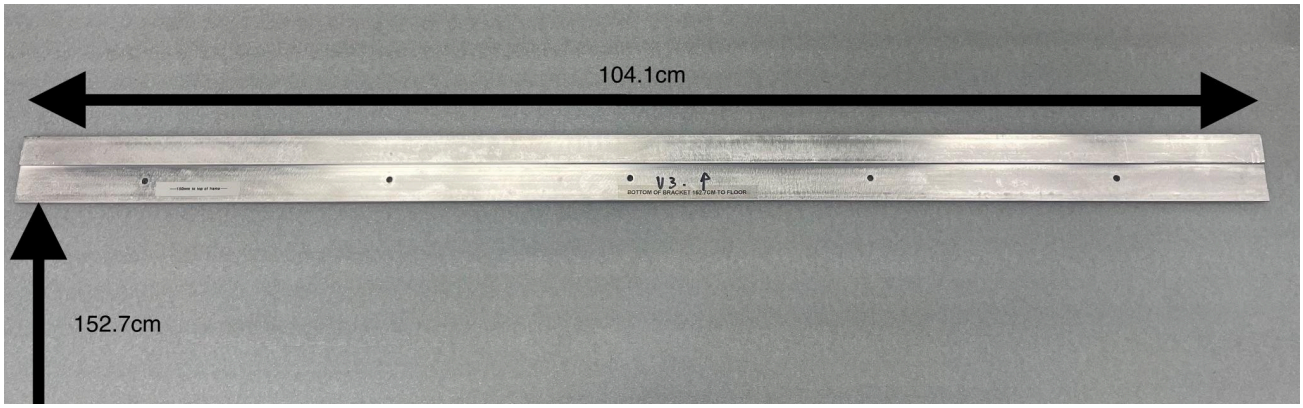
The vertical centre of the wooden frame should be hung at 150 cm (59 inches) from the ground. Before hanging the piece make sure the tension bar, visible in the screenshot below, is secure. The piece uses a french cleat and has an arrow pointing upwards on the metal bracket to indicate which way to hang it. The whole frame and monitor weighs about 20 kilograms.



The piece's bracket with the arrow indicating the top circled in red and the tension bar highlighted with a red square.

The artwork hangs on the wall via a french cleat system: it is easily hung by lifting its inner cleat above the cleat installed on the wall and slowly sliding it down until the inner cleat locks behind the wall cleat.

To ensure the centre of the frame is 150 cm from the ground. The bottom of the french cleat must be installed on the wall at 152.7 cm (60" ¼) from the ground. There is a sticker on the french cleat indicating this.

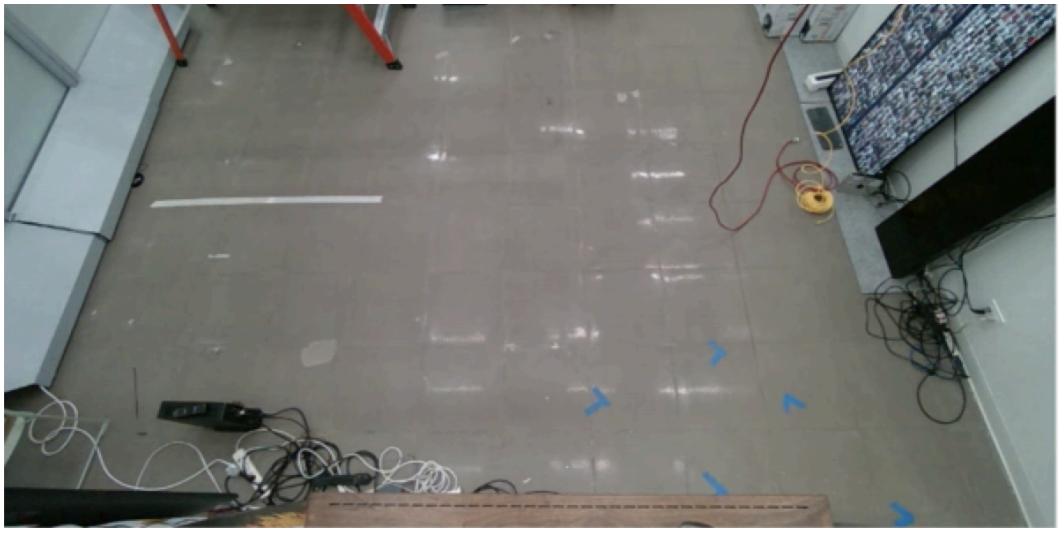


Once the piece rests on the cleat ensure it is sturdy on the cleat by trying to slide it off the cleat by gently pulling the frame away from the wall: it should have close to no leeway to be pulled away from the wall. Then try to slide the frame to the left and to the right: it should have about a maximum of 2 cm travel length while trying to shift it sideways. Finally check if the artwork is well levelled, using a level on the top edge.

The depth sensor should be installed anywhere between 280cm and 450cm (110-177") from the ground horizontally centered with the monitor. The lower the camera will be, the less physical interaction area width you will get within the software, requiring you to tweak several settings, including the software interactive area (X Divider angle) to enhance the left to right coverage. On the other end, a higher camera location requires reducing the left to right coverage. The sweet spot for the camera location is between 340cm and 400cm (134-158") from the ground.

This said, the system will be precalibrated for a specific distance, please follow studio's guidance on that matter, if any. Ensure that the depth sensor is secure.

Always ensure the depth sensor is tilted to see the frame of the display but none of the hosting wall (camera field of view can be seen under User GUI's section). This will assure a better tracking calibration.



In this view, the display showing the eyes set is visible at the bottom of the camera's FOV.

There should be enough free space in front of the display for people to move around fluidly. You should not install the frame too close to a perpendicular wall or another element: otherwise, the wall will be impacting the camera view and the interaction zone. You should keep at least 100cm (40") free on both sides of the artwork and at least 200cm (79") free in front of the artwork.

The computer can be stored in a nearby area, it should always remain in a well ventilated space and ideally hidden from the people looking at the artwork: a space like a cavity in the wall, a box with a proper mesh near the artwork, or in the room on the other side of the frame hosting wall, etc.

DETAILED TECHNICAL INFORMATION

Normal Software Operation

The artwork is set to automatically start when the computer is powered on and the computer is typically set to reboot daily, at night. We do recommend turning off the artwork when you don't plan to look at it for a longer period of time, to extend the lifetime of the components. The software currently needs a Python 3 environment installed in order to run and should be set to have a resolution of 3840x1080.

There are two applications that run on the startup of the computer. Their controls will be explained in detail in the next sections.

- The frontend application (the main software):
    - Controls the eyes and their movement.
    - Launches and adjusts the app's backend.

- The backend application:
    - Fetches the camera data and sends position information related to person tracking to the frontend.

The depth sensor should be precalibrated and if it is well oriented towards the person in front of the display, the artwork should display a set of eyes automatically as seen in the image below.

