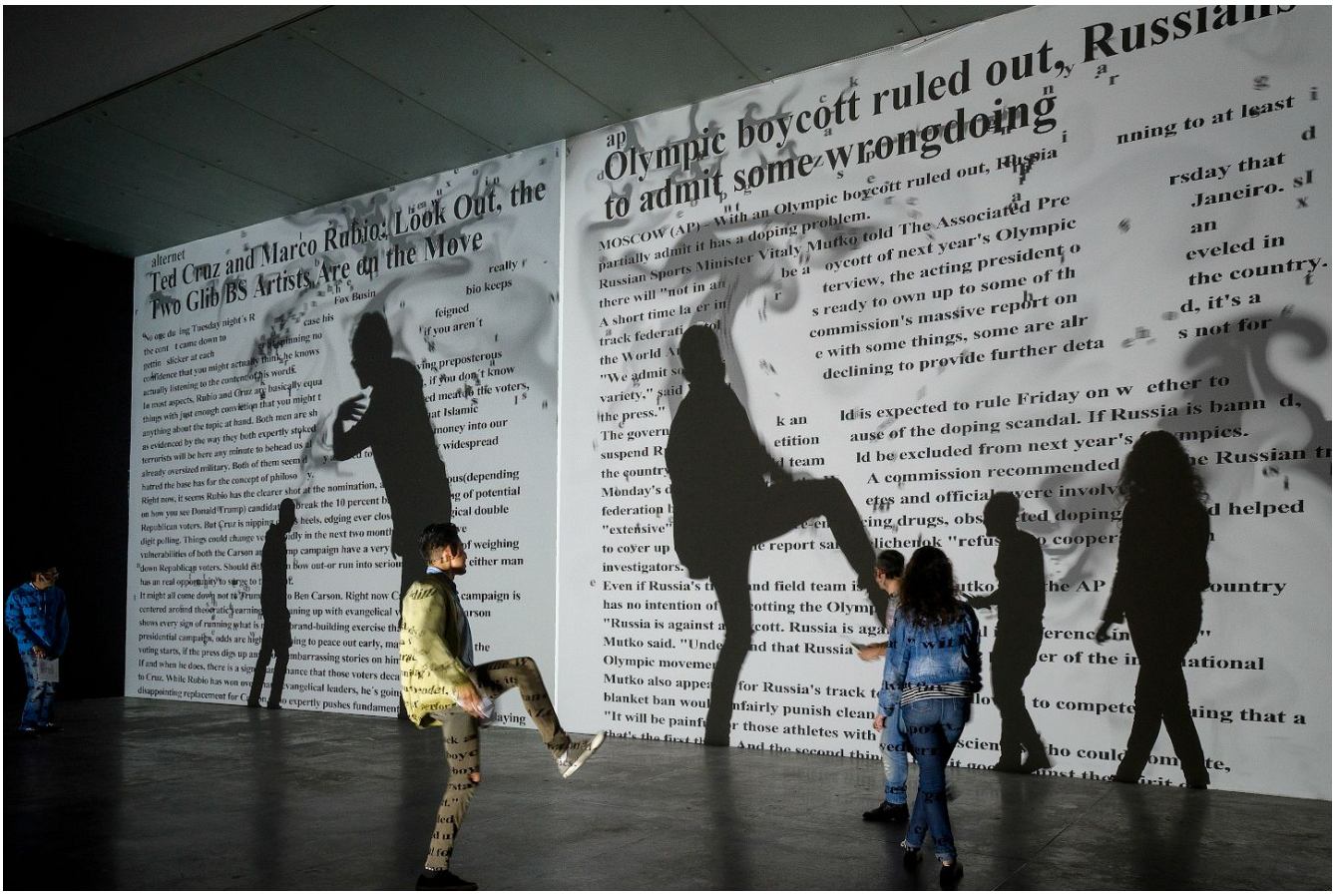
AIRBORNE PROJECTION

BY RAFAEL LOZANO-HEMMER



Version : 2018-11-22

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GENERAL IMPORTANT INFORMATION

This short section must be read for proper operation.

AIRBORNE PROJECTION (2013)

BY RAFAEL LOZANO-HEMMER

Technique

Projectors, computers, surveillance cameras, custom-made software running Navier-Stokes equations.

Description

Airborne Projection is an interactive shadow play where participants block the light of a projector casting their shadows on a wall, and these are tracked by computerized surveillance systems. Out of the shadows, emanated billowing smoke which is mapped onto the wall and accumulated in it. Readable within the smoke are clouds of text, themselves turbulent, from salient poetic texts on light and shadow.

Operation

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

1. Connect the computer, the camera, and the projector to electrical power. Use the supplied power cables.

2. Depending on the venue's ressources and installation setup, an automated Power ON/Power Down sequence has probably been set. If this is the case, check with the museum team and/or Antimodular team prior to changing anything, as a specific solution has been implemented.

3. To turn the piece ON, first power the projection using the remote. Wait about 10 seconds then hold the computer's power button down for one second, then release it. *Important note: please do not push the button again as this will shut down the piece.* Wait at least two minutes before pressing it again, as the computer might need this long to reboot. After two minutes (or less), you should see the piece.

4. To turn the piece OFF, press the power button on the computer. After ensuring Windows is shutting down, you can then turn off the projector using the remote.

5. If the piece does not start within two minutes, try turning the piece on again. If it still does not turn on, then hold the power button all the way down for 10 seconds. Then, wait at least three seconds, and press the power button all the way down for one second, and you should be up and running again.

Maintenance

The camera is usually installed near the ceiling, out of reach. Since this device is calibrated within the software, please do not, under any circumstance, touch it. There should not be a situation in which cleaning the lens would be needed.

The projector is usually installed as close to the floor as possible. Since this device is also calibrated within the software, please do not, under any circumstance, touch it. However, this device and its surrounding areas are also prone to accumulate a lot of dust, therefore an air blower pump could be used to clean the lens. Cleaning the area around the projector should be done very carefully to avoid any contact with the projector.

We recommend cleaning the piece at least every two months.

Placement Instructions

The placement of the artwork depends on the venue space. Discussions should be held between the studio and collector or institution prior to installation. Consult the Installation Layout Section to understand how the setup should be done.

DETAILED TECHNICAL INFORMATION

Software

The software main menu is accessible by right-clicking anywhere in the projection area. This menu looks like the following:

The following important sections will be explained in detail in the following pages: the setup buttons **Tracking**, **Calibrate**, **Projector, Smoke**, **Particles**, **Clips**, and **Piece**. The button **Obstacles** located under **View** will also be described in detail.

