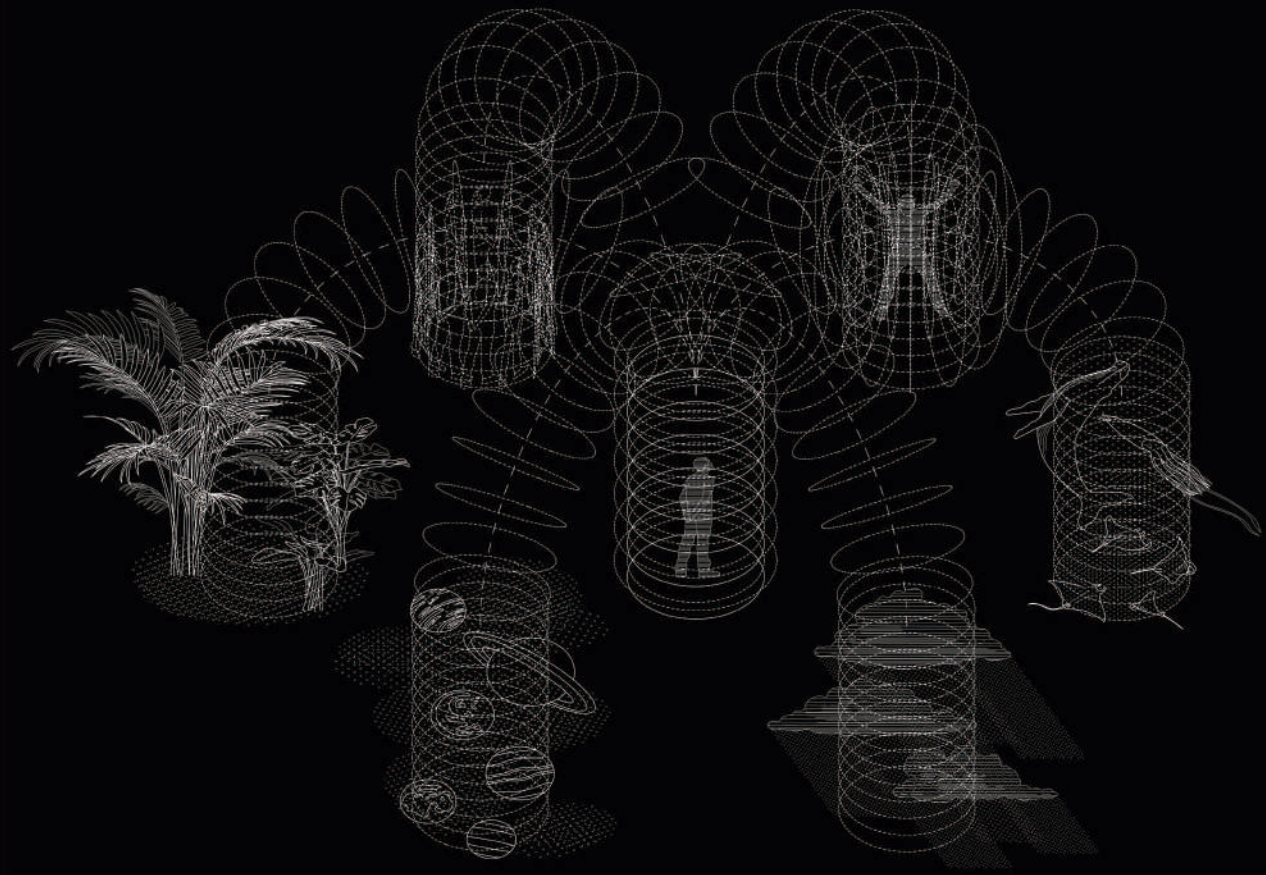


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atmospheric spaces

vessel for distant and imaginary realities

— MASTER THESIS —

submitted during winter semester 2020/21

Bauhaus-Universität Weimar
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22. February 2021

DECLARATION OF AUTHORSHIP

I hereby declare that I am the sole author of this master thesis and that I have not used any sources other than those listed in the bibliography and identified as references.

I further declare that I have not submitted this thesis at any other institution in order to obtain a degree.



Carlos García Fernández

Weimar, 22. February 2021

ACKNOWLEDGEMENTS

I would like to thank my family, friends, fellow mates, professors and tutors, whose support during this challenging time made this journey happen.

None of this would have been possible without you.

ABSTRACT

How would it feel to experience distant and/or imaginary realities in physical space?

How could these intangible locations be translated and rebuilt into *atmospheric spaces*, perceptible by the senses through immediate experience?

The aim of this thesis is to develop a set of mechanisms that embodied as a particular setup or *vessel*, will bring closer and remote whereabouts and yet-to-discover loci. The user -or *traveler*-, is able to directly feel and experience these *phenomenal realities* that used to remain in an intangible realm, now embodied in a multi-sensory environment.

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PREFACE

How to travel when your body is tied to a spatial location and to a particular point in time?

How to experience locations that are somewhat unreachable or even non(yet)existent?

Is it possible to *physically* perceive and explore distant and imaginary realities? If so, what would it feel like?

The act of travelling has been part of our lives since the very beginning, and has supposed a big part of our learning process; ranging from our early ancestors, who led a nomadic life in search for food and shelter, to the great explorers and travellers whose groundbreaking discoveries expanded the known world, and including the latest space travellers, currently spreading the limits of the space beyond what is visible to the human eye. This *experiential learning* promotes a transformation of how we understand our surrounding environment as a whole and improves our overall understanding in an empirical way. These immersive experiences are also aimed to make us grow by opening our mind and widening our self-knowledge.

Visiting distant places can turn into a difficult or even impossible challenge; due to the constraints specific to our non-omnipresence being, it takes time and energy to move our body from place to place, therefore rendering some destinations quite unreachable



KALEIDOSCOPIC SPACES
PROTOTYPE - 2020

for the majority of individuals. There are some other reasons why this might happen; economic challenges, travel restrictions or even mobility limitations, can keep willing explorers from experiencing other realities than the ones they are immersed in. Enjoying a warm sunset by the beach, having a walk through a dripping forest during a rainy day, returning to your missed hometown or even experiencing a revolution around the Sun on Mars, are all *multi-sensory* experiences that can bring back past memories, create new cognitive content as mental nourishment, and even provide some solace during tough and emotionally challenging times.

Literally recreating those and many other realities in an ultra-realistic way would be extremely complex, economically unviable, and it is quite outside the scope of this research. Instead, what is intended here, is to recreate the *ambiance* and *sensations* that those experiences would arise in the user [*traveller* from now on] by more subtle and suggestive means, that would leave room for their own interpretation, creating some kind of out-of-body experience. Therefore, the sensations perceived by the *traveller* will conform a final and individual experience, formed by fractal pieces of *sound*, *light* and *reflections* given to them; a *personal collage* that might be sensed and put together differently by every individual.

A *vessel* is created, a contained space where different ambient elements can be controlled and adjusted, allowing different *atmospheres* to be rendered inside it. In this case, the experience does not come in form of projected visuals or through a virtual

reality headset, but rather as a cloud of *ambience conditions* that will fill the space and let the *traveler* move around and perceive the *tangible realities* built around them. The set of elements used to render these atmospheres are, for this particular installation and at this point of the research, sound, light and reflections, but could be extended with many others that will be discussed later in the text.

The *vessel*, aimed to contain the space where the atmospheres are recreated, is able to replicate a range of different ambiances, acting as a *portal* that links the actual location where it is placed, with the *rendered destination*. Built as a soft enclosure, the *vessel* presents various entryways to its inside, leading each one of those to a different experience; as the light pieces of fabric on the outside are drawn, the *traveller* accesses a distant reality, leaving behind their bodily location and entering one of the many *atmospheric spaces*.



ATMOSPHERIC SPACES
DESIGN ITERATION V1 - 2020

CONSTELLATION OF IDEAS AND PRIOR PROTOTYPES

To better understand the journey that led to the prototype object of this study, I would like to present you with the evolutionary path of ideas, mock-ups and devices that were developed over the course of the creative process. I would also like to include a selection of previous works that influenced or set some of the core ideas for this thesis.

I. ARCHIVE OF IDEAS

As in many other of my works, this project is in someway a heterogeneous collage of references, personal interests and obsessions that have been in my head for some time now. These could be divided in the main following categories:

— the mirror and its endless reflections

— the mutant architecture and its adaptive potential

— the virtual realm and its tangible possibilities

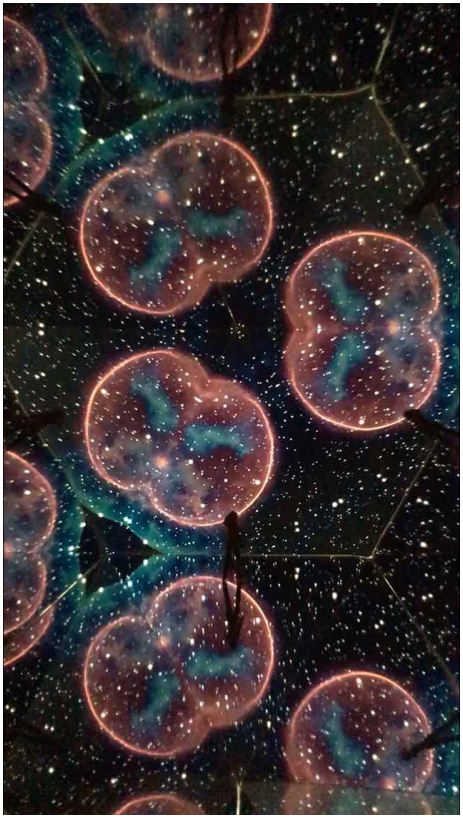
— the artificial atmospheres and their constituent elements

1. THE MIRROR

As an object of introspection and creator of virtual environments (reflected realities that exist but do not take actual space), the mirror and its reflections have been one of the main inspirations for this project. I would like to present here some of the mirror's most interesting features:

kaleidoscopes

First widely used during the Victorian era[i], kaleidoscopes are devices able to decompose tiny pieces of reality and rebuild them as a playful and dynamic collage, *just* using regular *-yet in a way, fascinating and mysterious-* objects: mirrors. The uncertainty created by *infinite reflections*, offers at the same time an omnipresent view of our surroundings and our own body's identity in space; our traditional single view-point becomes an endless fractal reflection that let us perceive the space in a completely different way. Kaleidoscope's never-ending reflections construct a *virtual endless space*, where the two main elements are the space that surrounds the set of mirrors and the viewers themselves. As a references here, I'd like to name the extensive work on kaleidoscopic devices carried out by Olafur Eliasson, with special attention to "Your spiral view"[ii], a faceted human-size kaleidoscope, or the mirrored room "Crystal Universe"[iii] developed by TeamLab, where the user gets immersed in a infinite space filled with dots of light and reflections.



KALEIDOSCOPIC SPACES
PROTOTYPE - 2020

spatial reflections, outer reflexions

Kaleidoscopes are able to create spatial arrangements that completely defy the laws that normally dictate our *real spaces*; up is down, down is front and back is everywhere. Gravity and weight do not longer affect this reality, where the elements float and repeat themselves in infinite loops, creating geometric *ever-changing configurations*. The volumetric mirrored sculpture "Sundial for Spatial Echoes"[iv]. from Tomás Saraceno greatly examples the idea of spatial reflections, creating in this piece a cloud of mirrors that extends the space where it is placed.

self reflections, inner reflexions

The kaleidoscopic collages do not offer just spatial reflections, but also the viewer's own image, mixed and fused with their context. This new perspective of self, result of an *endless iteration* of one's own perspective, dismantles one's own perception and identity, fusing it with the space that we occupy as active viewers. The traveller then merges with their surroundings in a fractal collage where the boundary between body and space blurs, creating a more intimate experience with the surrounding ambience. The idea of deconstructing one-self reflection is explored in the hexagonal tiled mirror[v] from Anish Kapoor, where the viewers reflection gets faceted and distorted, reflecting on the idea of presence and absence.