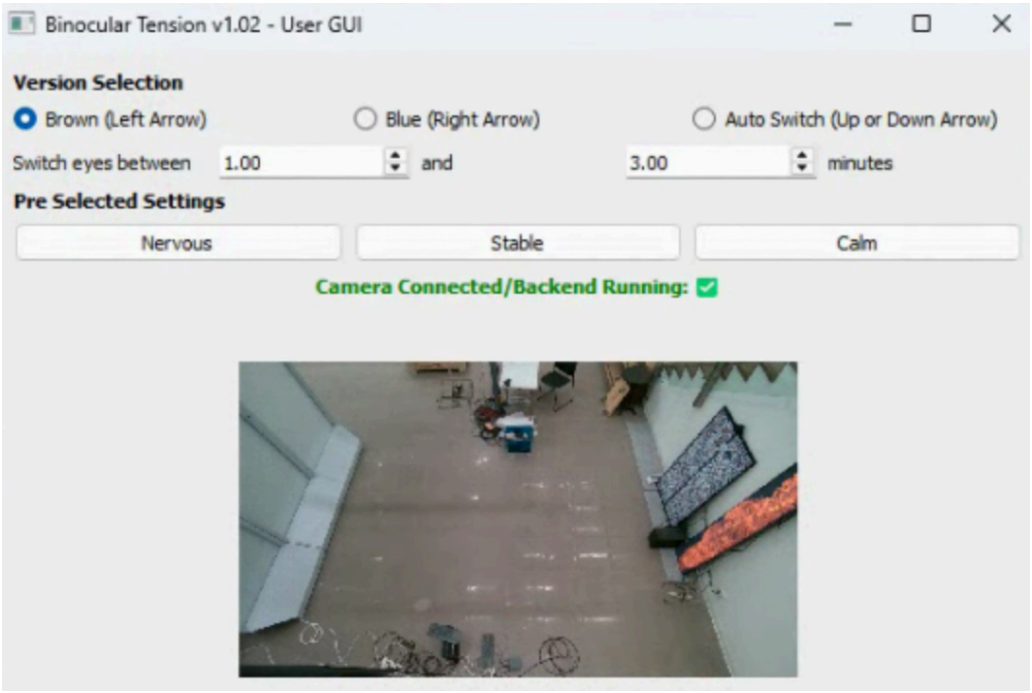
Software as typically rendered

The following keyboard shortcuts are available, while being within the front end (the software that renders the eyes).

- Press the **u** key to toggle the User GUI visibility.
- Press the **Left Arrow (←)** key to show only the set of brown eyes.
- Press the **Right Arrow (→)** key to show only the set of blue eyes.
- Press the **Up or Down Arrow (↑ or ↓)** key to turn on auto switching which will use a random number between the two interval settings available in the User GUI.
- Press the **ESC** key to exit the applications.

User GUI

The user's general settings can be toggled on and off the page by pressing the '**u**' button. This menu allows you to set the type of eyes shown and its switching timing, if such function is activated. Additionally, it allows you to select presets about the artwork's reactivity.



Settings	Description
Titlebar (Binocular Tension)	Lists the software version in use.
Eye Set Selection	Select the **Brown** radio button to only show the female eyes. Select the **Blue** radio button to only show the male eyes. Select **Auto Switch** toggle button to switch between versions automatically every X seconds.
Switch eyes between X_0 and X_1 minutes	When **Auto Switch** is selected, the displayed version will switch at some point between the two given values (X_0 and X_1) set in the input boxes seen displaying the values 0.5 minute and 1.00 minute in the screenshot above. We recommend the following intervals: - for context like a fair, between 0.5 and 1.5; - for a context like a collector's home, between 1.0 and 10.0; - for even slower intervals, between 30.0 and 300.0.

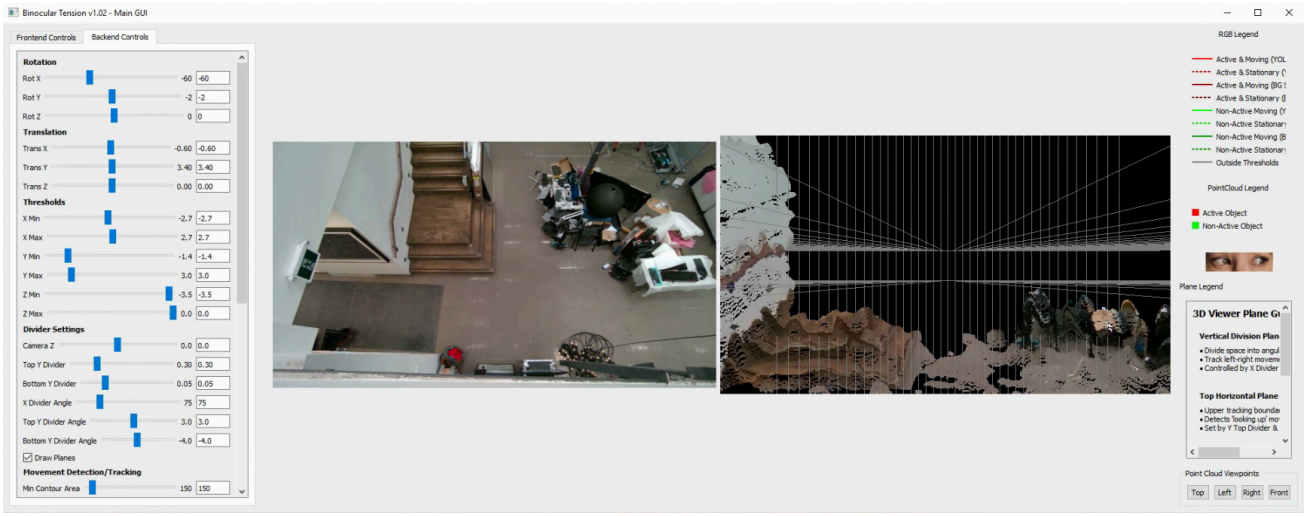
Settings	Description
Pre Selected Settings	Three buttons that will partially change the eyes reactions based on exhibition condition. **Nervous**: compared to the stable preset, the eyes pick targets faster, switch faster between targets, blinks and jitter more. Usually used for fairs and events with a lot of movement around the artwork. **Stable**: regular mode. **Calm**: compared to the stable preset, the eyes pick targets more slowly, with less switching between targets, blinking and jittering less than usual. To be used if the Medium preset is too active for your liking.
Camera Connection / Backend status	If the camera is well connected and detected by the front end software, this would display a check sign (✅), otherwise, it would display a (❎). Useful if ever the artwork seems to not track properly.
Camera Feed	If the camera is well connected and detected its color video feed would be present under the connection status.

Manual Software Calibration

More settings are accessible by calling up the General GUI by pressing a keyboard shortcut, while being within the front end (the software that renders the eyes): press the **g** key to open the General GUI.

The Main GUI then displayed gives more controls over the artwork's reactions and the tracking system. It should be used by the installer to set up the camera and adjust reactions, if need be: the presets in the User GUI are safer to use and would be a good way to revert to default values.