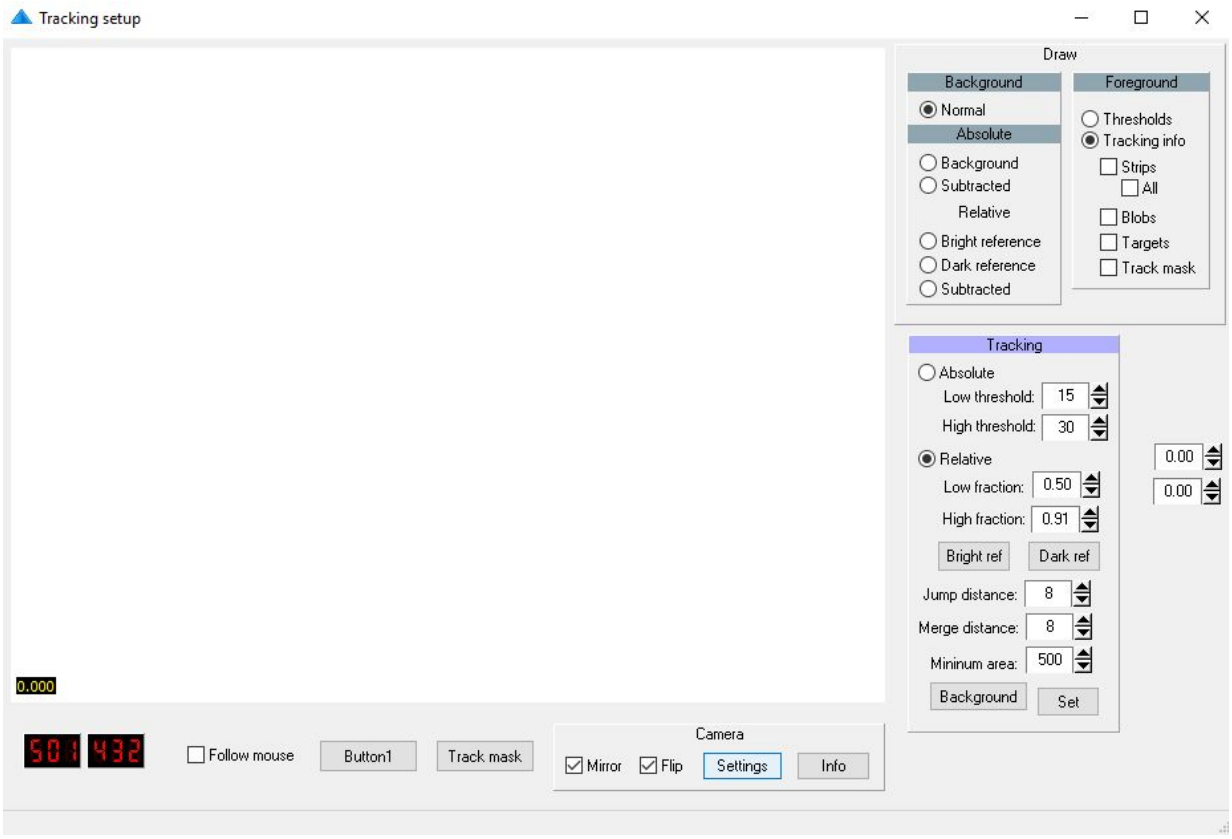
Please ensure that in the **Test** section, **Draw obstacles** and **Draw sources** aren't checked, and that **Text** is checked and, finally, that **Density** is checked.

Under **control**, you will retrieve the **Next clip** button which will change the displayed article to a new one.

Under **control,** you retrieve the buttons **Camera, All clips,** and **Loaded clips,** which are mainly used for debugging purposes (they will not be explained in this manual.)

Setup - Tracking

In this section, we can fine tune the tracking settings by adjusting the tracking mask, the camera settings, and the tracking parameters.

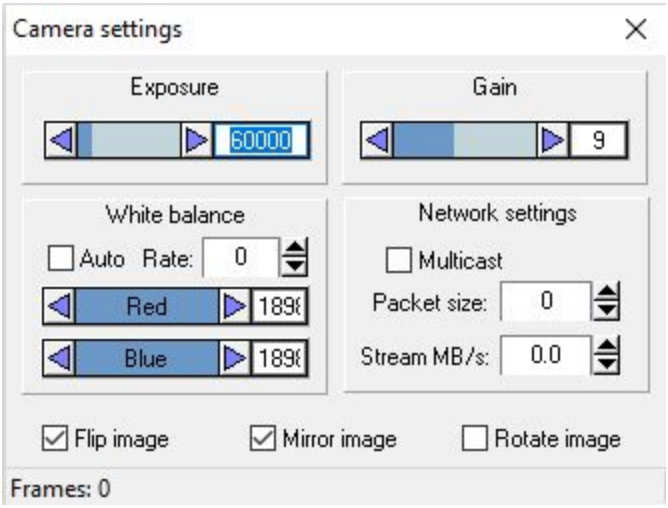


**Note: the white rectangle shown in the above image should display the high-contrast camera view of your projection wall.*

First, within the **Tracking** pane, the tracking type should be set to **Relative,** which works with two settings: **Low fraction** and **High fraction**. These two settings will be used in the shadow tracking to determine what is considered too dark or too bright to be a shadow casted onto the wall.

Next, turn to the two buttons right under **Bright ref** and **Dark ref.** These buttons allow for reference photos of the projection wall to be taken, when the wall is both fully lit and not lit at all. These references are used to compare the live feed, in order to figure out if there is or is not a shadow on the wall. When taking these reference images, ensure that no obstacles are in the way of the projector and the projection wall. If your installation consists of several projectors, ensure that all zones are running while taking these reference pictures.