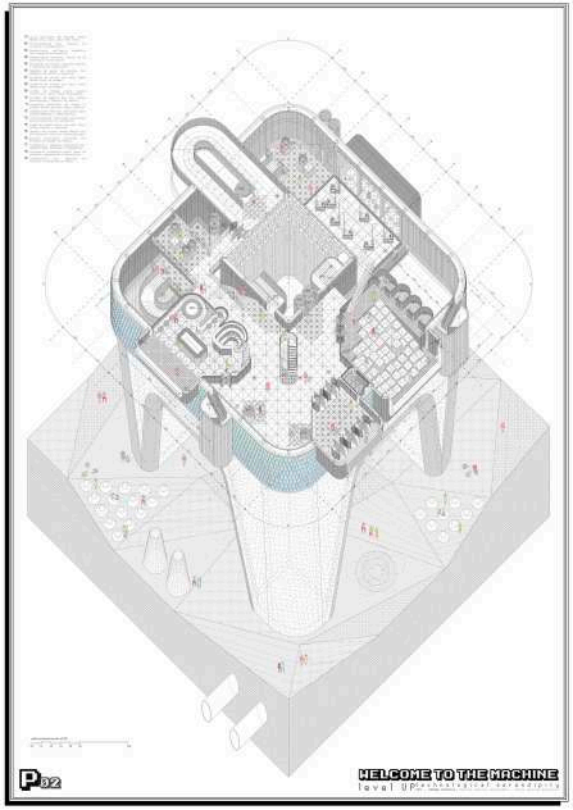


WIEDERHOLTE SPIEGELUNGEN
[ITERATED REFLECTIONS]
PROTOTYPE - 2020

2. THE MUTANT ARCHITECTURE

As my main academic background, architecture and spatial design are always present in some way on my work. An especially predominant idea is what I will describe here as *adaptive or mutant architecture*, ambiances that present a symbiosis between the human body and space, and create a user-environment synergy. These spaces become in a way a tailored second skin, that reacts to whatever happens inside and/or around them. We could consider these spaces as leisure environments or mutant shelters that provide an interactive and adaptive built environment where the user is the protagonist with the ability to interact and modify them according to their needs and moods.

Adaptive and interactive architecture has mixed with media and gamification and can be found in speculative projects from the 20th century, such as the settlement on legs from the 60s "Walking City"[vi] designed by Robert Erron, or its coetaneous reconfigurable "Plug-in City"[vii] by Peter Cook, both part of the english avant-garde collective Archigram. Another great example is the playful and high-tech "Fun Palace"[viii] designed by Cedrick Price, that would serve as influence for future built projects, like the "Centre Georges Pompidou"[ix] in Paris. In all of these examples, architecture turns playful and is able to transform itself, either by adapting its physical configuration or aspect, its content, or even its location. In 2016, using this framework as a design hypothesis, I developed my master thesis[x] in Architecture, designing a machine-like architecture that transforms and adapts, using *gamification* as learning process.



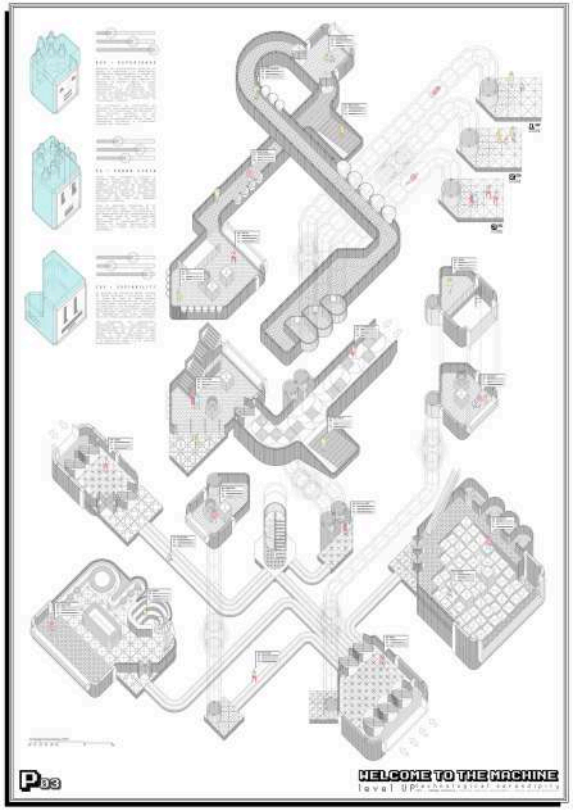
WELCOME TO THE MACHINE
ARCHITECTURE MASTER THESIS - 2016
GROUND FLOOR PLAN

Welcome to the Machine - Technological Serendipity

A machine with architectural proportions, invites the user/player to walk through its inner spaces, along the "*promenade architecturale*" that starts in the main atrium and ends in the technical spaces located in the topographic roof.

After entering the Machine, the gamer becomes a first person player, with the aim of collecting as many experience points as possible in order to complete the technological learning process. The *serendipity* pushes them from a capsule to the next one, following a path inspired by the classic platform video games, learning and experiencing in every space a different *tangible-digital environment*. It is possible to complete different levels, and by doing so, earning more experience, energy and social points, that will be helpful along the immersive experiential path.

The virtual reality turns real and tactile, melting and blurring itself with the path and the game, creating new experiences and environments that will be experienced by the gamer along their way to the final classification platform. Depending on the developed skills and the experience points, after completing the path, the user will arrive to one of the three different classifications, which lead to three different final experiences; the virtual leads to a spacial action. The user's mastery as a player allows them to experience the different realities inside the Machine.



WELCOME TO THE MACHINE
ARCHITECTURE MASTER THESIS - 2016
USE DIAGRAM - GAMIFICATION

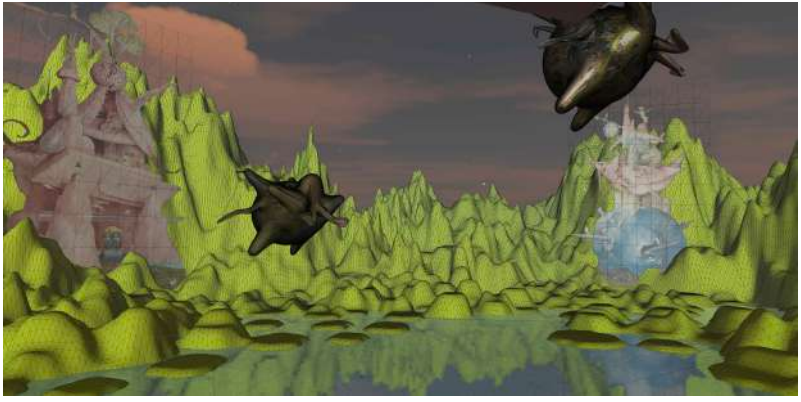
3. THE VIRTUAL REALM

I personally find this field of study specially interesting for architects, designers and artists, since it provides complete freedom when it comes to space design. In the virtual realm there are no budget or spatial restrictions of any kind, and anything can be built. The same as in the previously discussed *kaleidoscopic spaces*, the spatial arrangements that can be developed in the virtual realm are not affected by the rules that dictate on the *real spaces*.

Spaces and atmospheres that before where just possible to dream about, can now take virtual shape, be experienced through different means ranging from the simpler screens and mobile devices to the more advanced virtual reality headsets.

There are also examples where the virtual realm fuses with the tangible space; using this latter as canvas, virtual elements can be displayed on it. A great example of this *augmented spaces* are the immersive experiences designed by the Japanese interdisciplinary studio TeamLab, including the installations "LIFE",[xi] "Borderless",[xii] or "Planets",[xiii] where blank and minimalistic setups are used to project a virtual layer, rendering a completely different environment where tangible and virtual merges. It was also of great inspiration the immersive experiences designed by the architect and artist Philipp Beesley, such as "Hylozoic Soil",[xiv] where a completely artificial ecosystem of robotic and mutant plants and organisms is built, creating a responsive environments that reacts to the users actions.





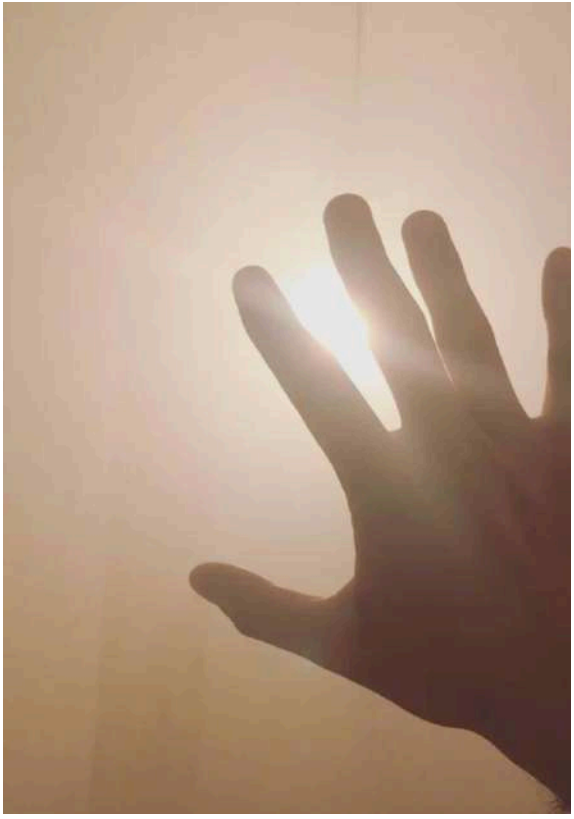
THE GARDEN OF THE EARTHLY DELIGHTS
VR IMMERSIVE EXPERIENCE - 2018

4. THE ARTIFICIAL ATMOSPHERES

To recreate specific ambiances and atmospheric conditions, countless elements can be used; wind turbines, water atomisers, fog machines, different light sources… The aim is sometimes to recreate existing atmospheric phenomena present in nature, while in some occasions the goal is to use these elements to build an completely new experience that is nowhere to be experienced in the real world.

The use of elements such as water, wind, for or light in some artist's production was a source of inspiration for this research, specially the work of Olafur Eliasson, previously referenced for his works with light and reflections. Installations such as "The weather project",[xv] "Beauty"[xvi] or "Your blind passenger",[xvii] reflect on these *artificial atmospheres* by recreating natural weather phenomena inside closed spaces, making possible to experience being close to the sun, touch a rainbow or immersed inside a foggy coloured cloud. All the pieces use the artificial ambiances to build an environment where the visitor can interact with it, establishing a direct and more intimate connection.

Artificial atmospheres can also be used as element of design in the architectural scale too. An impressive example of this is the project "Blur Building"[xviii] designed by the studio Diller Scofidio + Renfro, where a large scale human made cloud is used to shape a pavilion placed on the surface of a lake. The light structural components are then covered with this artificial cloud, being the space a mixture of build environment and atmospheric elements.