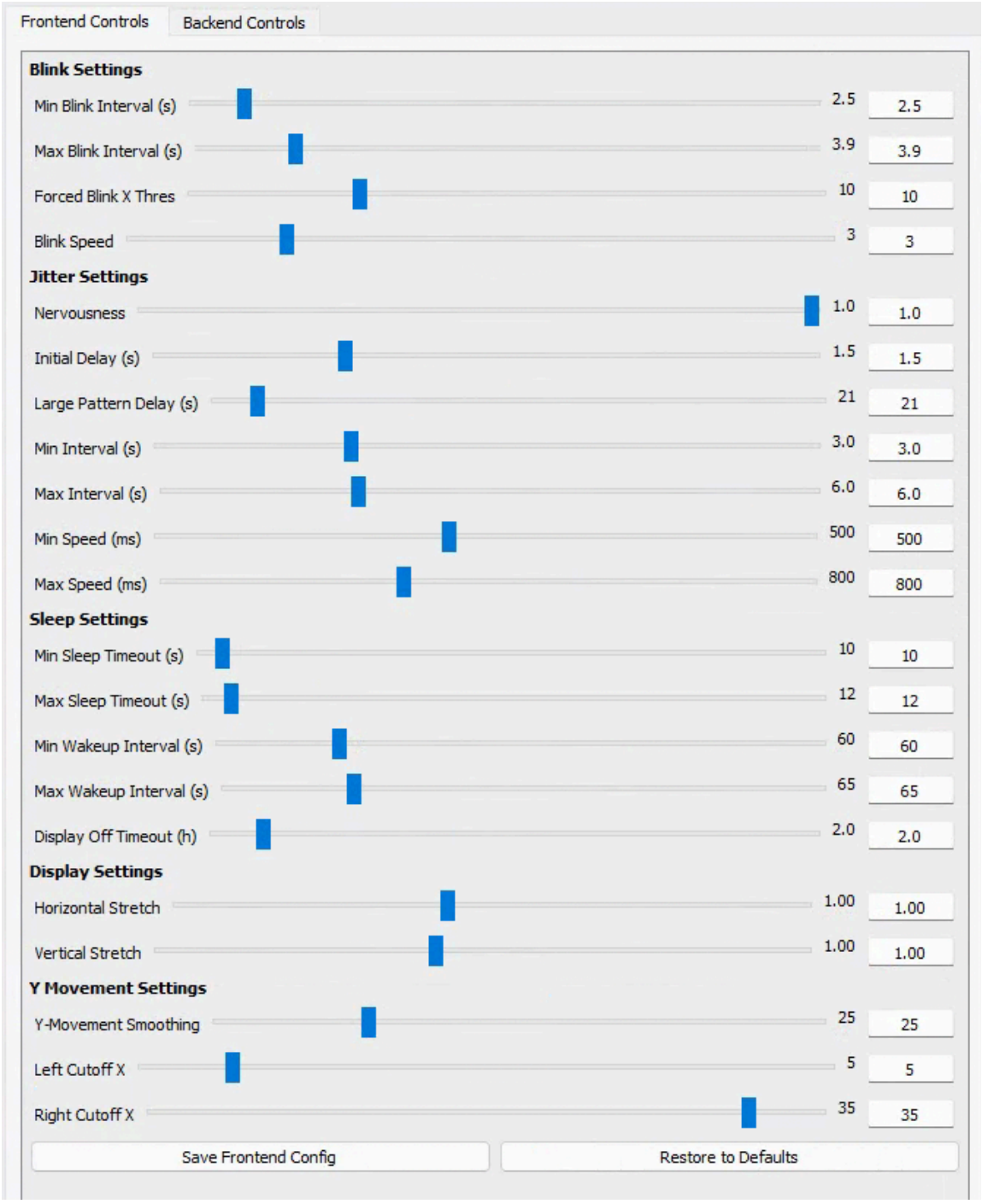
There are two different main tabs of the GUI exposed to users, the "frontend" tab and the "backend" tab. Additionally, the RGB camera feed (left) and the point cloud feed (right) are displayed in the GUI, to visualize how the tracking happens. At the bottom right of the menu, you also have buttons controlling the point cloud feed view.



Screenshot of the GUI

Main GUI - Frontend Application Tab

This tab allows you to set variables about the behavior of the eyes. It has several sections of controllable variables that are explained in detail in this section. Any change done in this interface must be saved by clicking on the Save Frontend Config button (lower in the window) to be used in the next software instances.



Blink Settings

Like for any human, the eyes will blink occasionally, controlled by the following settings.

Settings	Description
Min Blink Interval (s)	Sets the **minimum** amount of seconds that the eyes would wait to blink if no significant movement is detected.
Max Blink Interval (s)	Sets the **maximum** amount of seconds that the eyes would wait to blink if no significant movement is detected.
Forced Blink X Thresh	Checks if, between the previous and the current frame, the active target skips more than an amount of horizontal dividers (this setting), the eye set will be forced to blink rather
Blink Speed	How long each image in a blink sequence is displayed. Goes between 600ms and 60ms, controlled in steps from 0.0 to 10.0. **The default value is 5.0**.

Jitter Settings

A “jitter” is a small movement of the eye from right to left, randomly happening considering the next parameters, each at different intervals, at a different speed. Initially, the eye will do smaller jitter movements and past a certain point, the movements will get wider.

Settings	Description
Nervousness	Controls how often the jitters occur: a jitter is a small movement of the eye from right to left. The higher the value, the more often they happen.
Initial Delay (s)	To instantiate a jitter effect, the angle of the displayed eyes need to be the same for at least a period of time, this value is the Initial Delay.
Large Pattern Delay (s)	Once in jittering mode, this variable sets the amount of time to wait prior to triggering larger jitter patterns. Large jitters are more dramatic movements from right to left than the regular jitters.
Min Interval (s)	Sets the **minimum** amount of time between triggering a new jitter sequence.

Settings	Description
Max Interval (s)	Sets the **maximum** amount of time between triggering a new jitter sequence.
Min Speed (ms)	Sets the **minimum** amount of time a whole jitter sequence could take.
Max Speed (ms)	Sets the **maximum** amount of time a whole jitter sequence could take.

Sleep Settings

If there is no movement in front of the artwork for a while, the eyes will go to sleep: the eyelids will close themselves and, once in a while, reopen briefly.

Settings	Description
Min Sleep Timeout (s)	Sets the **minimum** amount of time it would take before the eyes would enter sleep mode, if no significant movement is detected.
Max Sleep Timeout (s)	Sets the **maximum** amount of time it would take before the eyes would enter sleep mode, if no significant movement is detected.
Min Random Wakeup (s)	Sets the **minimum** amount of time that eyes will remain in sleep mode before they reopen.
Max Random Wakeup (s)	Sets the **maximum** amount of time that eyes will remain in sleep mode before they reopen.
Display Off Timeout (h)	This parameter sets the amount of time before the software will display a screensaver (a plain black screen). If no target is detected within the last x hours as set by this variable the software will enter screensaver mode.

Display Settings

Settings	Description
Horizontal Stretch	Horizontal stretch of the eyeball image. Unless the display used has a different resolution than the typical unit, this value **should be set to 1**.
Vertical Stretch	Vertical stretch of the eyeball image. Unless the display used has a different resolution than the typical unit, this value **should be set to 1**.

Y Movement Settings

Settings	Description
Y Movement Smoothing	This setting ensures the target is calling for a new vertical angle of the eye for a certain amount of frames before reflecting it onto the display, to prevent abrupt movements.
Left Cutoff X	Used to limit the “looking down” effect on the wider angle of the camera FOV. This setting limits the first still frames (on the left) to only show the eye looking at the horizon level.
Right Cutoff X	Used to limit the “looking down” effect on the wider angle of the camera FOV. This setting limits the last still frames (on the right) to only show the eye looking at the horizon level.