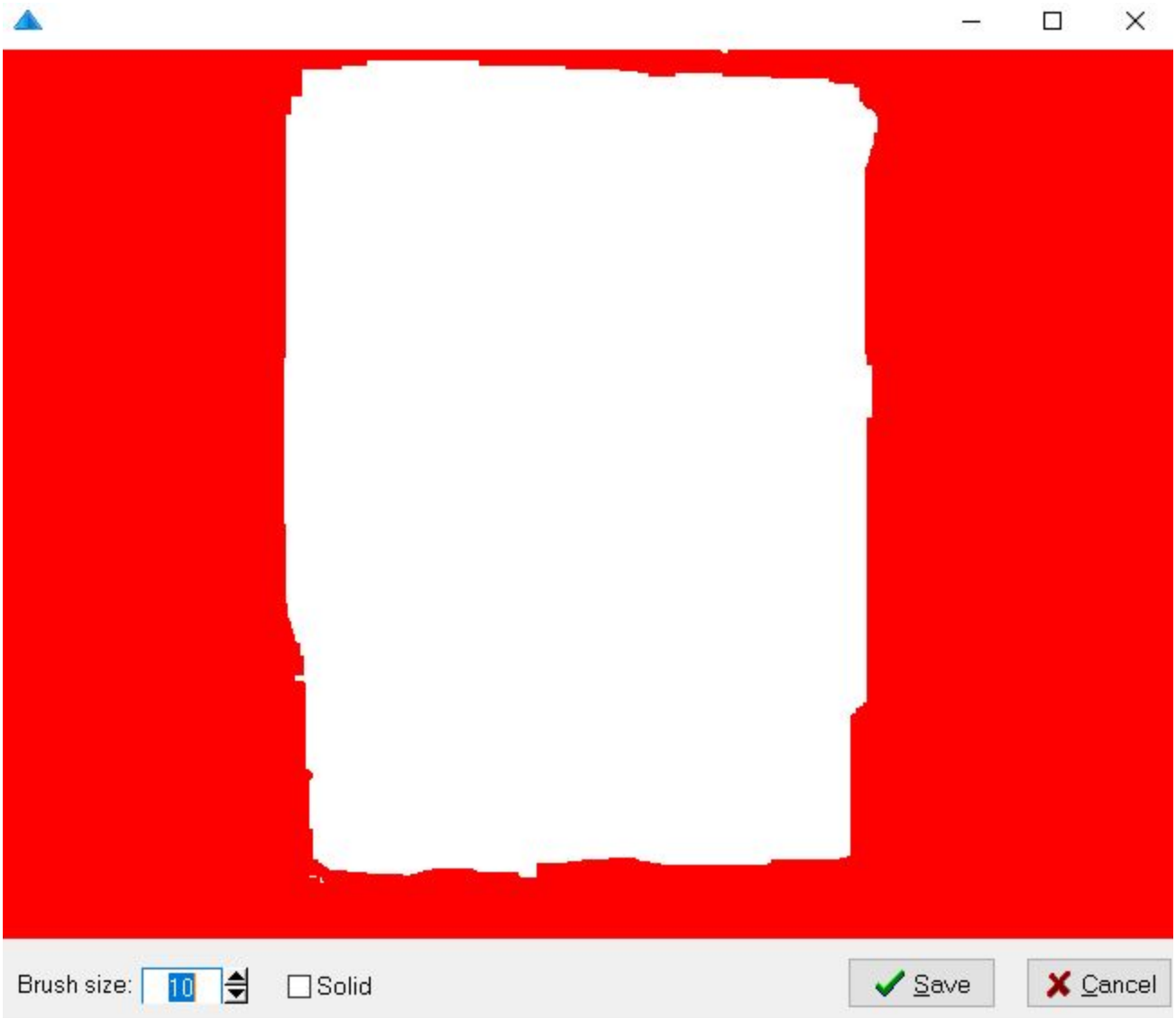
Next, in the **Camera** pane, you will notice two checkboxes titled **Mirror** and **Flip,** which will change the orientation of the camera view. In theory, these should not be touched since the studio technician already calibrated this, and will not need further modifications. There is also a **Settings** button which leads to the window shown below.



Setting	Description
Exposure	This progress bar will adjust the exposure of the camera. Generally, the value will be somewhere between 20000 and 60000.
Gain	This progress bar will adjust the gain of the camera. Generally, the value will be somewhere between 6 and 10.
White balance	Auto should be unchecked. Red and Blue values should be set to a value that makes the camera view with a proper white balance.
Network settings	With a GC650 camera, the **Multicast** setting should be unchecked. In turn, values are not necessary.
Flip and mirror image	Will mirror/flip the camera feed image horizontally and vertically.
Rotate image	Will rotate the camera feed image by 90 degrees.

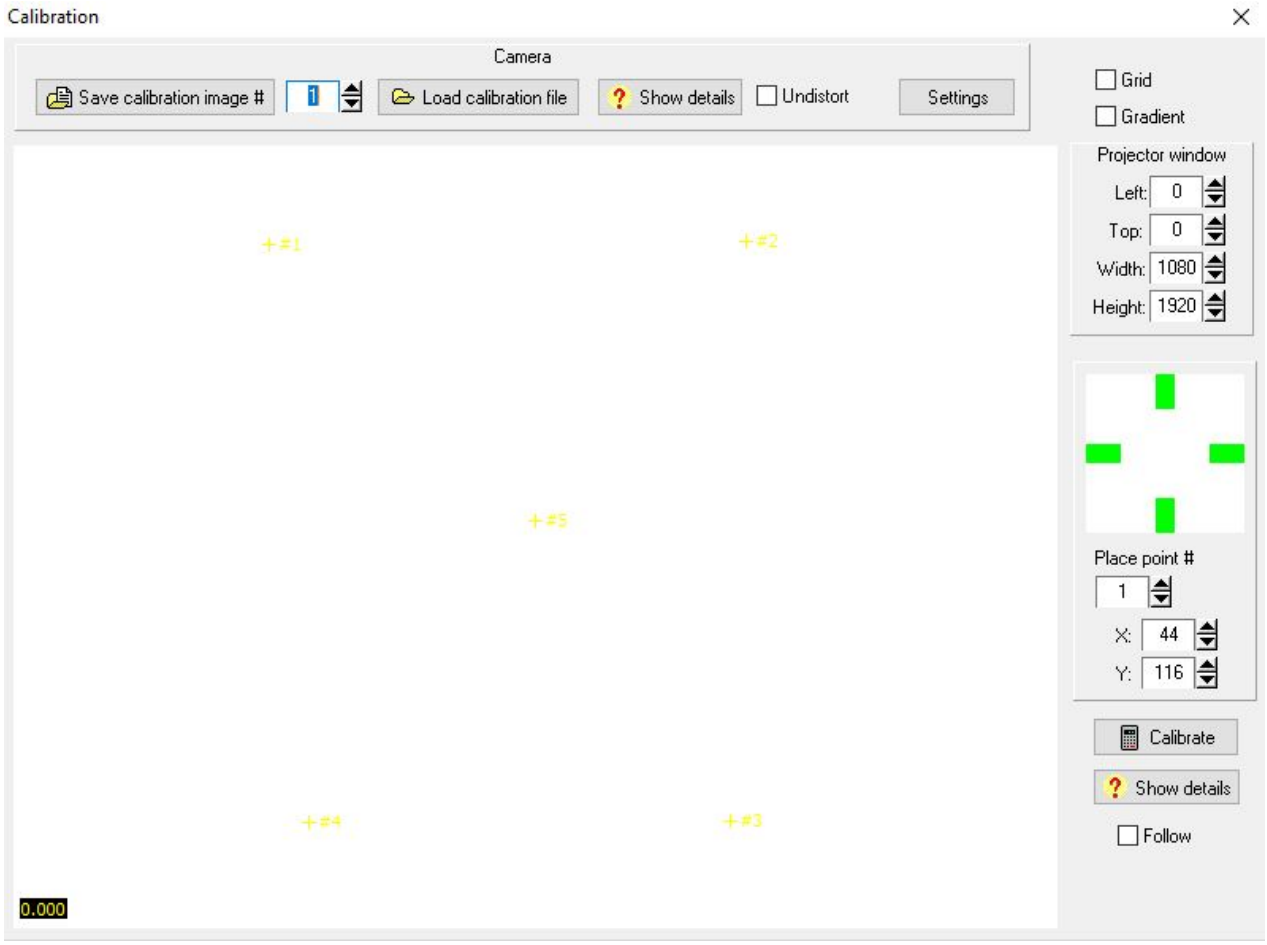
Back to the **Tracking setup** window, there is a **Track mask** button. When clicking on it, you will get into the following window, which allows for certain sections to be masked out where the tracking should occur. Usually, the white rectangle shown in following image should display the high-contrast camera view of your projection wall. On top of the image, you will notice transparent, red areas: these are the masked-out areas where tracking is not occuring.