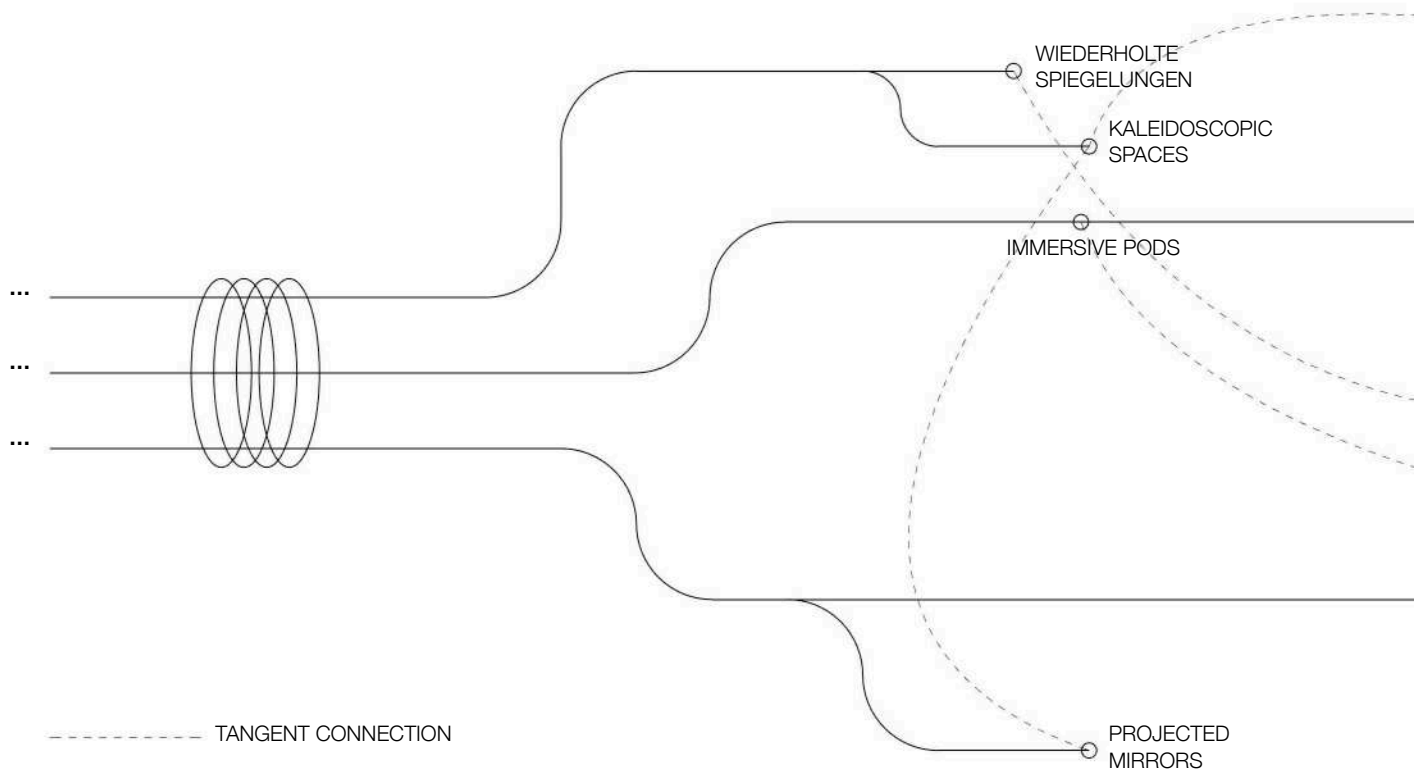


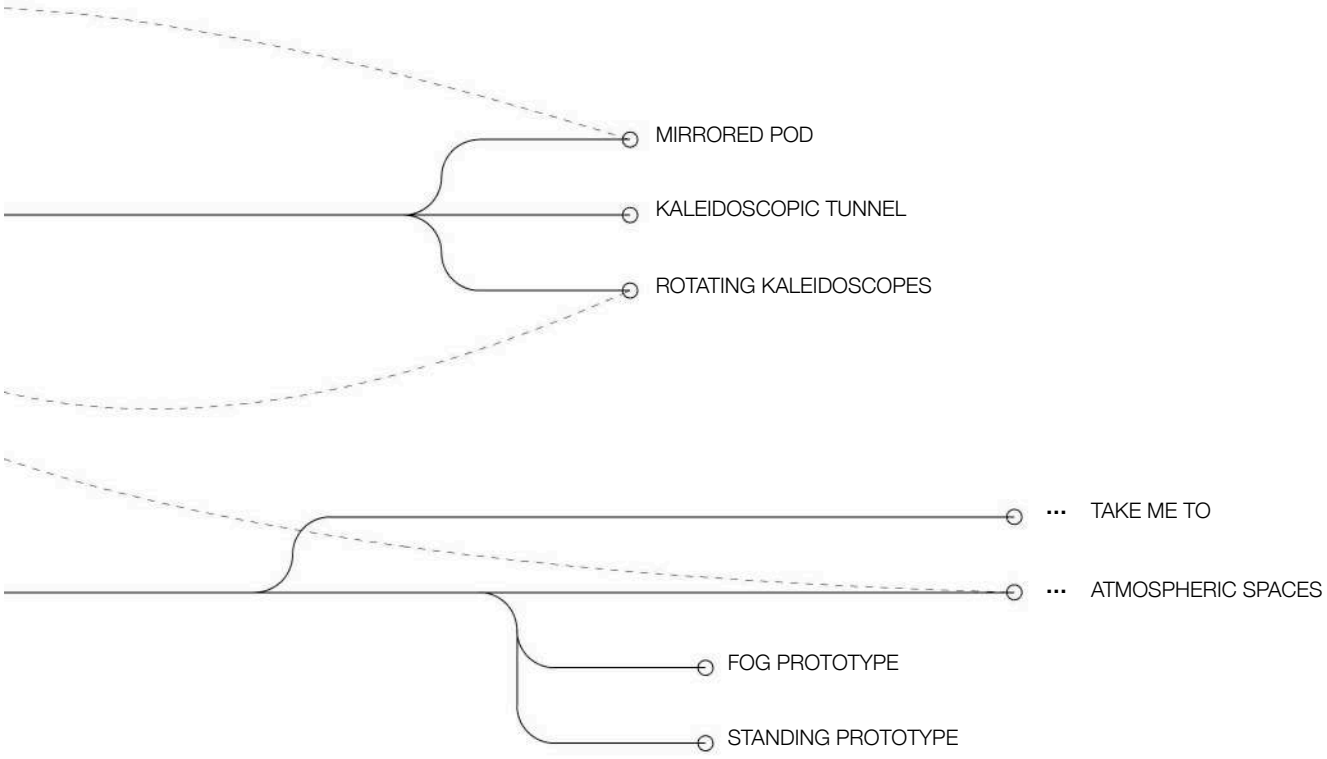
ARTIFICIAL ATMOSPHERES
EXPERIMENT WITH FOG MACHINE - 2020

II. CREATIVE CHRONOLOGY

The creation of the final prototype presented in this thesis has been a journey by itself, and has followed a non-linear process. Some of the ideas that shaped this research were born in previous projects, some died on the way and some emerged as parallel investigations, running at the same time as the prototype was being developed.

I would like to present here a timeline with a selection of the most relevant projects, ideas and experiments that proceeded or accompanied the creation process of the final prototype, and helped defining the thesis even before it started.


WIEDERHOLTE
SPIEGELUNGEN
KALEIDOSCOPIC
SPACES
IMMERSIVE PODS
...
...
...
TANGENT CONNECTION
PROJECTED
MIRRORS


MIRRORED POD
KALEIDOSCOPIC TUNNEL
ROTATING KALEIDOSCOPES
... TAKE ME TO
... ATMOSPHERIC SPACES
FOG PROTOTYPE
STANDING PROTOTYPE

1. WIEDERHOLTE SPIEGELUNGEN *[ITERATED REFLECTIONS]*[xix]

An interactive wunderkammer [collection of rarities] with infinite reflections of Thuringia.

Being this the first project where the idea of the mirror and its reflections is present, could be considered as the very beginning of this thesis topic. The installation was developed in collaboration with the Klassic Stiftung Weimar and showcased at the Bauhaus-Museum Weimar on the occasion of the exhibition Kultur Satelliten, and reflects on the idea of *experimental learning*. By interacting with the piece, the users can discover different location inside the german state of Thuringia.

The interactive installation presents "hidden satellites" from Thuringia in a playful way, creating *kaleidoscopic collages* of images inside the different mirrored cabinets that conform the piece. The users are encouraged to open these cabinets or chambers, that conceal a unique view from a distinct location, and also to interact with them and with other fellow explorers. They are able to rotate a set of pulleys placed on the inside of every mirrored cabinet to activate a rotating mechanism that triggers a process of fractal and ever-changing configurations. The inner separation between chambers is made with two-sided mirrors, creating different effects and overpaying collages whenever a different door is open; making some elements and configurations only visible when the installation is used by more than one visitor.







WIEDERHOLTE SPIEGELUNGEN
[ITERATED REFLECTIONS]
BAUHAUS MUSEUM EXHIBITION - 2020

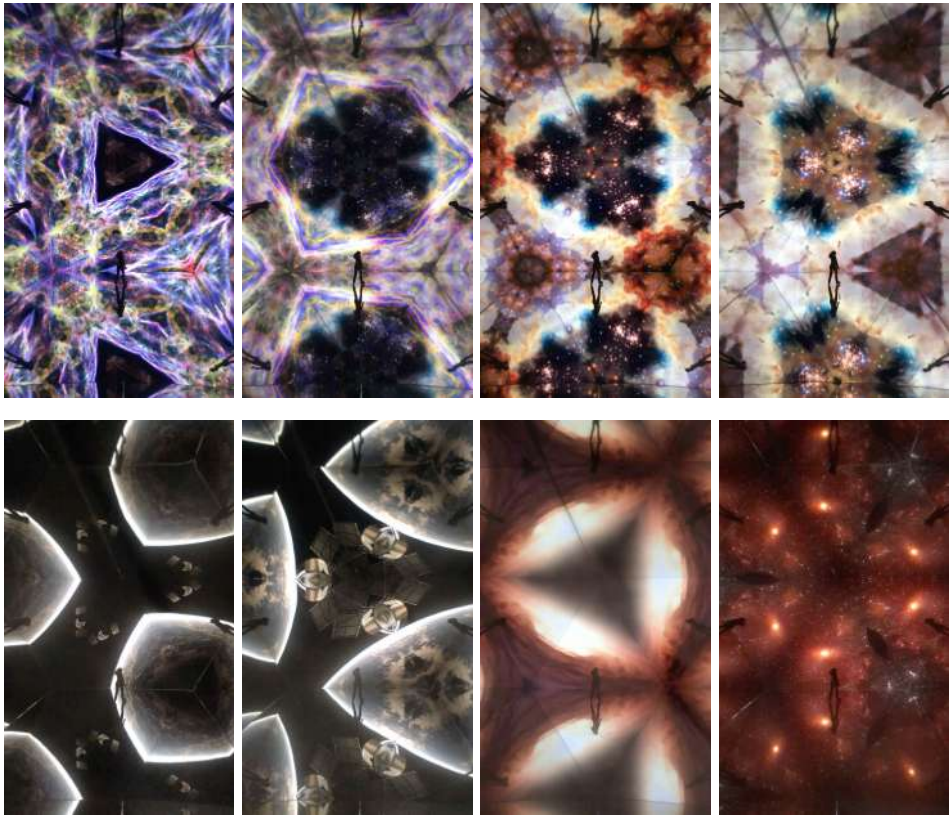
2. KALEIDOSCOPIC SPACES

After having worked with mirrors and reflections for the previously presented project, it was for me the next logic step to transform this kaleidoscopic experiments into a more architectonical scale. With the same idea of *endless reflections*, started to carry out some more experiments with bigger mirrors and the human scale. For that matter, I built a large scale kaleidoscope, that when placed in front of a screen could display fractal collages based on any desired video or image.

These experiments inspired a first thesis proposal, which was at that moment specially focused on the idea of mirrors and their reflections, and how immersive experiences could be developed using those two elements. A short abstract of that first draft can be found under the epigraph "archive of ideas / the mirror".

A set of videos and pictures were taken using this prototype, and served as inspiration for the later stages of the project. In all these experiments, images of the universe captured by NASA's Hubble telescope where used to create the kaleidoscopic compositions, also opening new research paths about space travel and experiencing *non-reachable locations*.

Also some experiments with water vapour were carried out inside the kaleidoscope, showing the first steps of what would turn into a main element inside the *atmospheric spaces* research.



KALEIDOSCOPIC SPACES
PROTOTYPE - 2020

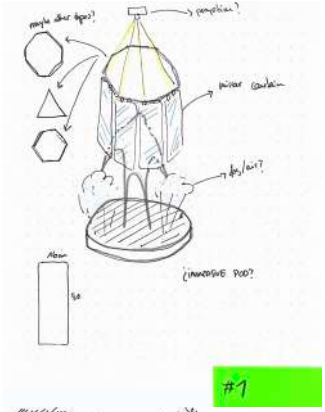
3. IMMERSIVE PODS

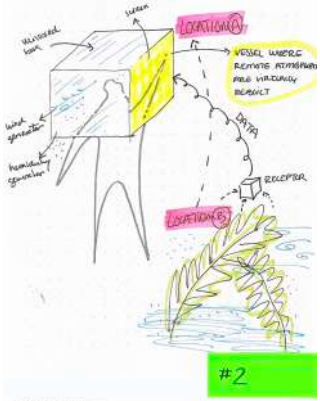
Next step on the process was to scale down the kaleidoscopic spaces prototype, creating a set of small *immersive pods* that followed the same idea of immersion through reflecting mirrors and *atmospheric phenomena*.