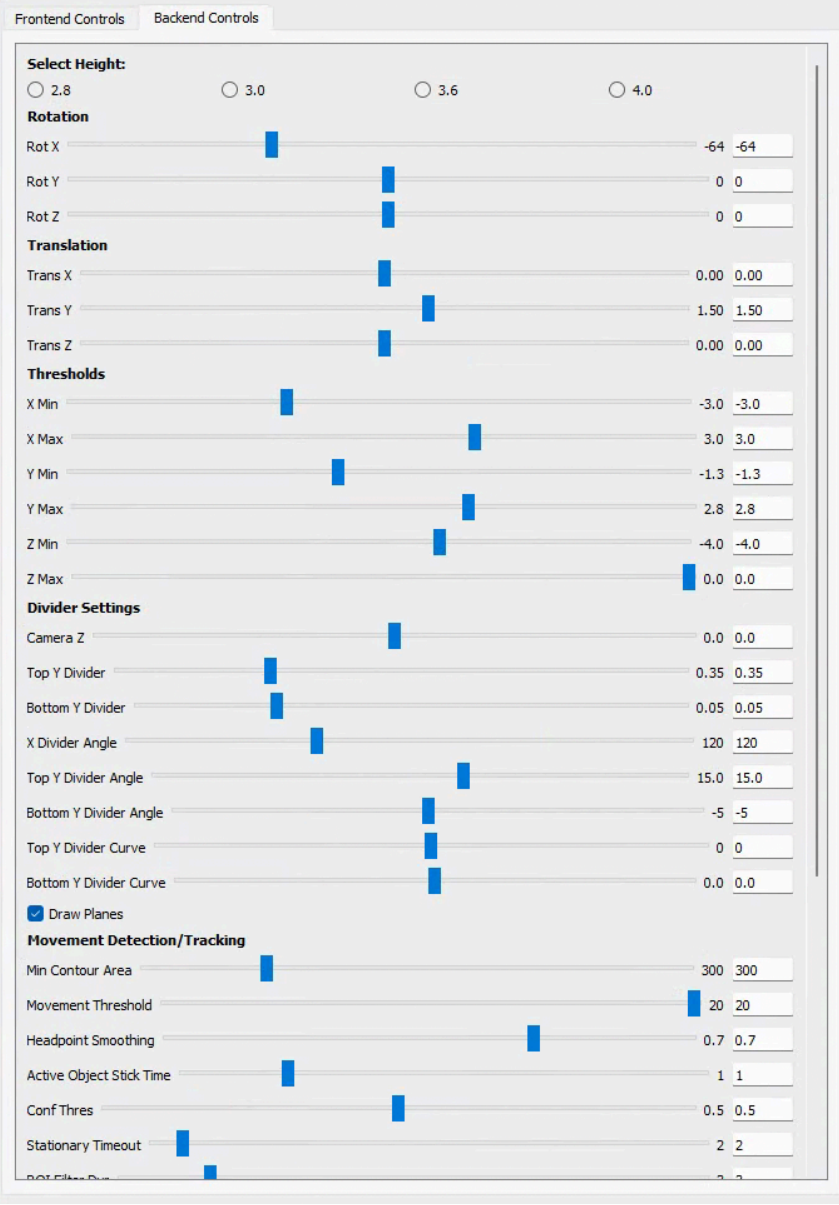
System Buttons

These are actionable to save or reset all the settings.

Settings	Description
Save Frontend Config	Saves all current values. Cannot be undone.
Restore to Defaults	Apply all default settings from a file named default_display_config.json in the project’s source code folder under a subfolder named 'fe'.

Main GUI - Backend Application Tab

Any change done in this interface must be saved by clicking on the Save Config button to be effective in the next software instances.



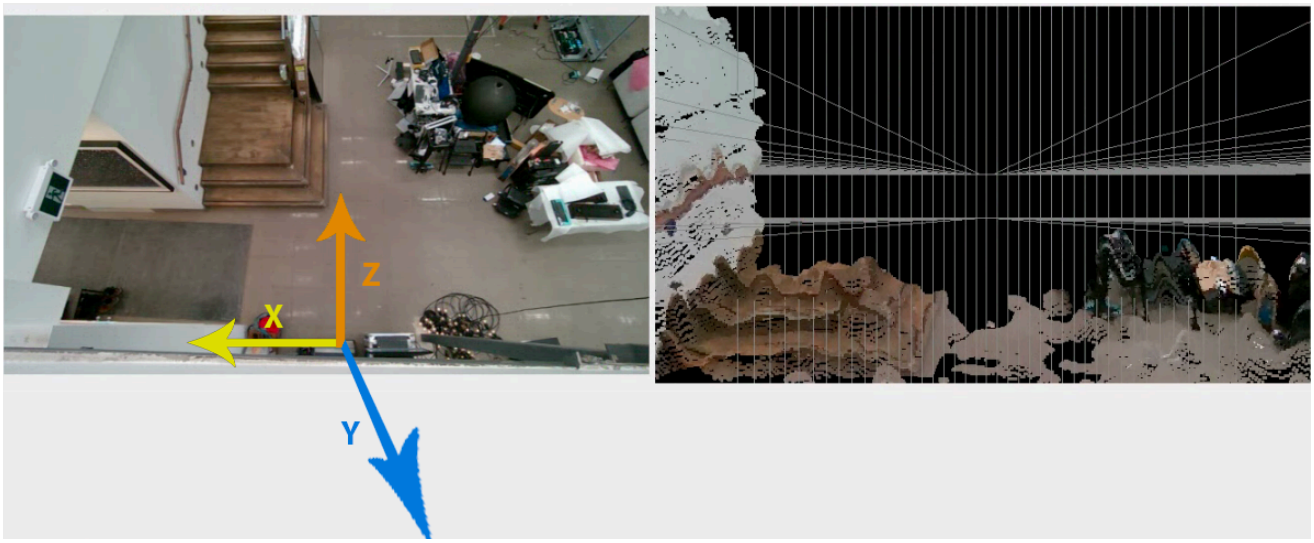
The system maps the sensor's data (point cloud) into a virtual 3D world. That 3D space's main reference point is a vertical line visible within the point cloud feed (you might need to zoom out in the feed view to reveal the line). That vertical line matches with the display's center point and, ultimately, the sensor's center point.

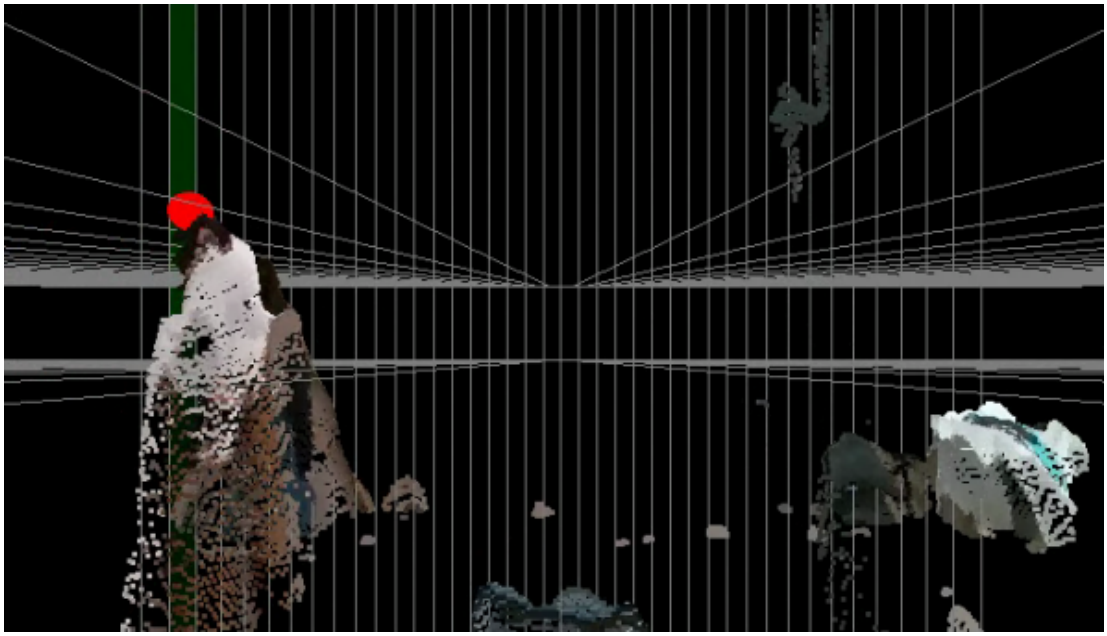
Around that line, we build a 3D world to roughly recreate the real space the display and sensor are installed in. We will have to correct the rotation of the sensor, translate its position and add thresholds (virtual walls / limits). Note the different axes in use here:

- X, referring to the horizontal axis along the wall where the screen is installed;
- Y, referring to the vertical axis along the wall where the screen is installed;
- Z, referring to the depth axis along the floor in front of the screen.