To add a mask, simply right-click and drag over the camera feed image; this will “paint” the mask, by adding red around the mouse pointer. To remove the mask, do the same sequence, but by left clicking. Use the **Brush size** setting to change the size of the brush. Also, the brush is a square shape, meaning that, for example, if the value is set to 10, it will draw a 10-pixels-by-10-pixels square around the mouse pointer.



Setup - Calibrate

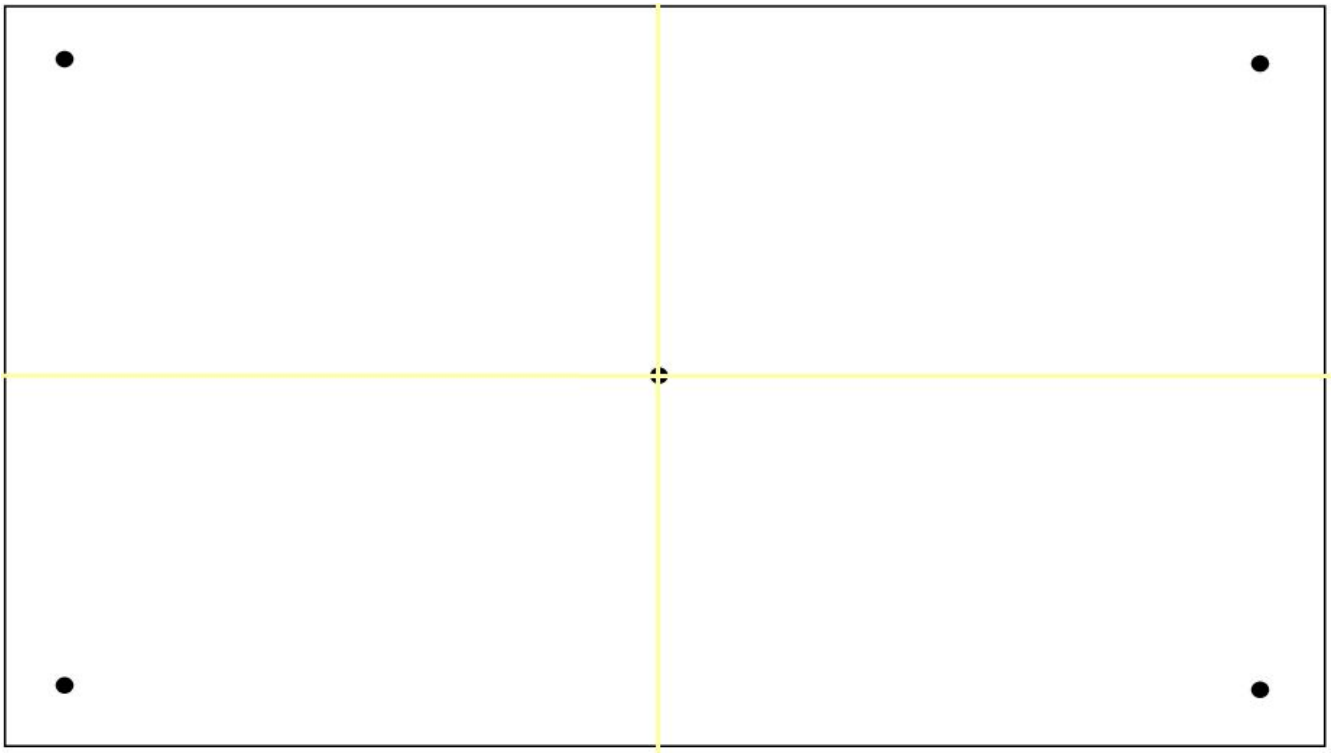
In this section, we can fine tune the calibration, in order to correlate the camera and the projection. The following includes a summarized explanation of the settings available in this section. Before making any modifications to these settings, please consult with a studio technician.



Setting	Description
Save calibration image # (button)	This, combined with the numerical value in the box on its right, will record an image to be used for calibrating the camera/projector relationship.
Load calibration file (button)	This will load the camera's internal calibration file needed prior to calibrating the camera/projector relationship.
Show details (button)	This will show a dialog with the details of the internal calibration file.
Undistort	When checked, this will modify the camera view, showing it as undistorted. If checked, and the camera view is distorted, this means that the internal calibration file is not good.
Settings (button)	This will prompt the camera settings window previously explained in Setup - Tracking section.
Grid / Gradient	Both of these settings should remain unchecked.
Projector window - Left, Top, Height, Width	This setting determines where the projection area starts, and its size. Usually, **top** and **left** are set to **0**, except if you have another display hooked to your system, which may result in different values. **Height** and **width** correspond to the resolution of the projector being used.
Place point #	This is in fact three settings: the point #, and it's X and Y coordinates. Please consult the explanation following this table to understand how these settings should be used.
Calibrate (button)	Once all calibration points are in place, press this button, and the system will calibrate the camera/projector relationship, and the system should track and outline shadows properly.
Show details (button)	This will show a dialog with the details of the camera/projector calibration file.
Follow	When checked, the system will project a crosshair onto whatever area over the mouse pointer, in the camera view.