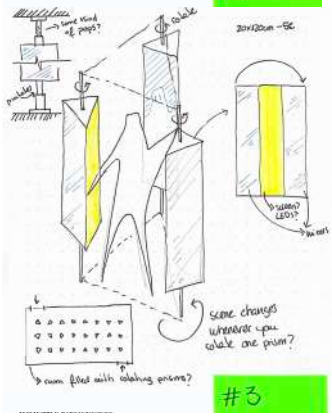
Although every proposal had a different spatial configuration, all pods shared the same core idea: a small closed space where the users could immerse themselves in different *ambiances*, that would be reproduced using natural elements like plants, water or steam.

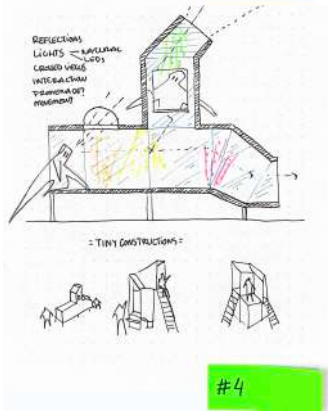
Some of the pods also presented reflective elements, like mirrored curtains (#1), compartments built using two-sided mirrors (#2), or even large scale kaleidoscopic tunnels (#4). On every proposal, the interaction user-space is key, triggering some change or response on the installation itself.

The idea of the user as a *traveller* appears already in some of these examples (#2, #3); presenting the possibility to experience distant locations inside the pod. For some prototypes, it was planned to collect live data from these distant locations, affecting the inside of the pod by determining parameters such as light or sound.









IMMERSIVE PODS
SKETCHES - 2020

4. PROJECTED MIRRORS

The first built prototype was based on some of the previous sketches, consisting of a circular space enclosed with light fabric, with a mirrored curtain all along the inner perimeter. The mirrors, divided into tiles, worked as a canvas where visuals and colours were displayed using projectors placed on the upper part of the setup.

This was the first prototype where the idea of a *soft vessel* or space container appears, creating an enclosure where all the experience happens. There were still no additional light sources, audio or morphing reflections involved, but I consider this prototype as the very first version of the current installation. The projections were after some experimentation discarded, and therefore this version of the prototype disregarded.

The research moved into a more *abstract* and *suggestive* direction, using colours instead of projected visuals, allowing more room for the traveler's own interpretation of the atmospheres rendered inside the *vessel*.









PROJECTED MIRRORS
PROTOTYPE - 2020

5. TAKE ME TO - ATMOSPHERIC DEVICE

Parallel to the development of the final prototype, and using some of the elements developed for it, I started to work on a device that could provide part of the same experience but at a more accessible scale. The aim was to create a small and convenient object that could be easily used at home, and could convey the experience of the set of different atmospheres developed for the bigger prototype.

After some research and prototyping, I came up with a white thin frame containing a light source that can reproduce different colour palettes and animations inspired on different distant locations and experiences. The user can select using their smartphone where they want to be taken to, choosing from a range of different atmospheres. The device works using similar technology to the bigger prototype, and can connect to the wifi network to be controlled wirelessly.

At this point, the divide is still under development, but the aim is to create a finished product that could be used by people to experience different *atmospheric spaces* from every possible location.











TAKE ME TO
PRODUCT DESIGN - ONGOING

ELEMENTS OF DESIGN

To render the different *atmospheric spaces* and experiences, a range of various elements will be used to reproduce different phenomena, including light, sound and reflections. All these factors will be controlled and carefully adjusted for every different rendered destination or atmospheric space, to create an *immersive experience* that resembles either a distant or a non yet existent/reachable location.

The different locations will be translated and reinterpreted inside the *vessel* using two different light sources. These are placed on both the top and bottom ends, creating gradients of colour that fill the contained space, bouncing and sliding on the soft enclosure that forms the vessel, creating an almost *tangible ambiance*. The immersion is enhanced by the *spatial audio*, that emanates from the top part of the installation and fills the space. To complete the experience, a *morphing mirror* placed above the traveller's head creates mutant and ever-changing reflections and throws scattered bits of light all over the vessel. The traveller is also able to see their own *morphing reflection* on the mirror's surface, while it fuses with the colours and shapes that surround them.

I. THE VESSEL

To display the different *atmospheric spaces*, a closed environment is created, allowing full control of a range of parameters. The vessel consists of two main elements: the *upper plate*, that holds the mechanics, provides structural support for the installation, and closes it on the top part, and the soft enclosure, that delimitates the space and acts as a *soft membrane*, establishing a physical barrier between the actual location where the installation is placed, and the atmospheric space that it's rendered inside it.

The circular shaped space directly responds to the human-size, big enough to allow the *traveler* to move, but still tight to provide as intimate experience. As in some examples of vernacular architecture like some igloos, the size of the space responds directly to the human body measurements, being the inner radius of the vessel equal to the standardised distance from the index finger to the elbow. In that way, the traveler, while standing on the centre of the space, can reach the membrane at any time with the tip of their fingers. On the vertical axis, some more space is left between the traveler's head and the upper lid, creating a big blank canvas where the light and reflections will fill the empty surface.

The whole installation is designed to be hanged from the ceiling using three anchor points forming a one meter equilateral triangle. While all the technical elements are contained in the vessel itself, the power supply needs to be placed on the floor.



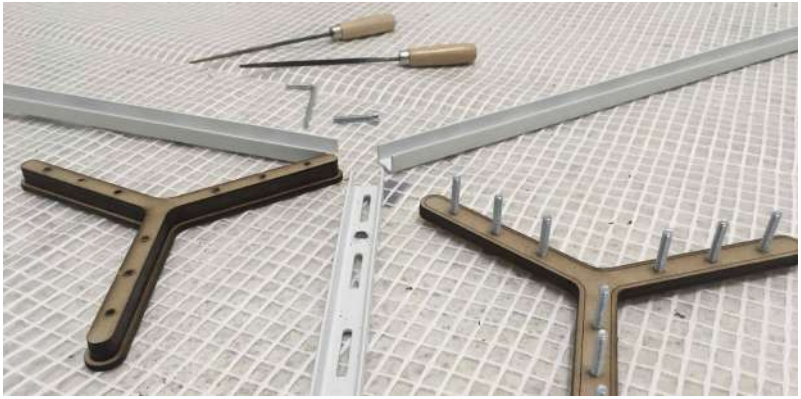
ATMOSPHERIC SPACES
VESSEL
BUILT INSTALLATION - 2020

1. UPPER PLATE

The upper structure consists of three concentric rings held together using six metallic railings with clips, equally distributed every 60º, providing support to the rest of elements that conform the installation. While the outer and inner rings hold the soft membrane, the middle ring acts as a frame, holding the top light source, as well as the lid that closes the vessel on its upper side. To ensure the stability, three of the metallic railings (one every 120º) are tied together using a custom laser-cut element on the central point. The central piece also holds the morphing mirror placed on the top of the installation, as well as the audio system embedded in the upper structure.

2. MEMBRANE

The membrane consists of two parallel layers of soft light white fabric, and are hanged from the upper structure with a fifteen centimetres offset between them, leaving some space for the upper light ring. The membrane provides some closure from the outside, yet allows light and sound pass through, creating some kind of permeable and ephemeral space. The membrane is divided into six different sections, letting the traveler cross its perimeter and access the atmospheric space on its inside, leading each entrance to a different location or experience.





ATMOSPHERIC SPACES
BUILT INSTALLATION
UPPER PLATE STRUCTURE - 2020

II. LIGHT RINGS

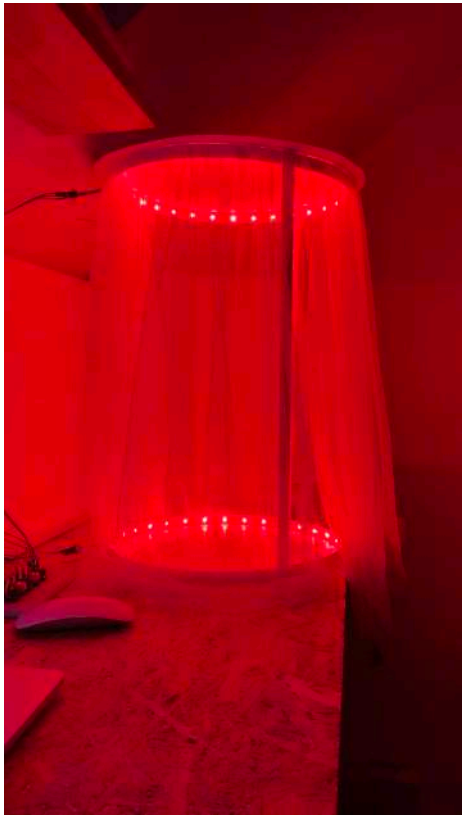
To reach the desired level of tone and saturation, two different sources of light are placed inside the vessel; one on top, attached to the upper structure, and another parallel to it, laying on the floor. Both rings are made of a structural PCV ring, and a RGB LED strip connected to the microcontroller that runs the whole installation.

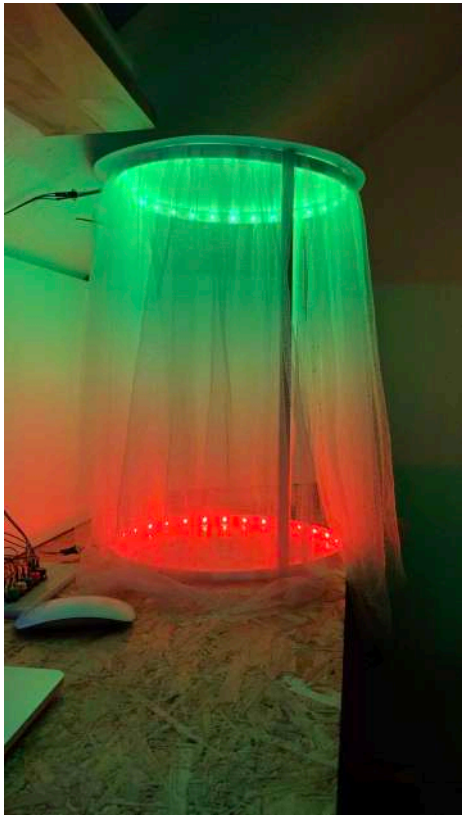
The upper ring, attached to the metallic railings using tubular clips, doubles as the frame to hold the upper lid, made of stretchable white fabric, closing the capsule and offering some diffusion for the light. The lower ring, placed on the floor, serves as delimitation for the enclosed space, and is able to display light independently from its upper counterpart. The LED strip here is placed inside a diffuser channel attached to the PVC ring that forms the main structure. This enclosure covers the light source, creating a softer and more evenly distributed colour, while keeping the light source hidden from the view.

Both light rings can display a single static colour that will fill the space with smooth top-to-bottom gradients over the soft enclosure, light animations or even strong strobe effects. All the light animations and gradients are designed using colour palettes based on pictures taken from the actual locations, that were then used to create colour palettes (shown for every atmosphere under the section "distant and imaginary realities" later on the text).