Once this mapping of the point cloud data is done in the 3D replicated space, we will tweak the dividers to adjust when the eyes will look at different angles (horizontally and vertically).

The following settings allow adjustments within the tracking software and its behaviours.





Select Height

These radio buttons allow you to enforce default values on specific settings, based on the distance between the camera and the floor. This would impact the rotation, the translation, the thresholds, some of the divider settings and some of the detection settings. The height value is in meters. Clicking a specific height value will not permanently save the settings. It will just apply some of these defaults, and allow you to fine tune them.

Settings	Description
2.8	Sets the 3D world and reactions like if the sensor is installed 2.8 metres away from the floor.
3.0	Sets the 3D world and reactions like if the sensor is installed 3.0 metres away from the floor.
3.6	Sets the 3D world and reactions like if the sensor is installed 3.6 metres away from the floor.
4.0	Sets the 3D world and reactions like if the sensor is installed 4.0 metres away from the floor.

Rotation

Rotates the point cloud in X, Y, and Z direction. Use this to account for the rotation of the Realsense camera, so that the point cloud looks as though it were captured straight on (i.e., in line with the display).

Settings	Description
Rot X	Corrects the vertical rotation of the sensor, which refers to the sensor's angle in comparison to the ground. **Would generally be a negative value.**
Rot Y	Correction of the Y-Axis rotation of the sensor. **Default is 0**, but could be slightly adjusted, especially if the wall is slightly crooked.
Rot Z	Corrects the horizontal rotation of the sensor, which refers to the sensor's angle in comparison to the horizon line (level). **Typically it wouldn't be more than 2-3 degrees correction.**

Translation

These variables allow the user to adjust the position of the point cloud data in relation to the center of the display - which also matches the horizontal center of the depth sensor. These values roughly match the physical distance, in meters, between the sensor and the center of the display.

Settings	Description
Trans X	Moves the point cloud horizontally. Negative if the sensor is to the left side from the display center line, positive if on the right. **Typically, this should be set to 0.**
Trans Y	Moves the point cloud vertically, increasing the value would move up the point cloud. **This value would be close to the physical height difference between the display's center point and the sensor's position.**
Trans Z	Moves the point cloud, in depth, further or closer to the display center point.

Thresholds

Use these settings to ignore objects past a certain threshold in X, Y, or Z space, a limit past which we stop tracking, imaginary walls if you prefer. It will be directly reflected in the point cloud, as only the points within the threshold would be drawn, the others being filtered out. In the RGB Camera Feed, objects outside of bounds are drawn with grey bounding boxes.

These values roughly match the physical distance, in meters, between the center of the display and the boundary being set.

Settings	Description
X Min	Sets the boundary on the left side of the display. The value would be negative.
X Max	Sets the boundary on the right side of the display. This value would be, most of the time, the same as the X min, but positive.
Y Min	Sets the boundary under the display, a floor if you like. The value would be negative and roughly match the distance between the display center and the floor minus a slight margin, **the value would usually be negative 1.3.**

Settings	Description
Y Max	Sets the boundary above the display, a ceiling if you like. The value would be positive and would depend on the camera height and your location.
Z Min	Sets the boundary further away from the display, a back wall if you like. The value would be negative and roughly match the distance between the display center and where you want to stop tracking.
Z Max	Sets the boundary closer to the display, a front wall if you like. **The value would typically be 0.**

Divider Settings

The eye would mostly look along the horizon line. If you are a person about 160cm (63 inches) tall or smaller, in a half-meter range (20 inches) from the display, if you crouch low enough or if you get a pet in the interactive area, the eyes should look under the horizon line. If you are a person taller than 185cm (73 inches) in a half-meter range (20 inches) from the display or if you climb up high enough on a chair or ladder, the eyes should look above the horizon line.

The dividers are crucial in order to determine if a target - represented by a red sphere - is above, under or parallel to the horizon line, therefore if the eyes should look up, down or towards the center. They also define the viewing angle of the eyes, depending on your location in relation to the display.

Settings	Description
Camera Z	Moves the virtual camera in Z direction. **Should always be 0.**
Top Y Divider	When the red sphere is above this divider, the eye will look “up. Increasing this value moves the divider up in the 3D world. **The value should be roughly around 0.35**: the height difference between the display center and the height of a tall person who should trigger the eyes looking up, when standing in front of the display.
Bottom Y Divider	When the red sphere is below this divider, the eye will look “down”. Increasing this value moves the divider down in the 3D world. **The value should be around 0.05.**
X Divider Angle	There are 41 vertical cake “slices”. Increasing the angle means increasing the total space taken up by these slices. All angles radiate from the center where the virtual camera or display is in the 3D world. **The higher the sensor will be installed, the lower this value would be.**
Top Y Divider Angle	How the top divider is angled on the Y axis, in the Z direction. **This value would typically be positive** as the divider should go higher in the space the further away from the display it gets.
Bottom Y Divider Angle	How the bottom divider is angled on the Y axis, in the Z direction. **This value would typically be negative** as the divider should go lower in the space the further away from the display it gets.
Top Y Divider Curve	This applies a correction curve to the divider as the targets appearing on the sides of the camera field of view tend to be considered further away from the camera than they are. **This value would typically be negative, at -0.9 to ensure we detect the correct height.**

Settings	Description
Bottom Y Divider Curve	This applies a correction curve to the divider as the targets appearing on the sides of the camera field of view tend to be considered further away from the camera than they are. **This value would typically be set to 0**.
Draw Planes	Draws the horizontal and vertical dividers. Toggle off to show just the point cloud and object spheres.

Movement Detection/Tracking

The following parameters control how the tracking happens, what to consider as a target.

Settings	Description
Min Contour Area	In background subtraction, the smallest allowable size of a detected contour to be considered valid for further processing. **The higher the sensor will be installed, the lower this value would need to be**, as you will need to track smaller targets**.**
Movement Threshold	The minimum distance the center of an object's bounding box must move between frames to be classified as significant movement. **The higher the sensor will be installed, the lower this value would need to be**, as you will need to track smaller movements**.**
Headpoint Smoothing	Headpoint refers to the red and green spheres in point cloud space. Increasing this value reduces noise and abrupt movement by smoothing out the movement.
Active Object Stick Time	Minimum number of seconds to stay with the current active object before switching to a new, closer, object.
Conf Thres	This is the confidence threshold used by the YOLO object detection engine. It will only use targets that YOLO gives confidence higher than this threshold.
Stationary Timeout	For background subtraction, how long after an object stops moving to keep detecting it.
ROI Filter Dur	When an active object disappears, how long (in seconds) the system waits (keeps looking in the lost target area), before it starts to look for new targets.