Placing the Calibration Points

To calibrate the camera/projector relationship, we need to set a pattern of five points arranged in a cross formation, with four of them forming an outer rectangle and a fifth at its center. The rectangle's external points should be about 20 centimeters away from the corners of the projection area. Please consult the schema below. Consider the top left point as point #1, the top right point as point #2, the bottom right point as point #3, the bottom left point as point #4, and the center point as point #5.



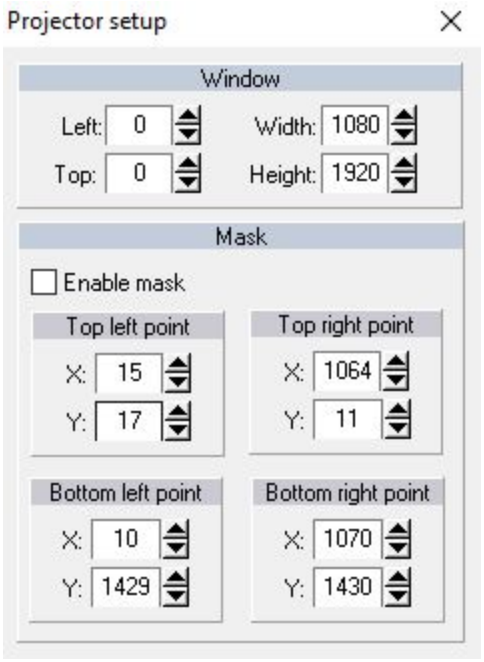
When a point is selected, click inside the camera view to set the point location for the camera.

While the same point number is selected, adjust the X and Y values to move the two yellow lines (vertical and horizontal, forming a cross) on the projection area. This will set the point location for the projector.

The goal here is to set the five points by clicking in the camera view and then aligning the yellow lines with these points, within the camera view. Once this is complete, click on the **Calibrate** button, and the software will calculate and calibrate the correlation between the camera view and the projection area. This ensures that the video projection will match the camera tracking.

Setup - Projector

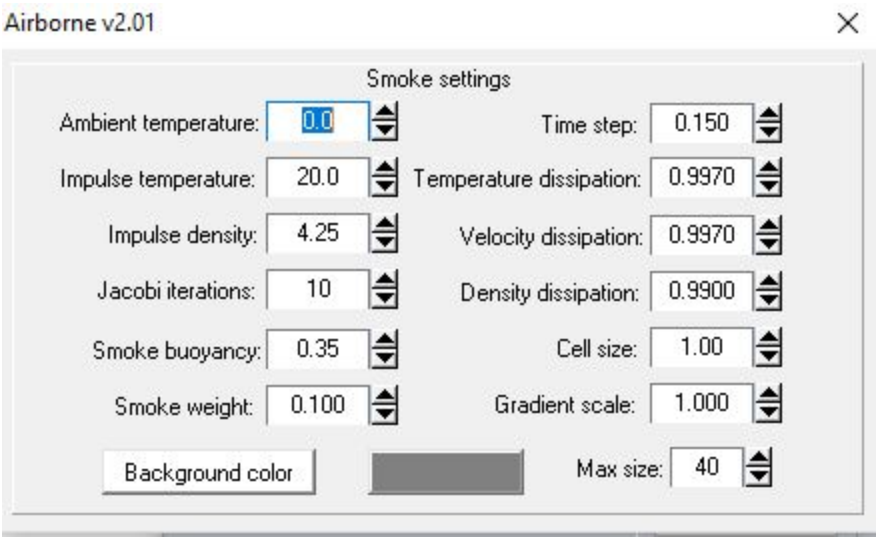
This section is used to adjust the projection area: the pale rectangle projected onto the wall.



Setting	Description
Window - Left, Top	This indicates where the projection area begins. Usually, both are set to **0**, except if you have another display hooked to your system, which may result in different values.
Window - Width, Height	This is the resolution of the projector in use.
Mask - Enable mask	Should always be unchecked.
Mask - Top left, Top right, Bottom left and Bottom right points - X, Y	These are used to map the projection area in 2D. Adjust the X and Y settings of each point, to bring them in a position to correct the actual lines on the wall and make them straight (covering the projection area). All these values should be larger than **10**, and smaller than the projector height (or width), minus 10.

Setup - Smoke

This section is used to adjust the smoke affect. Before making any modifications to these settings, please consult with a studio technician.

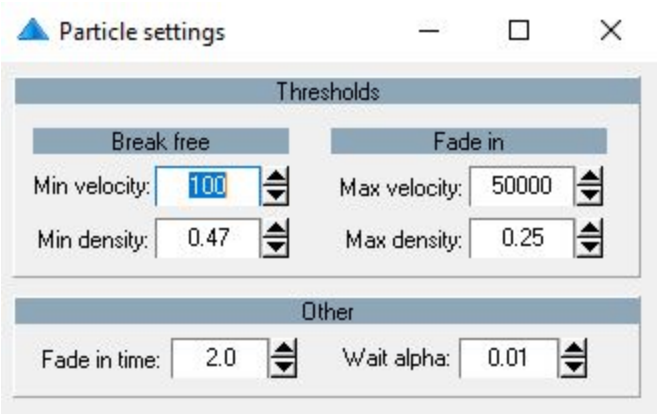


Setting	Description
Ambient temperature	The smoke floats around in an ambient "environment" based on the temperature weight and speed of the elements. This setting sets the standard temperature of the projection area.
Impulse temperature	This is the original temperature of generated smoke blobs.
Impulse density	This is the original speed of the smoke blobs.
Jacobi iteration	Will affect the number of blobs generated at the same time.
Smoke buoyancy	The tendency rate for the smoke to float in the environment.
Smoke weight	Weight of the smoke blobs.
Time step	The speed in which smoke blobs are generated.
Temperature dissipation	The speed in which the smoke temperature blends to the ambient temperature.

Velocity dissipation	The speed in which the smoke loses its velocity.
Density dissipation	The speed in which the smoke loses density.
Cell size	Minimum size of the smoke blobs generated.
Gradient scale	Adjusts the transparency of the smoke blobs.
Max size	Maximum size of the smoke blobs generated.
Background color button	Clicking on this button will activate a window that allows you to select the color of the projection area. Most of the time, it will be a pure white (255,255,255).
Colored button centered at the bottom of the window	Clicking on this button will activate a window that allows you to select the color of the smoke. Generally, this will be a mid-grey color.