ATMOSPHERIC SPACES
BUILT INSTALLATION
LIGHT RING - 2020









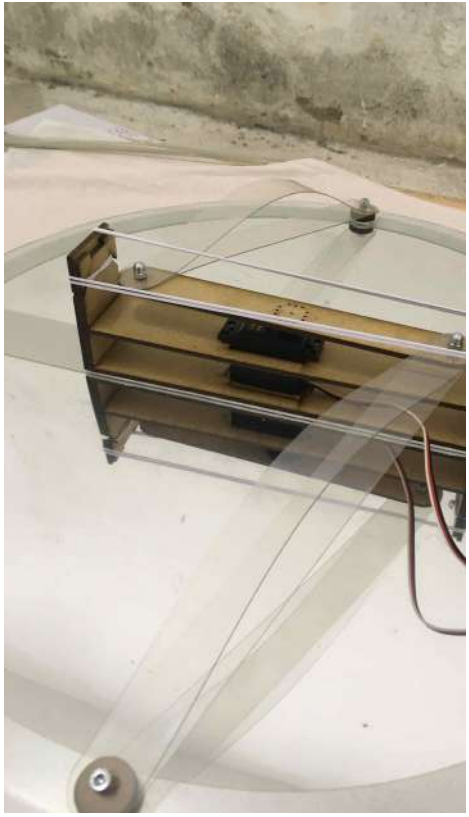
ATMOSPHERIC SPACES
1:6 PROTOTYPE
COLOUR GRADIENTS STUDY - 2020

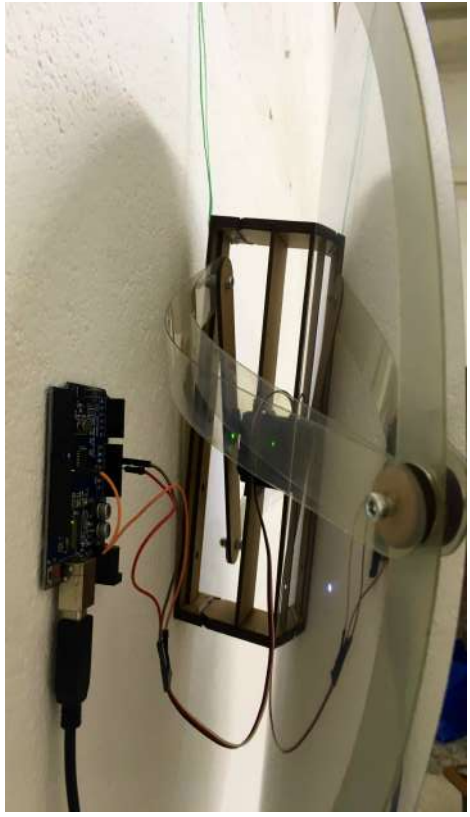
III. MORPHING MIRROR

The mirror element is implemented in the vessel through a reflective element attached to the upper structure, hanging bellow the fabric lid and pointing downwards, directly to the central point of the space. This mirror, shaped as a circle, changes its shape, bending both its surface and the reflections that it produces. This creates an ever-changing and sometimes distorted reflection of the traveller, as well as a range of morphing light reflections on the inside of the vessel's membrane and floor.

The mirror is built using a thin sheet of reflective PVC, attached to a moving mechanism on its back, that allows the surface to bend upwards and downwards. The mechanism, designed using cad software, is partially built using MDF 3mm thick sheets, and was laser cut to create the structural part of the moving pieces. For the flexible structure, transparent PVC was laser cut, to create a pair of flexible arms and a frame to add rigidity to the reflective surface.

To make the mirror move, a strong servomotor is used, enough to provide torque to rotate the mechanism and produce movement on the reflective surface. The servomotor is then, as well as the led strips in the light rings, to the microcontroller that runs the whole installation.





ATMOSPHERIC SPACES
BUILT INSTALLATION
MORPHING MIRROR MECHANICS - 2020

1. INNER REFLECTIONS

When the traveler looks up and faces the top part of the installation, they can observe themselves surrounded by the space inside the vessel, immersed in the rendered atmosphere. After a more careful look, they can see how their reflection starts to morph, bending and fusing with the also distorted surrounding. The mirror offers the traveler unlimited visions of themselves, as in the *kaleidoscopic spaces*, and creates an ephemeral collage that merges traveller and destination.

2. OUTER REFLECTIONS

When the light rings turn off and just the traveller and the mirror reflections remain inside the vessel, unknown sea-like creatures seem to appear, slowly walking on the surface of the membrane, as if a new ecosystem was suddenly created there. These evolving shapes change, and sometimes, turn into water reflections, bits of scattered light all over and around the traveller. Some other times, they even turn into human-like creatures, that slowly walk by, before they transform back into morphing light reflections.



ATMOSPHERIC SPACES
BUILT INSTALLATION
MORPHING MIRROR, PERSONAL REFLECTIONS - 2020









ATMOSPHERIC SPACES
BUILT INSTALLATION
MORPHING MIRROR REFLECTIONS - 2020

III. SOUND

To enhance the immersive experience with every atmosphere rendered inside the vessel, stereo sound is used. Speakers placed inside the upper plate provide another layer to the multi-sensory experience, changing the track and adapting the volume according to every different distant and imaginary reality displayed.

The atmospheric sounds are triggered the same way as the light rings, whenever the traveler enters the vessel. Sometimes it runs parallel to the light animations and the reflections produced by the morphing mirrors, but some other times plays with no other element active inside the vessel. Depending on the rendered atmosphere, the audio ranges from plain recordings taken at the different distant locations to auditive collages, processed audio tracks more subtle and suggestive.



ATMOSPHERIC SPACES
BUILT INSTALLATION
UPPER PLATE LAYING ON THE FLOOR - 2020

IV. DISCARDED PHENOMENA

A selection of atmospheric elements were tested during the design process, but have not been included in the final prototype. I would like to present here the experiments that showed more potential, and that could possibly be implemented in future versions.

1. FOG

Some experiments were carried out with artificial fog, that would be connected on the upper plate to a distribution system to evenly spread it from there. The fog provided more tactile properties to the light, thickening the air and creating a more dense atmosphere. The lack of natural ventilation and a proper exhaustion system made it impossible to implement this element on the final prototype.

2. BREEZE

It was intended from the very beginning to have some breeze and wind inside the installation, creating movement on the textile membrane and providing the illusion of a breeze for some of the atmospheric spaces.



DISCARDED PHENOMENA
EXPERIMENTS WITH LIGHT AND FOG MACHINE - 2020



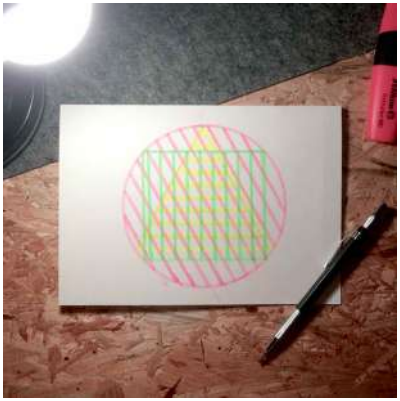
DISCARDED PHENOMENA
EXPERIMENTS WITH BREEZE AND FABRIC - 2020

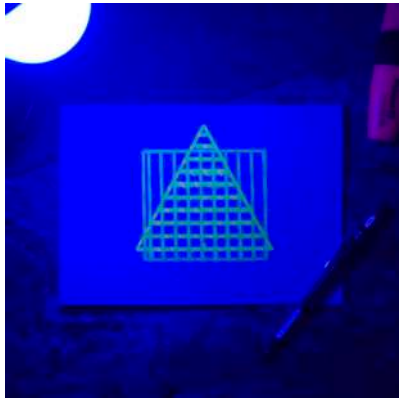
3. PRIMARY COLOUR FILTERING

Looking for ways to display graphics and patterns on the surface of the vessel, some experiments using RGB colour filtering were carried out. When using a strong coloured light with any of the primary colours as a filter, it is possible to either reveal or conceal overlapped images printed with the same RGB colours. With just a change of colour, the vessel's outer membrane would acquire a completely different aspect, making it possible to easily and quickly shift the traveler's perception of the space.

4. TWO-WAY MIRROR PROJECTION

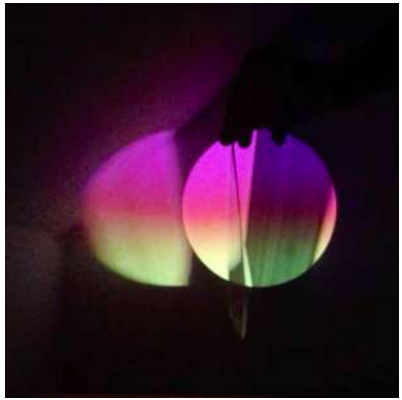
To create the illusion of holographic images, multilayered projections were done on regular mirrors and two-way mirrors. When the projection hits the two-way mirror, part of the image reflects on its surface, while part of it passes through the mirror and lands on the surface behind it. With one light source or projector is possible to create intricate compositions, a kind of kaleidoscopic projection that can turn into a dynamic image by rotating the two-way mirror.





DISCARDED PHENOMENA
EXPERIMENTS WITH PRIMARY COLOUR FILTERING - 2020





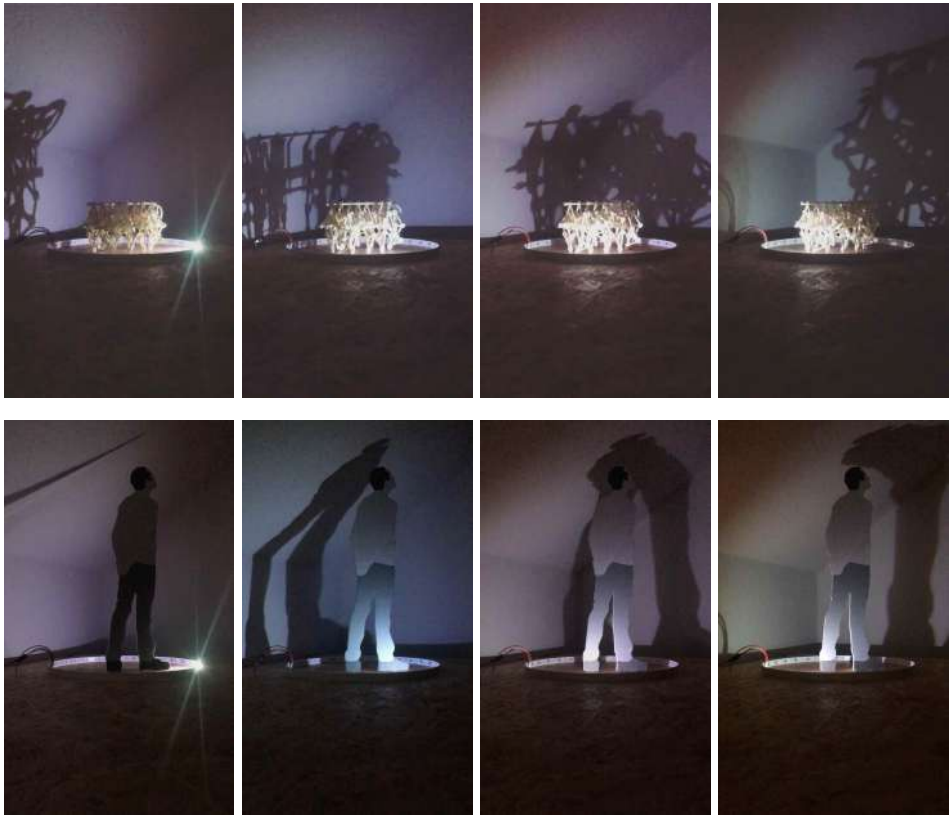
DISCARDED PHENOMENA
EXPERIMENTS WITH TWO-WAY-MIRROR PROJECTIONS - 2020

5. CINEMATIC SHADOWS

Based on the idea of the phenakistiscope[xx], an optical device invented in the 19th century that used spinning images to create the illusion of smooth motion, some tests with fast moving lights were made. The idea was to create, from the travellers point of view, the illusion of motion inside the vessel, projecting their shadows on the enclosure. At a very fast pace, an LED in the bottom light ring is turned on, while the previous one is turned off, creating the illusion of a bright white light running along the ring. The shadows projected on the vessel appear then to move around the traveler, creating a distorted stroboscopic projection.

6. ATMOSPHERIC LIGHTING

In order to produce heat inside the vessel, infrared lights could be used to recreate the sensation of standing in the sunlight. This light, also known as heat radiation, is part of the electromagnetic spectrum, and is able to emit big amounts of energy (infrared radiation) which the human body feels as heat. Infrared lights could be used to recreate warm atmospheres, and in combination with some of the other elements, make the user feel *real sunlight* inside the vessel.



DISCARDED PHENOMENA
CINEMATIC SHADOWS - 2020

ITERATIVE DESIGN

After conducting experiments and building some prototypes shown in a previous section, I started using 3d software to model different versions of the installation, adding and removing elements and changing also the building process from version to version.