Point Cloud Settings

Settings	Description
Point Size	The pixel size for each point shown in the point cloud render. **This value should be around 5.**

Grid Settings

Settings	Description
Num Divisions	This refers to the number of angles (divisions) we have to generate the different eye angles. **This slider is disabled** as changing it would affect the artwork's behaviours and is more for development purposes.

Detection Type

The system can rely on 2 different detection systems: YOLO engine and previous frame background subtraction.

The YOLO engine requires a bit more context in the data returned from the point cloud to establish if a 3D blob is a decent target, or not. This implies it will work better when the sensor is not too high in the space, to get more data from a potential target.

While YOLO ensures a more precise tracking, it struggles finding good targets the higher the sensor gets, that's where the previous frame background subtraction feature gets useful.

Generally speaking, we would benefit from using both tracking types at the same time.

Settings	Description
Detect Yolo Objects	Returns the targets detected by the YOLO engine.
Detect Other Objects	Returns the targets detected by doing a previous frame background subtraction.

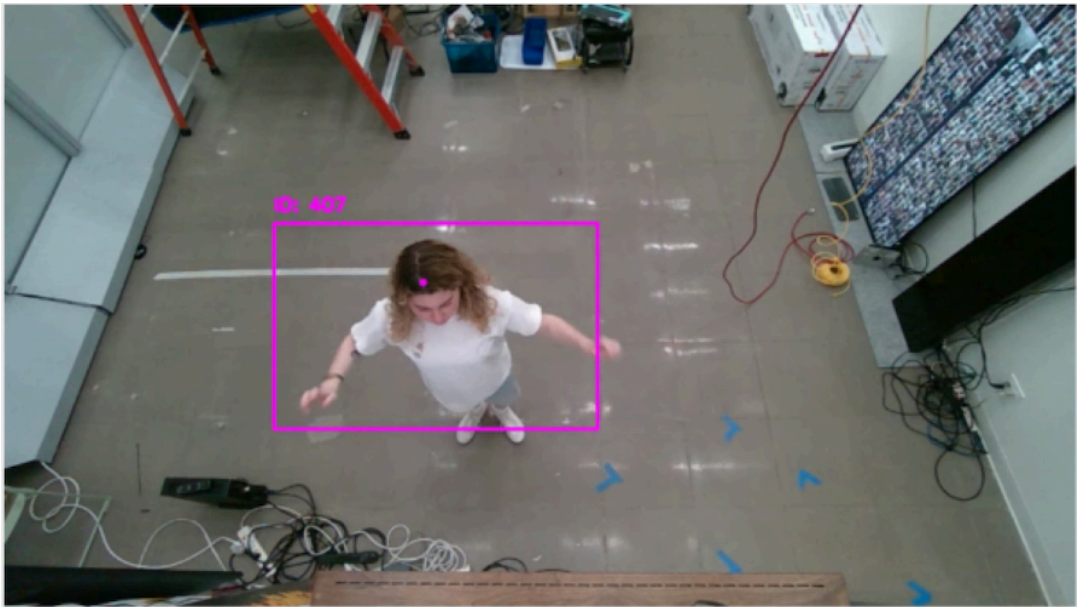
System Buttons

These are actionable to save or reset all the settings.

Settings	Description
Edit Cubes	**Deprecated feature -** Open a small GUI where you can add, remove, and edit existing cubes. Cubes show up in the 3D Point Cloud space, and can be used to block out movement in specific areas.
Save Cubes	**Deprecated feature -** To save all current cubes so that next time the app opens up, they have these cubes. Cannot be undone.
Restore to Defaults	Apply all default settings from a file named default_config.json in the project's source code folder under a subfolder named 'be'. These settings do not include any settings that are controlled by the height radio buttons.
Save Config	To save all current GUI values so that next time the app opens up, they have these values. Cannot be undone.

Main GUI - Sensor's RGB Feed

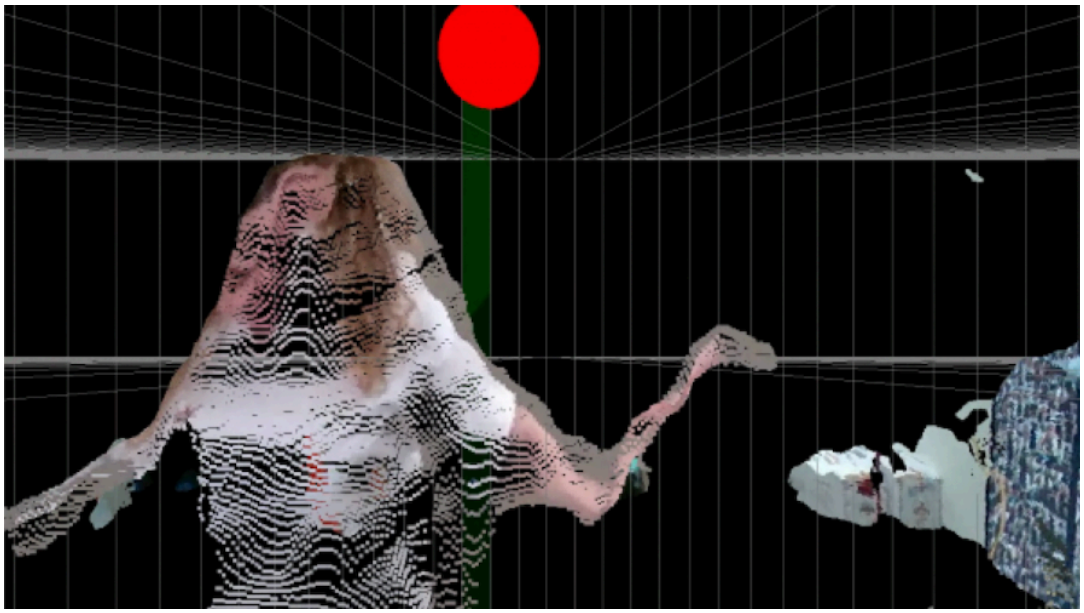
Within the two sensor feeds visible in the menu, the sensor's RGB feed is displayed on the left hand side and displays some information overlaid on top of the feed: target Ids, and a bounding box around the different targets. Line type and colors give more context about the type of target contained in the box.



Settings	Description
Solid Line	The target is actively moving.
Dotted Line	The target is not moving enough.
Pink	The target is detected via YOLO and is the active target the eyes are following.
Deep Purple	The target is detected via background subtraction and is the active target the eyes are following.
Light Green	The target is detected via YOLO but the target is inactive, the eyes aren't following it.
Dark Green	The target is detected via background subtraction but the target is inactive, the eyes aren't following it.
Grey	The target is detected by any detection system, but is outside of the defined detection range.

Main GUI - Sensor's Point Cloud Feed

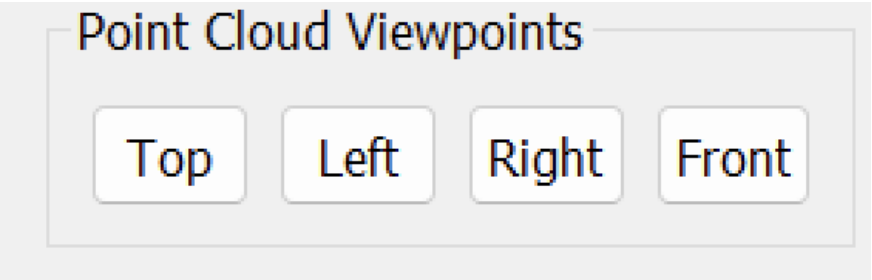
Within the two sensor feeds visible in the menu, the sensor's point cloud feed is displayed on the right hand side. The highest point of the "active" object from the RGB feed is shown at its corresponding position in 3D space, as a red sphere. Where this red sphere is located, in relation to the vertical and horizontal slices, determines where the eye looks. A vertical slice is highlighted green when the red sphere falls within it.