Setup - Particles

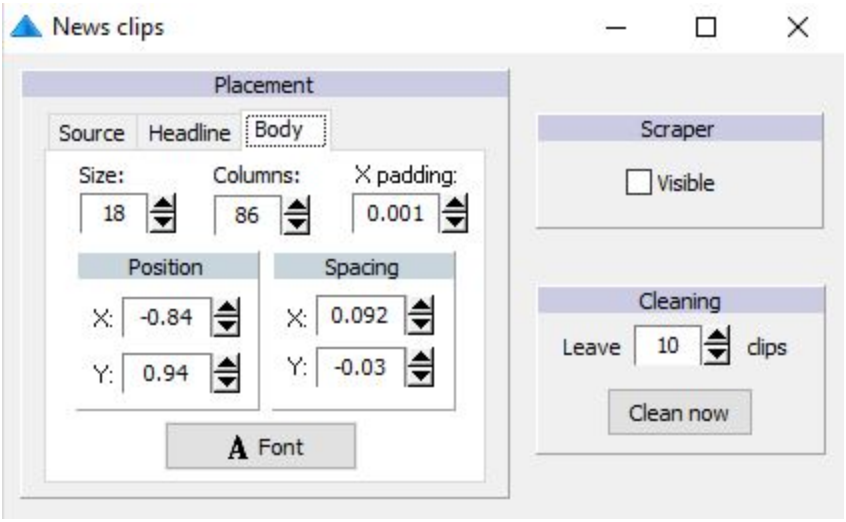
This section is used to adjust the reaction of particles in the system. Before making any modifications to these settings, please consult with a studio technician. The image shown below should be used as a reference for adjusting the standard values.



Setup - Clips

This section is used to adjust the alignment of the articles (named clips in system) onto the projection area. Before making any modifications to these settings, please consult with a studio technician.

The headers **Source**, **headline**, and **body** share roughly the same settings, so you can apply the following the settings for all the types of texts. **Source** corresponds to the provenance of the article, like. “New York Times”, for example. **Headline** corresponds to the title of the article, while **body** corresponds to the article texts itself.

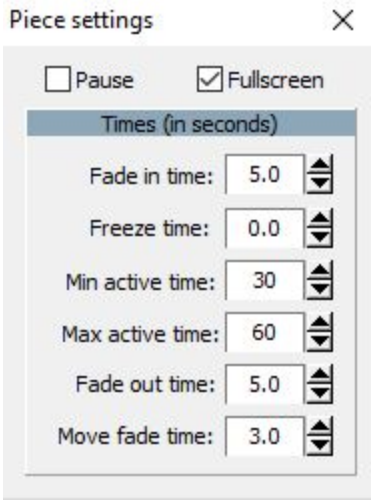


Setting	Description
Size	The font size of the actual text portion.
Columns	The number of text columns of the actual text portion. Note that this setting is only available for **headline** and **body**.
X padding	This will adjust the horizontal padding between the letters of the text.
Position - X, Y	This will set the origin point (top left) of the actual text portion.
Spacing - X, Y	This will adjust the horizontal and vertical spacing between letters of the text.

Font	This will activate a window in which you can select the **Font** type used for the text.
Scrapper - Visible	This setting should be left unchecked (used for debugging).
Cleaning	When clicking on **Clean now**, the system will purge all the articles, except for the amount indicated in the box above (eg. Leave "10" clips). This should be done only prior to the artwork's exhibition or opening.

Setup - Piece

This section is used to adjust the general reactions of the artwork. Before making any modifications to these settings, please consult with a studio technician. The values listed below are the default values.



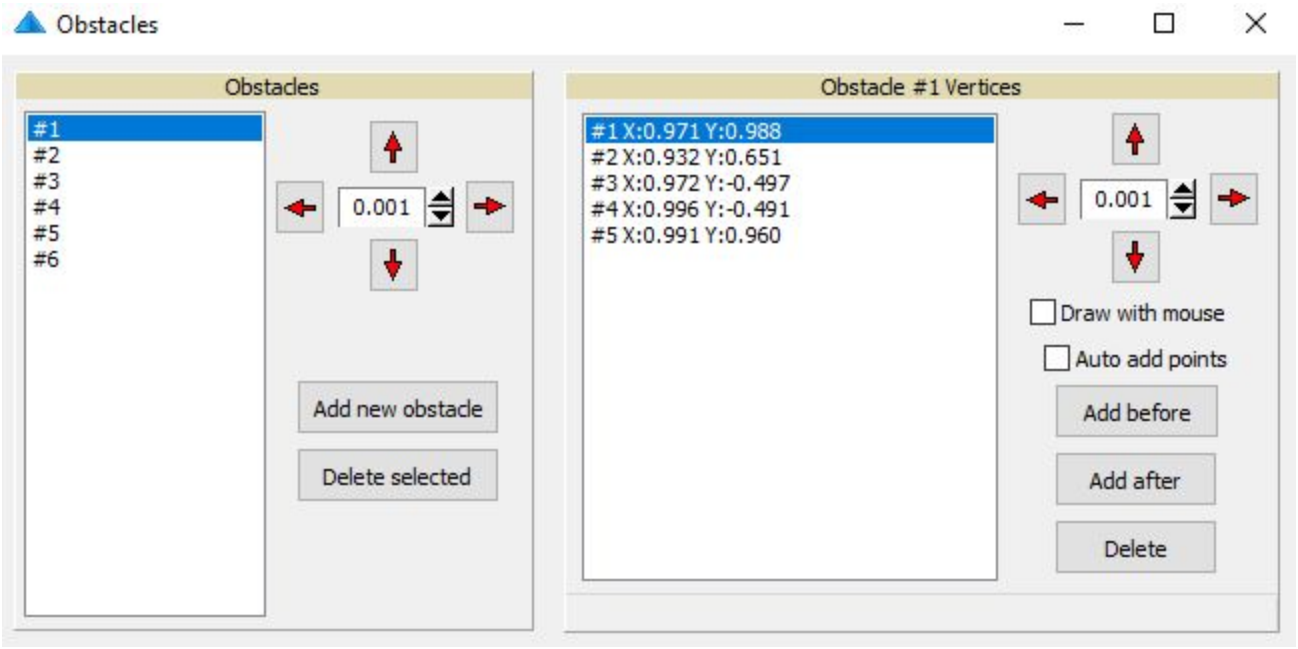
Setting	Description
Pause	Pauses the software. Should be left unchecked.
Fullscreen	Should be checked.
Fade in time	Indicates the speed, in seconds, of the fade-in of an article.
Freeze time	The amount of seconds in which the interaction stops, when a new article is loaded.
Min active time	Minimum time, in seconds, in which an article is displayed.