From the very beginning in the design process, it was clear that the installation would happen inside an enclosed space, contained by a soft circular membrane that would hold the atmospheric spaces within itself. Following that premise, every version presents a similar outer shape, using fabric as a light material to create the separation inside-outside, but changing its proportions on every design iteration.

The bigger changes during the design process are visible on the elements that conform the inside of the vessel, and the way they are arranged on the setup; some elements disappear, change their shape or number, or evolves to a more complex version. While some of the atmospheric elements made all the way through the process until the last version, some of them were discarded, but still kept as possible options for future iterations of the installation (those elements are also presented in this text under the section "discarded phenomena").

V1

This first proposal of the installation presents a single layered outer shell, made out of a heavier fabric. On the inside, three curtains of reflective tiles cover most of the perimeter, leaving space for three entrances to the inside of the vessel. The light source is not designed yet, but is planned to be installed somewhere in the upper plate, a heavy black lid that contains the technical elements and serves as structural support for the whole installation. A circular pipe, also attached to the upper piece, is connected to a fog machine, that will fill the space with artificial fog when the atmospheric spaces rendered need this element.

At this point, there is no structural or building concept, and the whole installation is thought to be attached either to the ceiling or held by thin poles attached to the upper lid and to the floor.



ATMOSPHERIC SPACES
DESIGN ITERATION V1 - 2020

V2

In the second iteration, a refined version of the previous one, three projectors are added to the set of technical elements. Attached to the upper structure, they would project over the mirrors and the membrane, creating an immersive 360º projection that mixes reflections from the curtain of mirrored tiles and projected graphics. Also, a ring of light is planned, attached to the railing from where the reflective curtain hangs.

On the upper part, it is also possible to see three fans that would provide some breeze to the installation, and work as an exhaustion system to get rid of the artificial fog when it is no longer needed inside the vessel. Also, a central element is designed to hang from the upper plate, and hosts three different lamps: an RGB lightbulb, a stroboscopic and an infrared light. These light elements are part of the discarded phenomena, and would have been used to produce some atmospheric lighting and to recreate the primary colour filtering effect, both previously introduced in the text.

The structural concept is still not developed, but it is assumed that the upper plate will be rigid enough to hold all the technical elements.



ATMOSPHERIC SPACES
DESIGN ITERATION V2 - 2020

V3

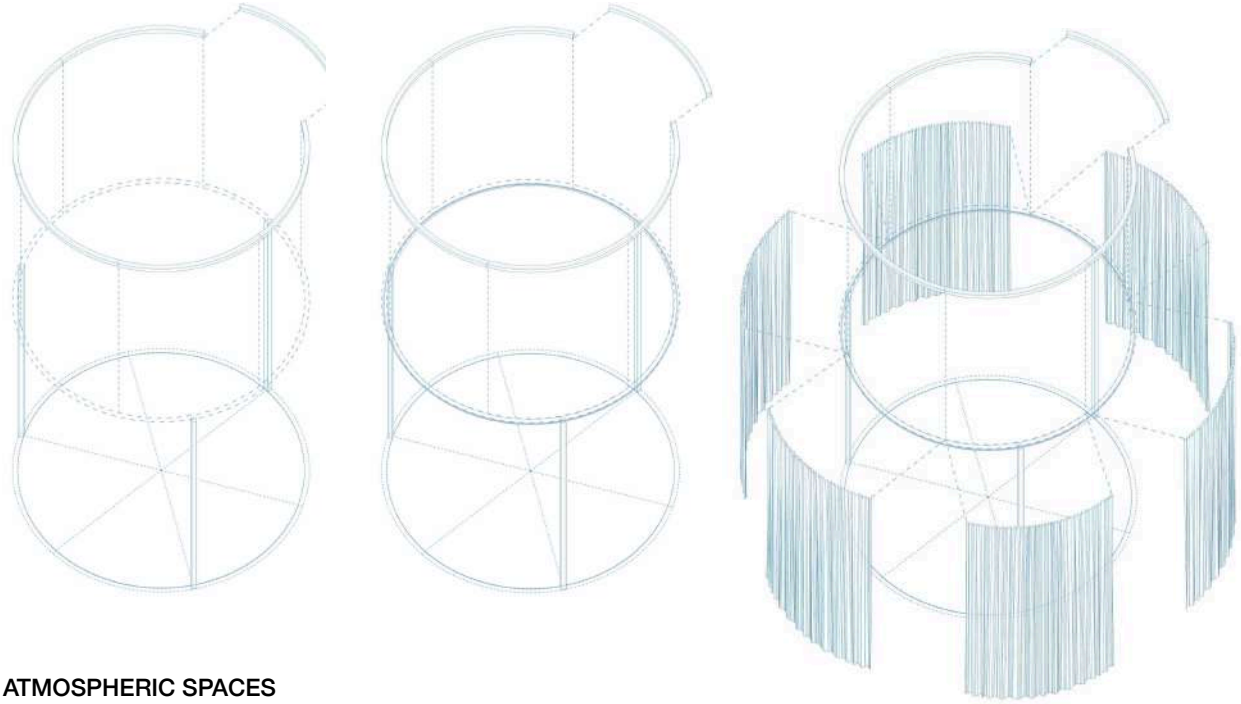
In the third version, the installation presents already a structural concept, where three poles attached to an upper structural ring hold the outer membrane and the curtain of reflective tiles.

In this iteration, many of the previous technical elements disappear, creating a more minimal and suggestive experience. The projectors and atmospheric lighting are replaced by a brighter light, adding a second ring of light parallel to the first one, also attached to the main structure. The artificial fog is distributed using a transparent plastic pipe that runs parallel to the previously mentioned light rings, acting also as a light diffuser.

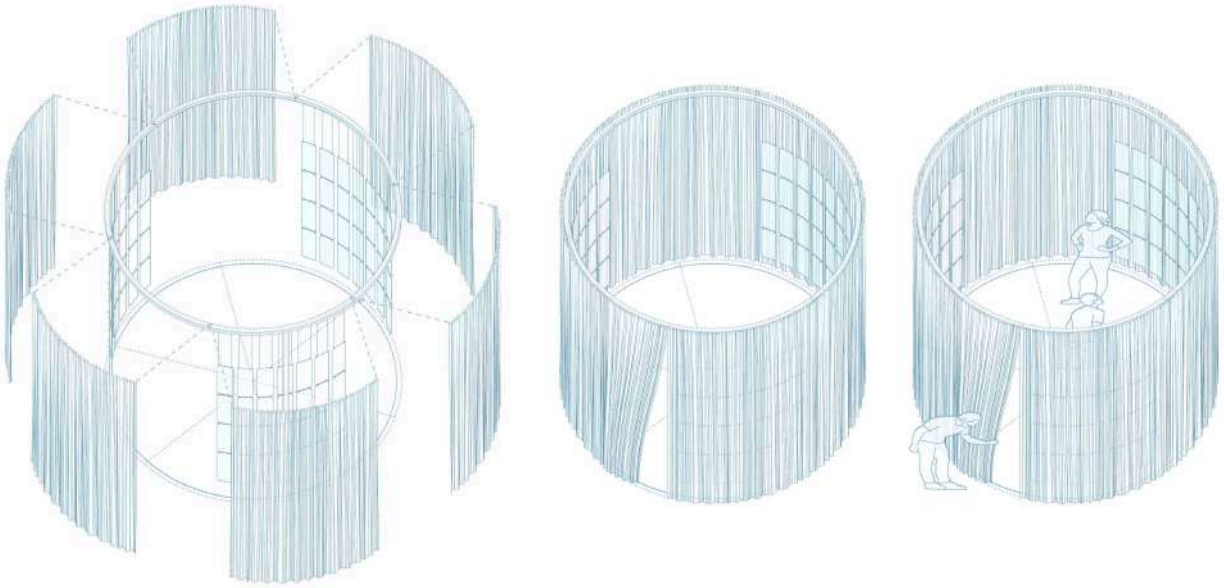
For this iteration of the design, some kind of reflective floor is planned, augmenting the reflections from the mirrored curtain and making the light coming from the upper light rings bounce back to the membrane.



ATMOSPHERIC SPACES
DESIGN ITERATION V3 - 2020



ATMOSPHERIC SPACES
BUILDING PROCESS
DESIGN ITERATION V3 - 2020



V4

This iteration is the last and final version, and includes all the elements present on the built installation. The structural concept changes from a set of poles supporting the upper plate to a hanging system, consisting on three anchor points forming a one meter equilateral triangle. The structural rings, made from PVC pipes, are held together by metallic pieces, and act as a frame for the upper stretchable plate, as support for the light rings, and as railing for the curtains that conform the membrane.

In this iteration the membrane gets a second layer, creating a deeper and more complex enclosure. The overall dimensions also change, making the enclosed space taller and narrower, allowing the traveler to have a more intimate interaction with the piece.

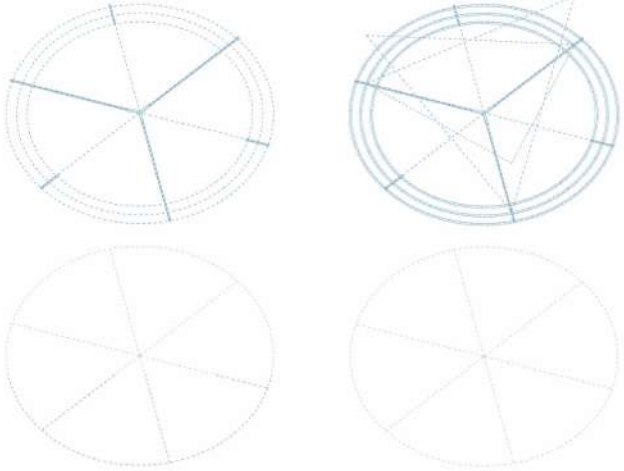
One of the light rings is moved from the upper plate to the floor level, allowing gradients of colour that go from the top part of the vessel to the ground.

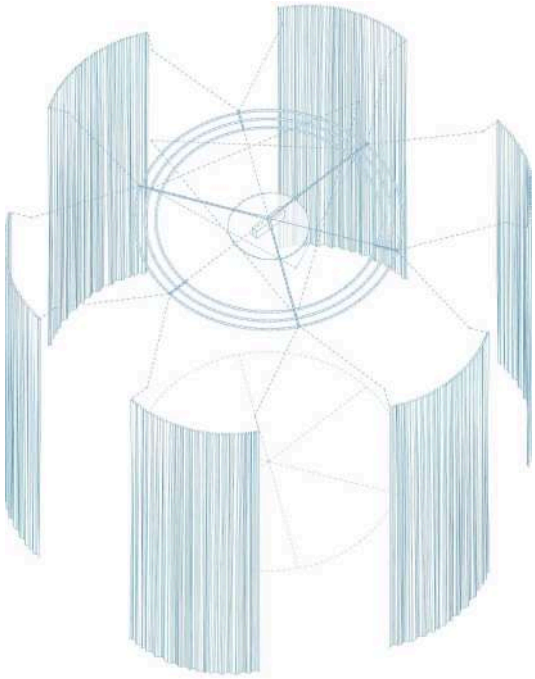
The curtain of mirrored tiles disappears, evolving to the morphing mirror, that is now placed on top of the traveler's head, hanging from the upper plate.

The artificial fog disappears, creating a more light and less suffocating experience, and making the use of exhaustion fans unnecessary.