The key for understanding what planes indicate can be seen on the bottom right hand side of the screenshot above. The contents of the key are also recorded and explained in the table below.

Element	Description
Vertical Division Planes	Divides the space into angular sections and tracks left-right movement. Has a toggle box allowing users to show or hide this plane.
Top Horizontal Plane	Sets the upper boundaries of tracking. Detects "looking up" movements. Has a toggle box allowing users to show or hide this plane.
Bottom Horizontal Plane	Sets the lower boundaries of tracking. Detects "looking down" movements. Has a toggle box allowing users to show or hide this plane.

Underneath this key there are additional buttons as seen in the screenshot below that changes the viewing angle of the point cloud.



Screenshot of pointcloud viewing angle adjustment buttons.

Remote Access to Artwork's Computer

There is a software installed on the computer running this artwork that allows the studio to connect remotely to the artwork. This feature is helpful when you require assistance from the studio, as we can remotely connect to it, do a quick inspection, and do a debugging session of your components, if needed. In order to enable this feature, the computer has to be connected to the internet at all times. Depending on the computer's operating system (Windows 7/8/10/11, OSX), the procedure to set the computer online will vary. Please look online for tutorials, if necessary.

Preliminary Troubleshooting Steps

After plugging the cables in and turning ON the artwork, if nothing seems to happen.

Ensure your PC and display are up and running. Check that your display's selected input is set to the display's video port where your video cable connects into.

If the artwork does not show up, or displays in an unusual way.

You can connect a keyboard and mouse to the PC. hit the **ESC** key to stop the artwork. You can navigate to the windows 'start' icon, on the power button icon, select 'restart' and let your computer turn off then on again. It should come on and start the artwork again. If it does not come back on, inspect all cable connections and secure them. You may alternatively simply turn **OFF** and turn **ON** the artwork by pressing the computer's power button for maximum 2 seconds for both actions. If it still does not come back on, you may need technical support from our team.

The display is dark/nothing is being displayed.

Make sure the display is properly connected to power and that the video cable is securely connected to the computer and the display. If you see a "no signal" notification that then goes black there is a problem with the cable connecting the display to the computer.

The menus are not showing up on display.

For some reason, you might need to give focus to the front end software by clicking somewhere in the display, on the eyes on display. Then try again to call the menu you tried to access. If this doesn't work, confirm the keyboard works properly and it is using good batteries.

The eyes are not moving at all.

If, after pressing the '**u**' button, the User GUI confirms the camera or the backend are not connected or running, double check the camera is properly connected to the computer: the RealSense camera must be plugged into the USB-3 port not a USB-2 port, wait 30 seconds to see if the User GUI shows the sensor as connected. If the camera still doesn't show up, try shutting down and booting up the computer. If it still does not come back on, you may need technical support from our team.

The eyes appear blurry/too small/ too large for the display.

Check that the computer's resolution is properly set to 3840x1080. If the front end Horizontal Stretch or Vertical Stretch got modified, they should be modified back to a value of 1.

The eyes aren't following me or won't wake up

Try turning the artwork off and on. If when the artwork initially turns on you see a "no signal" sign before it goes to black the video signal is not properly making its way to the display. Remove the screen from the wall following the Placement Instructions and Photos and ensure that the video cable connection is well connected.

The frontend application isn't starting

Check if the files with the images have been moved. They should be located in the project folder, normally named "binocular-tension" under the path > fe > eyeballImages. Within that folder there should be two folders named "Brown" and "Blue" that contain the JPEG images, there should be 451 images in the Brown folder and 410 images in the Blue folder.

Troubleshooting Assistance

Prior to contacting the Antimodular Studio with a problem about your artwork, please ensure that you went through the preliminary troubleshooting steps outlined in the previous section.

The troubleshooting process will vary depending on the problem. In order to make the process easier, it is recommended that you collect and send the following information to the studio:

- Date and time when the problem first happened;
- Description of the problem;
- Actions taken so far and conclusions;
- Detailed photographs (or videos) displaying the problem;
- Detailed photographs (or videos) of the suspected faulty component;
- Detailed photographs (or videos) of the whole artwork and its surroundings;
- Personnel involved.

Support (Contact Us)

If you would like support for the piece, please feel free to call Lozano-Hemmer's studio in Canada:

Antimodular Research
4462 rue Saint-Denis
Montréal, Québec, Canada
H2J 2L1
Tel 1-514-597-0917
info@antimodular.com
www.antimodular.com