Max active time	Maximum time, in seconds, in which an article is displayed.
Fade out time	The speed, in seconds, of the fade-out of an article.
Move fade time	The amount of seconds in which the smoke stops carrying the text while fading to a new article.

View - Obstacles

This section is used to set the obstacles (any black shapes in the projection area). Before making any modifications to these settings, please consult with a studio technician.

An obstacle consists of a black shape formed by at least three points, or vertices. Using these obstacles, we can prevent the projection of certain regions we want to avoid (doors, beams, or any object that may cast shadows or be badly tracked by camera once lit). The X and Y values of the vertices work within a Cartesian coordinate system, typically spanning from **-1** to **1**, wherein **0** is located at the center of the projection, **-1** is located on the left or bottom, and **1** is located on the right or top.



Setting	Description
Obstacles - Up, down, left, right arrows (buttons)	Moves the selected obstacle (highlighted in blue in the list on the left) in the corresponding direction, by the amount indicated in center of the arrow buttons. This value can be adjusted to move the obstacle faster or slower.
Obstacles - Add new obstacle (button)	Adds a new obstacle that will be at the end of the list.
Obstacles - Delete selected	Deletes the selected obstacle (highlighted in blue in the list on the left).
Obstacles #? Vertices - Up, down, left, right arrows (buttons)	Moves the selected vertice of the selected obstacle (highlighted in blue in the lists on the left) in the corresponding direction, by the amount indicated in center of the arrow buttons. This value can be adjusted to move the obstacle faster or slower.
Obstacles #? Vertices - Add before/after (buttons)	Adds a vertice before/after the selected vertice (highlighted in blue in the list on the left).
Obstacles #? Vertices - Delete	Deletes the selected vertice (highlighted in blue in the list on the left).
Obstacles #? Vertices - Draw with mouse	Allows you to move the selected vertices with the mouse.
Obstacles #? Vertices - Auto add points	Keep this unchecked. This adds points to the obstacle depending on where you click. This feature has not been used in previous iterations of the artwork.

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, OSX), the procedure to set the computer online will vary. Please look online for tutorials, if necessary.

Preliminary Troubleshooting Steps

After pressing the button, nothing seems to happen.

Do you hear any sound coming from the computer? If so, the computer is running and the projector should display the piece shortly. If not, check that the projector is powered and try to turn it on with a remote control. Also, check that the projector's source is set to the same port where the cable is plugged in (usually HDMI but could be DVI, DisplayPort, SDI, etc.)

Smoke is being emitted even if no one is casting a shadow onto projection area, OR smoke isn't emitted when someone is casting a shadow.

If the smoke is being emitted by a square at the bottom of the projection, this means that the camera isn't being detected by the software. First, while avoiding moving the camera, ensure that the camera network cable is well connected into the computer port. Also, ensure that the camera is still powered; there are two LEDs at the back of the camera which should be lit or flashing if the camera is receiving power and is connected to computer. Next, stop all parts of the software and start a shadow. If the smoke-square is still there, try rebooting the computer. If the issue persists, contact Antimodular Studio for more instructions, as there might be an issue with the camera and further debugging might be needed.

If the smoke emits from random locations or near the edges of the projection area, or if smoke isn't emitted when someone is casting a shadow, this means the lighting conditions have changed since a technician from Antimodular Studio last installed and calibrated the artwork. Please ensure the following:

A. No ambient light has been turned on/off in the room. If this is the case, please return the lighting conditions back to their original state, if possible, either by replacing burned-out lights, or by turning off extra lights, for example.
B. No fluctuating light is being emitted in the room near the projection area. Any fluctuations in light near the projection area will result in weird reactions with the smoke.
C. The projection area (white rectangle) should be filling the whole projection surface. If ever the light doesn't cover the room in the same way that it did after calibration, it may mean that the projector have moved. Correcting the shape of projection by doing a quick recalibration may do the trick. Follow the instructions listed in the Recalibration of the projection area section.
D. The projector light includes a dimmer. When the system is calibrated, the light should react better with a quick recalibration. Follow the instructions listed in the Recalibration of the light thresholds section.

The smoke seems slower than usual.

Ensure that the dedicated NVidia graphic card is being used by the computer system. Right-click in Windows desktop, click on **NVidia Control** panel and click on **Configure Surround**, PhysX. On the right side of the window, there is a **PhysX settings** section where you can select a Processor. Select the graphic card corresponding to your system; for example, select a “GeForce xxxxxxxxxx” for a “GeForce GTX 1060 6GB” system. Once selected, click on **apply** and quit the window.

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
4060 St-Laurent, studio 107
Montréal Québec H2W 1Y9 Canada
Tel 1-514-597-0917
Fax 1-514-597-2092
info@antimodular.com
www.antimodular.com