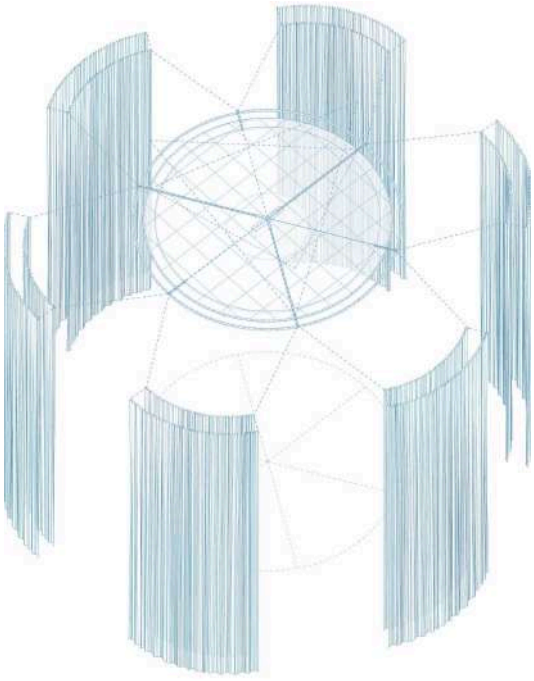


ATMOSPHERIC SPACES
DESIGN ITERATION V4 - 2020





ATMOSPHERIC SPACES
BUILDING PROCESS
DESIGN ITERATION V4 - 2020





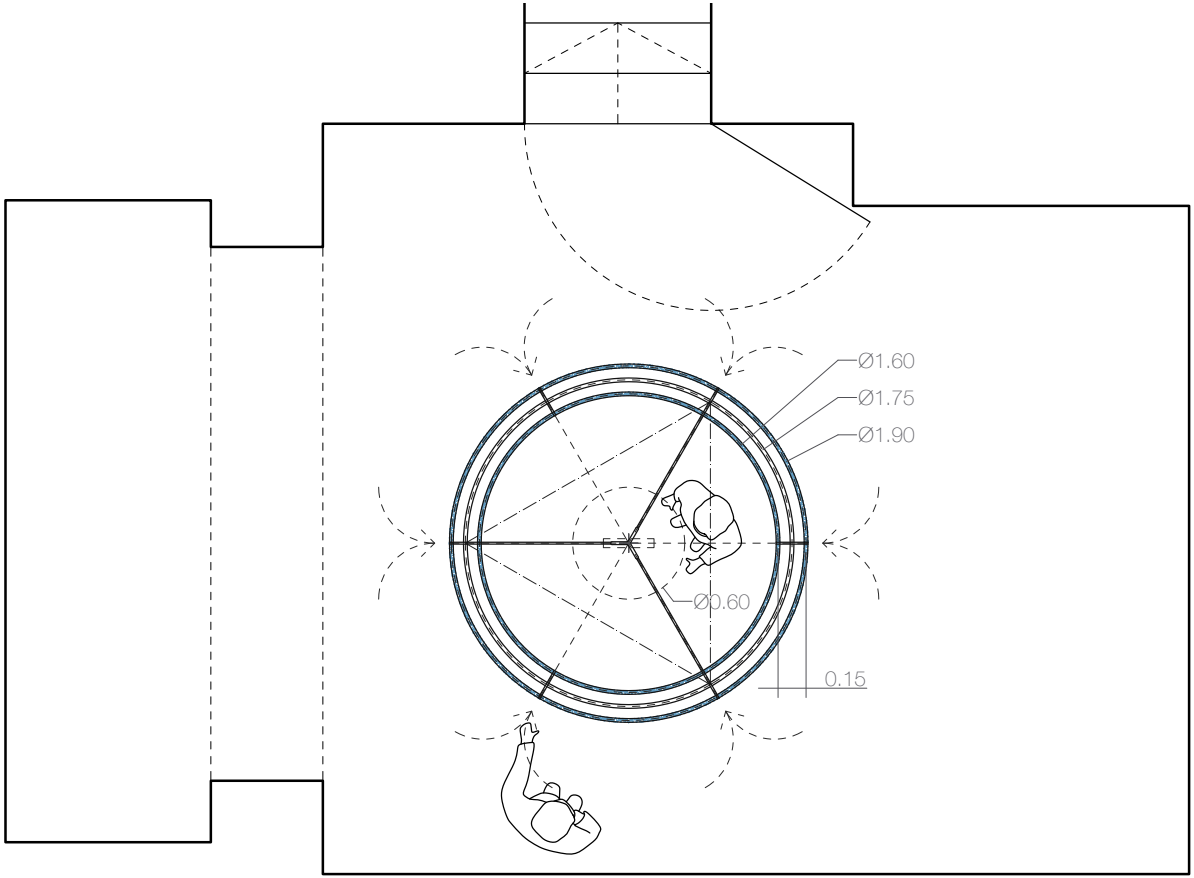


FINAL PROTOTYPE

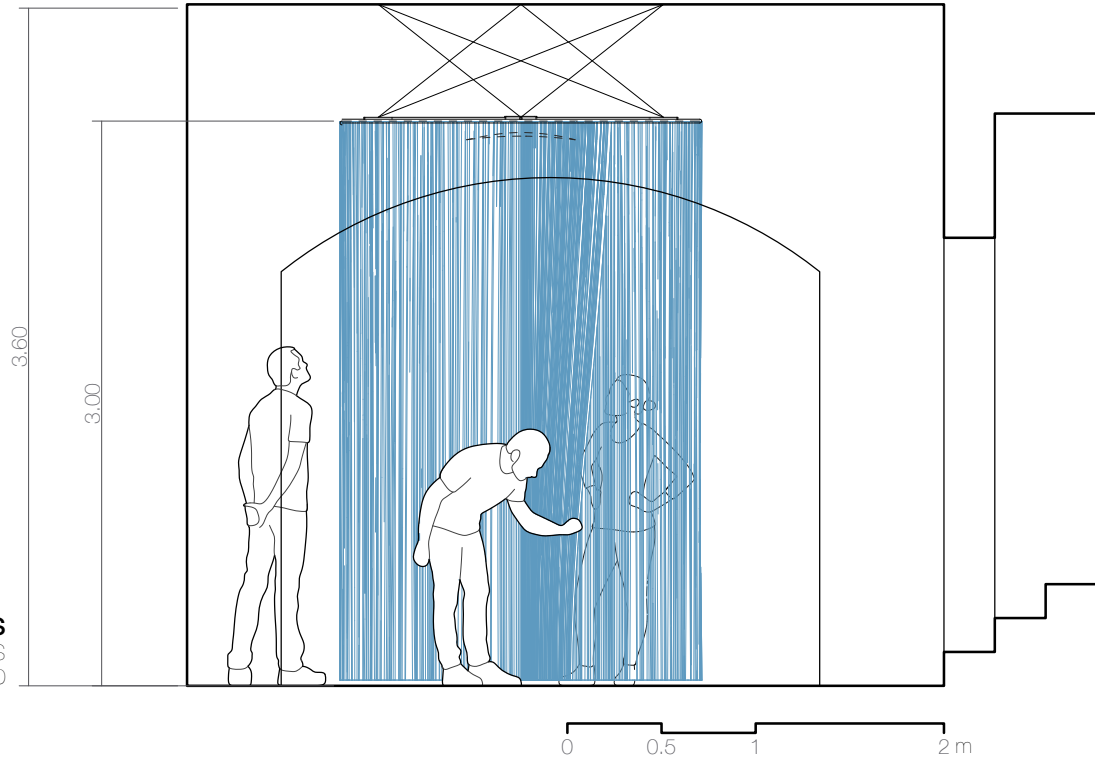
In order to test the different atmospheres and to refine the overall design of the installation, a 1:1 scale prototype was built, following the design of the V4 iteration already presented in the previous section. The prototype followed several transformations, parallel to the ones presented on the iterations V1-V4, adding and removing design elements during the process.

I. TECHNICAL DRAWINGS

In the following drawings, the prototype is presented in the space where it was developed and built, and shows general dimensions of the installation and its elements. The prototype could be installed in any dark space with more than three meters and a half of height and with at least four by four meters of free surface.


Ø1.60
Ø1.75
Ø1.90
Ø0.60
0.15

I. TECHNICAL DRAWINGS



ATMOSPHERIC SPACES
TECHNICAL DRAWINGS
DESIGN ITERATION V4 - 2020

II. PICTURES

All the pictures shown in this section were taken from the actual built prototype at its latest iteration, and show the working installation and some closer details of the different elements that conform the vessel.

The prototype was build over the period of four months (including all the different iterations) at one of the basements at the Bauhaus-Universität Weimar. The dimensions of the space are big enough to accommodate the installation, but a wider location would provide more perimetrical space to walk around the vessel. Also the presence of pipes made it impossible to reach three meters of hight inside the installation, having around two meters and a half from the upper plate to the floor. Some electrical boxes are also installed on the walls, making the space a bit less clean than desired. Although the space is not optimal, it provided enough room during the prototyping process.

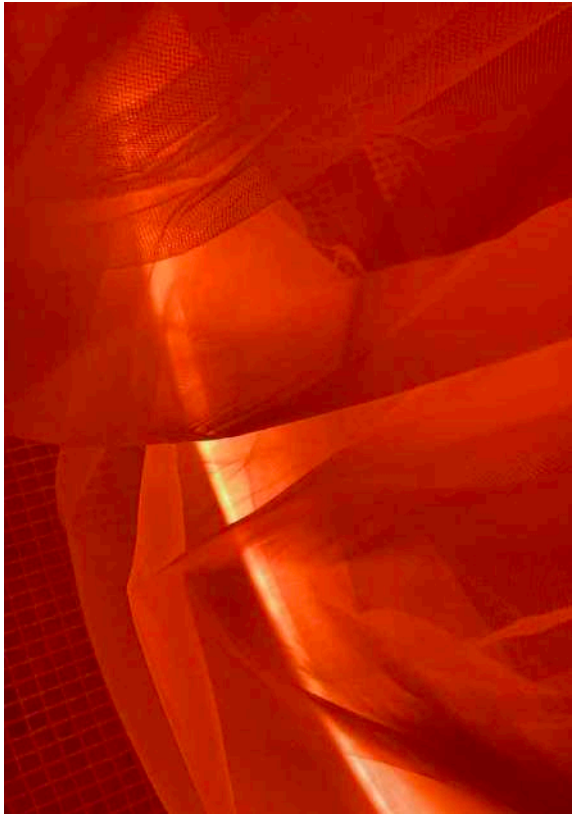
For future hypothetic exhibition venues, the space would ideally be wider, higher and with dark flat walls, with the possibility of having complete darkness on its inside. A good ventilation would also be needed if additional atmospheric elements like the artificial fog were added to the setup.

For a video showing the installation in action, please visit www.carlosgarciafernandez.com











INTERACTION

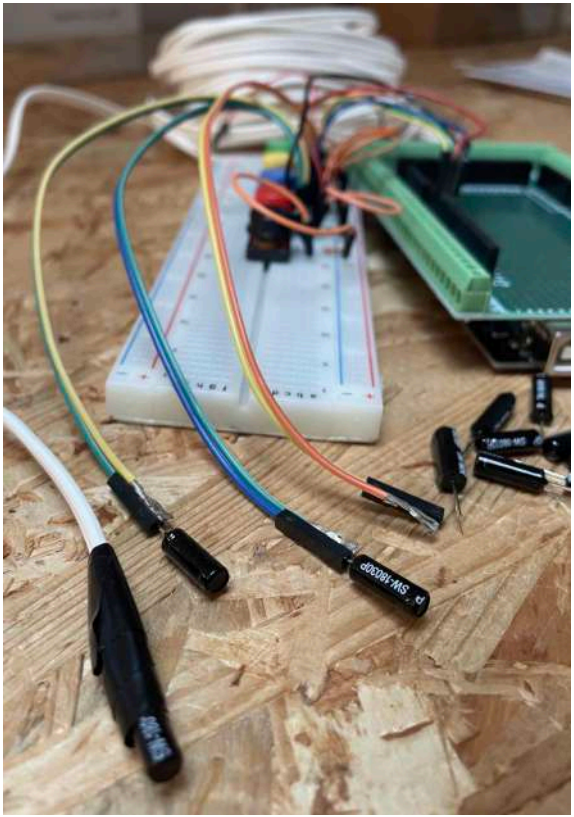
The interaction traveller-installation happens naturally and does not need prior knowledge or explanation, making use of the *affordance* of the vessel's outer membrane, shaped as light semitransparent curtains. Affordances, from an interaction design point of view, are the features of an object that clearly presents how the object should be used or what can be done with it. Making use of this property is key in user interaction design, making the process effortless and intuitive.

Standing outside the vessel, the traveler perceives that they can get across the membrane by drawing the curtain that conforms its perimeter, and will be able to decide which one of the six openings in the fabric wants to use to access the inside. As long as the traveler does not touch the curtains, the vessel remains in a dormant state, sometimes showing some slight sign of activity with a subtle light movement that resembles the breathing pattern of an unknown sleeping creature. This slow and soft pattern, acts as standby mode, and serves to trigger the traveller's curiosity to see what hides behind the semitransparent membrane.