APPENDIX I - INSTALLATION

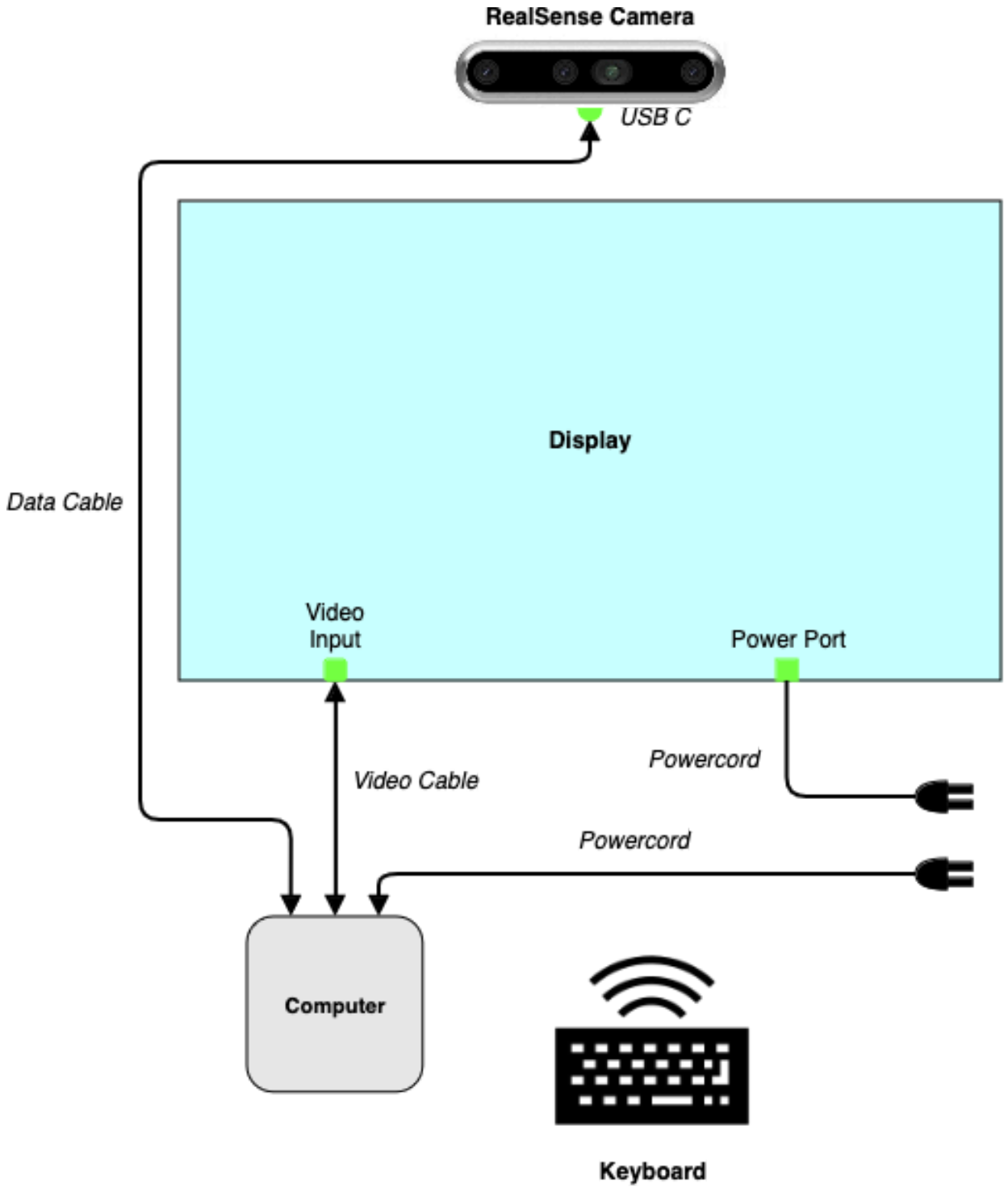
Description of Components

This artwork requires the following components:

Component	Description
Computer	Computer running at least Windows 11.
Wooden Frame	Surrounds the display and contains a tension bar and cleat allowing the piece to be easily hung.
Display	A distinctive 32:9 rectangular display.
Video Cable	Connects the computer to the display and transmits video signals.
Data Cable	Ensures the link between the computer and the Depth Sensor. Typically a USB-C 90 degrees sideways to USB-A, matching USB 3.2 Gen 1 standards.
Depth Sensor	A depth camera to track visitors in front of the piece. In this version, an Intel Realsense D455 is used.
Keyboard	While not required for normal use of the artwork, it allows you to calibrate the system.

Wiring Diagrams and Connections

In order for the piece to run properly, the computer should be connected according to the following diagram.



APPENDIX II - TECHNICAL DATA SHEETS

Wooden Frame

This custom built wood frame has internal foam shock absorbers all around and internal vertical tensioning system. Vent holes have been drilled into the top and bottom sides of the frame to help with the display's natural ventilation.

Most versions are built with walnut wood, but other wood types might have been used.

Specification	Details
Color and Finish	Stained to a light walnut color with Osmo oil stain, which gives the wood a matte finish.
Dimensions (LxHxD)	115.5 x 38.5 x 11 cm

Display

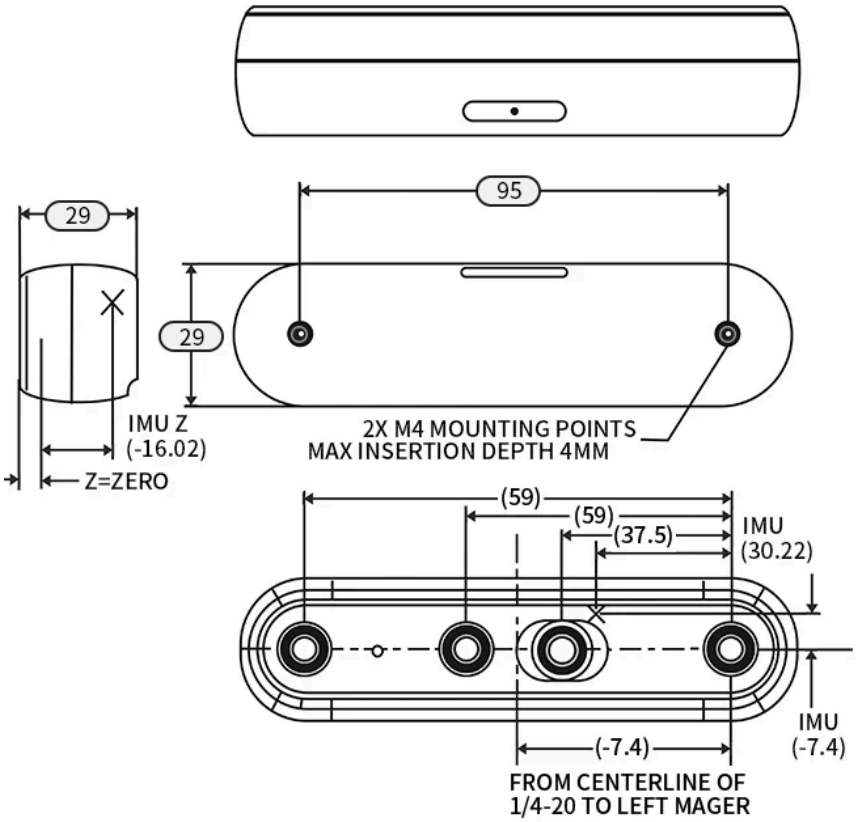
The LC Power 32:9 resolution display used in this artwork has been selected for its form factor and image quality. Future versions might rely on different display models: here are the minimal specs to match or improve for an easier migration process.

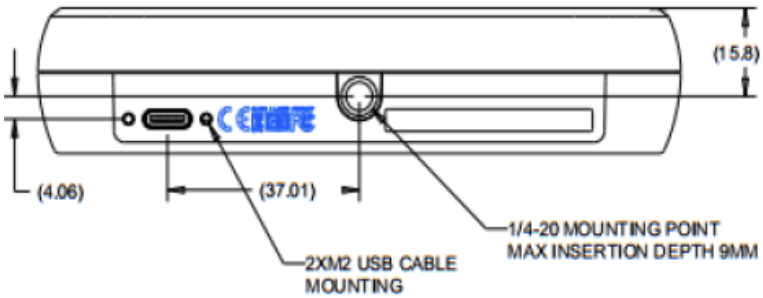
Specification	Details
Manufacturer	LC Power
Model Number	LC-M44-DFHD-120
Resolution	3840 x 1080 pixels
Refresh Rate	120 HZ
Contrast Ratio	1000:1
Viewing Angle (H / V)	178° / 178°
Screen Surface	Non-glare surface
Dimensions (LxWxD)	109 x 33 x 84 cm
Video Connections	HDMI, DisplayPort
Power	AC 100-240V 50/60Hz 2.2A

Depth Sensor

The Intel RealSense D455 sensor, a stereoscopic depth camera, detects the elements in space in front of the display and can return the distance of such elements from the sensor. The artwork software requires this exact device to be used. Future versions might rely on different sensors: here are the minimal specs to match or improve for an easier migration process. A technical drawing can be found on the next page.

Specification	Details
Resolution	Up to 1280 x 720, up to 90 fps
Tracking range	60 cm to 600 cm
Depth Field of View	87 degrees (horizontal) X 58 degrees (vertical)
USB Standard	USB-C Connector (USB 3.2 Gen 1 standard)
Mounting Point	¼-20 UNC thread
Dimensions (W x H x D)	124 x 29 x 26 mm


95
29
29
IMU Z
(-16.02)
Z=ZERO
2X M4 MOUNTING POINTS
MAX INSERTION DEPTH 4MM
(59)
(59)
(37.5)
IMU
(30.22)
IMU
(-7.4)
(-7.4)
FROM CENTERLINE OF
1/4-20 TO LEFT MAGER
124


(15.8)
(4.06)
(37.01)
2XM2 USB CABLE
MOUNTING
1/4-20 MOUNTING POINT
MAX INSERTION DEPTH 9MM