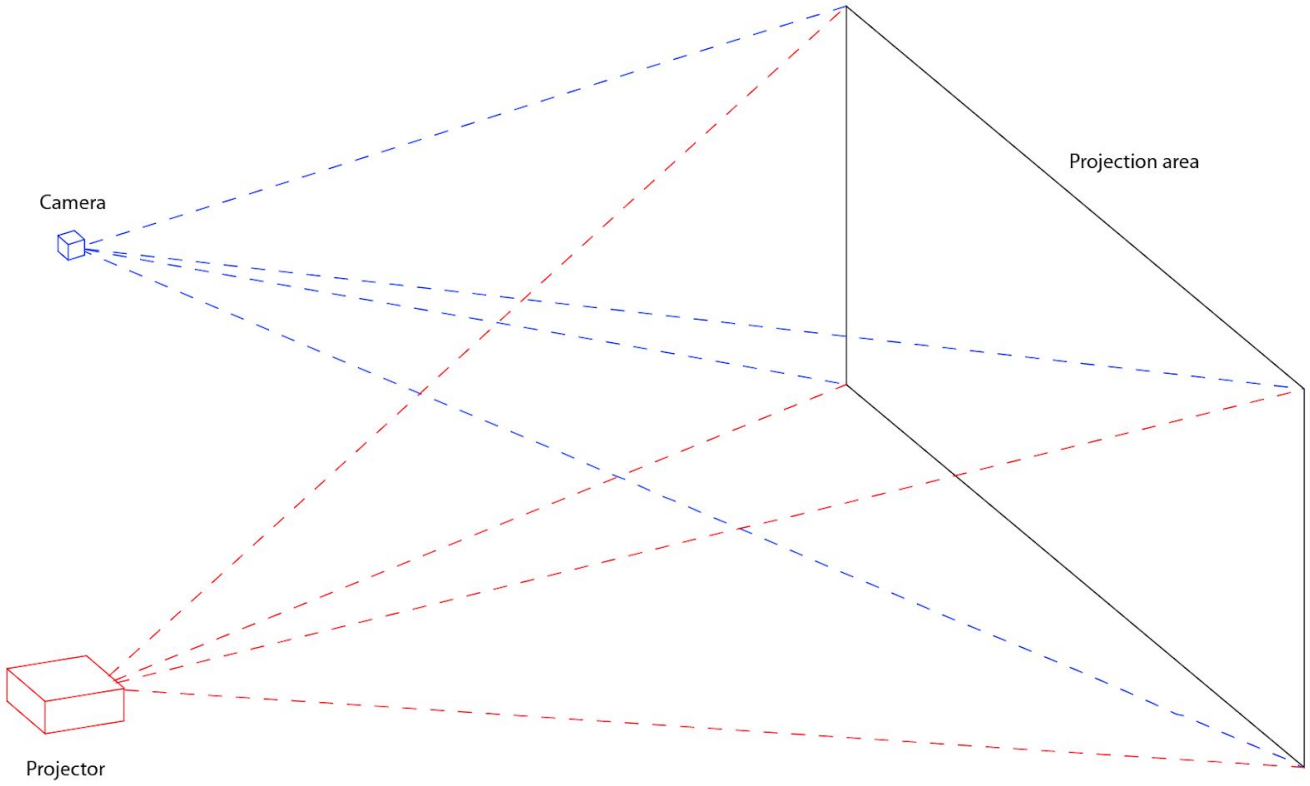
APPENDIX I - INSTALLATION

Description of Components

This artwork requires the following components:

Component	Description
Computer	Computer running on Windows 7 OS at least, with a NVidia graphics card (at least GTX 960) and a Gigabit ethernet port.
AVT Prosilica GC650 with power supply	This is the sensor that allows the system to track individuals present in front of the artwork. It connects to computer through a network cable and is powered by a power supply connected to an electrical outlet.
Camera lens	This lens has been selected and calibrated for the desired artwork dimension. It is a C-mount lens or a lens mounted on a C-mount adapter.
Network cable	Used to connect camera to computer. Should be at least a CAT5e cable.
Video signal cable	Connects the computer to the display (usually it is an HDMI cable.)
Projector	A FullHD (1080p) projector, at least. Ideally, the projector is as bright as possible. Also, the projectors are typically protected from public by either embedding them within a wall or by covering them with a box or casing.
Keyboard	While not required for normal use of the artwork, it allows you to calibrate the system fromyour actual location.

Installation Layout



Wiring Diagram

APPENDIX II - TECHNICAL DATA SHEETS

Allied Vision Technologies Prosilica GC650

Interface	IEEE 802.3 1000baseT
Resolution	659 (H) × 493 (V)
Sensor, sensor type	Sony ICX424, CCD Progressive
Sensor size	Type 1/3
Pixel size	7.4 µm × 7.4 µm
Lens mount (default)	C-Mount
Max. frame rate at full resolution	90 fps
ADC	12 Bit
Image buffer (RAM)	16 MByte
Bit depth	8/12 Bit
Monochrome pixel formats	Mono8, Mono12, Mono12Packed
RGB color pixel formats	RGB8Packed, BGR8Packed
Raw pixel formats	BayerRG8, BayerRG12, BayerGR12Packed
TTL I/Os, Opto-isolated I/Os	1 input, 1 output. Opto-isolated: 1 input, 1 output.
Operating temperature	0 °C to +50 °C ambient (without condensation)
Power requirements (DC)	5 to 25 VDC
Power consumption	3 W at 12 VDC
Mass	99 g
Body dimensions (L × W × H in mm)	59 × 46 × 33 (including connectors)
Regulations	CE: 2014/30/EU (EMC), 2011/65/EU, including amendment 2015/863/EU (RoHS); FCC Class A; CAN ICES-003

APPENDIX III - QUICK RECALIBRATIONS

Recalibration of the Projection Area

Before doing this, ensure that there is a backup of the software on the computer. We will need it if the smoking setup is corrupted. In any case, it is always good practice to make a new backup.

Please communicate with a studio technician prior to conducting the following steps. If there is an issue, we will be able to connect remotely to the computer and assist you with this.

Refer to the Software section to see reference photos of the different menus/sections.

1. Access pieces menu by right clicking anywhere with the keyboard.

2. In the menu, click on **Projector**, this will bring you to the projector setup menu.

3. Here, adjust the bottom left, bottom right, top left, and top right points (X and Y settings) to bring these points in position to correct the actual lines on the wall and make them vertical (covering the projection area). Values should be greater than **10**, and smaller than the projector height (or width) minus 10. Ensuring this will prevent any harm to the software's smoking system. In fact, recent experiences allowed us to determine that the values should never be lower than **10**, and at least lower than the width minus 10 pixels OR the height minus 10 pixels.

4. Once you have a levelled projection area on the wall, you can quit this window.

5. Follow the steps outlined in the Recalibration of the light thresholds section in order to ensure a proper reaction from the system.

6. After following the previous steps, if the piece reacts properly and covers the whole wall, then you are finished. If not, follow the next steps.

7. Go in the main menu, click on the **calibrate** button, which will activate the calibrate window.

8. The important thing here is the following: on the right side, there is a Place point # section. If you cycle through the points 1-2-3-4-5, using the up and down arrows, you should see lines appearing in the projection area. These lines should match with the yellow crosshair pointer of the same number, visible in the camera feed. If this isn't the case anymore, adjust the X and Y values for each point.

9, Once all the individual lines and intersecting points match with the corresponding yellow crosshairs, click on the **Calibrate** button. This will make new calculations and will fine tune the tracking system.

10. Quit the menu and check the tracking of the shadows again by playing with the interaction area.

11. **If these processes fail**, copy the backup files on top of the actual files, This should revert all the previous steps and should bring the system back to its original setup prior to these modifications. Contact the studio to see what can be done beyond this point. **ON the other hand, if these processes fixed the issue**, you can do the same thing on the right side.

Recalibration of the Light Thresholds

From the main menu, click on the **Tracking** button, which will activate window. On the right side, in the **Tracking** panel, there are two buttons: **Bright ref** and **Dark ref**. Ensure that no one casts shadows onto any part of the projection area and sequentially press each button. Quit the menus to get back to the runtime.

Now, go into the interaction area and cast shadows onto the wall.