As soon as the traveler draws the curtain, the vessel immediately awakens and starts rendering an atmospheric landscape inside it, acting as some sort of teleporting device. The traveler, at first, has no way of knowing which atmospheric space can be accessed from every different opening in the membrane, leaving room for a surprising process of

discovery. Once one atmospheric space has been rendered and experienced by the traveler, the vessel comes back to the dormant mode, indirectly inviting the traveler to exit the enclosed space and try again, and if desired, to enter a different atmosphere by drawing a different curtain.

Shake sensors are embedded in the fabric, and wired up to the top of the vessel, where they are connected to the microcontroller that runs the whole installation. In total, six sensors detect which curtain was drawn, and will trigger a different atmosphere inside the vessel accordingly.



ATMOSPHERIC SPACES
INTERACTION
SHAKE SENSORS CONNECTED
TO THE ARDUINO BOARD

DISTANT AND IMAGINARY REALITIES

For the final prototype, a total of six different atmospheric experiences were designed, making use of the different atmospheric elements inside the vessel, namely light, sound and reflections. Each experience is tied to a different access point to the vessel, rendering a different experience depending on which entrance the traveler chooses to enter the installation.

For future design iterations, more experiences could be added to the catalogue, but the ones here presented provide a wide selection that covers from distant locations to atmospheric experiences:

I - MARS

II - BY THE SEASIDE

III - DEEP OCEAN

IV - ELECTRIC STORM

V - BUSY METROPOLIS

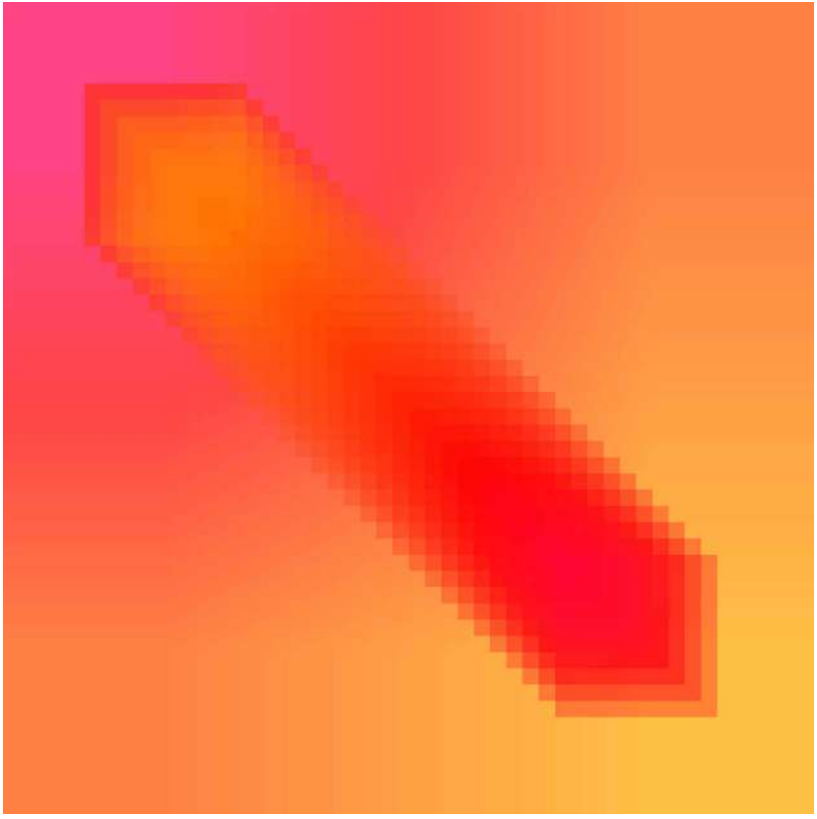
VI - WALK IN THE FOREST

I. MARS

#DISTANTREALITY #SPACETRAVEL #COLOURBLOCK

This first experience is based on a revolution around the Sun on the planet Mars, and actual pictures and footage of the red planet, taken by NASA's Hubble telescope, were used to create the colour palette and animations used.

DURATION	60 seconds
PREDOMINANT COLOURS	light red, dark orange, ochre
LIGHT	yes
SOUND	yes
REFLECTIONS	no



MARS
COLOUR PALETTE STUDY
PROCESSING - 2021

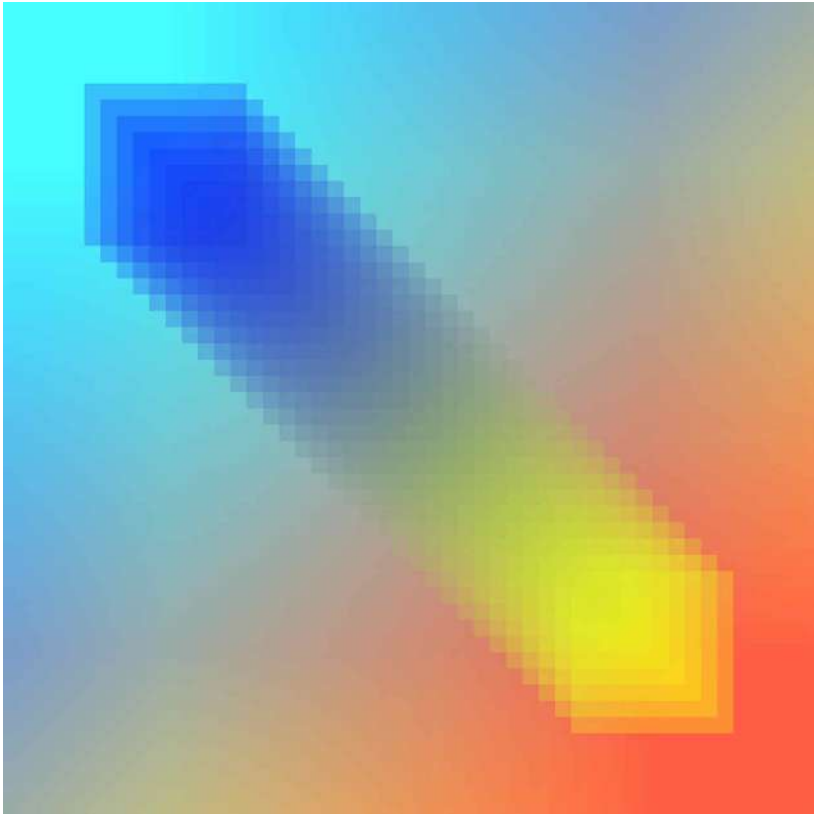
II. BY THE SEASIDE

#DISTANTREALITY #ANIMATEDPALETTE #REFLECTIONS

This experience represents the sunrise and sunset by the seaside, focussing on the water reflections and the natural sounds of the distant location.

For this experience, pictures, videos and audios taken during a trip to the island of Norderney in north Germany during the summer of 2020 were used.

DURATION	80 seconds
PREDOMINANT COLOURS	ochre, light blue, light green, white
LIGHT	yes
SOUND	yes
REFLECTIONS	yes



BY THE SEASIDE
COLOUR PALETTE STUDY
PROCESSING - 2021

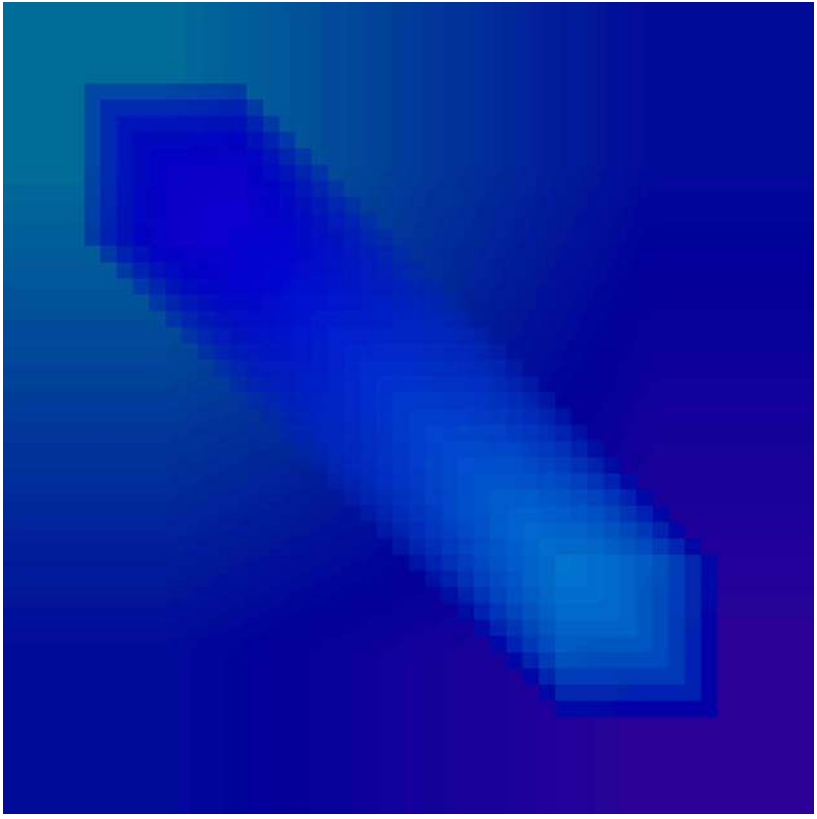
III. DEEP OCEAN

#IMAGINARYREALITY #COLOURBLOCK #REFLECTIONS

This experience represents an unknown ocean, filled with non-yet-discovered water creatures. The moving creatures fuse and mix with the reflections of the light created far above, over the surface of the sea.

For this experience, collages of underwater audios and sea creature sounds were used.

DURATION	60 seconds
PREDOMINANT COLOURS	dark blue, dark green, white
LIGHT	yes
SOUND	yes
REFLECTIONS	yes



DEEP OCEAN
COLOUR PALETTE STUDY
PROCESSING - 2021

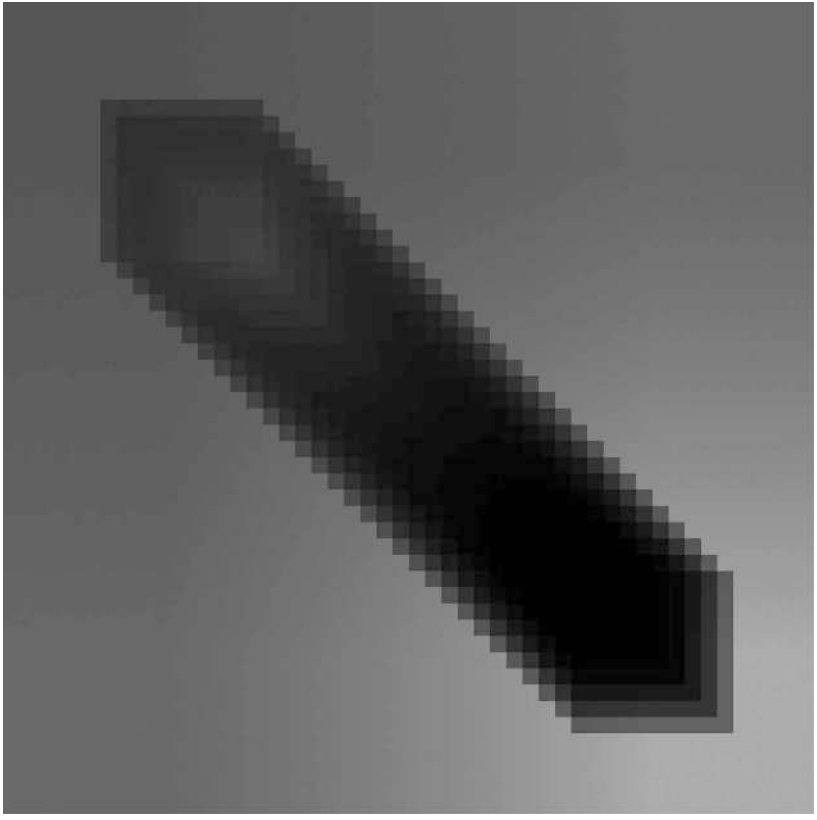
IV. ELECTRIC STORM

#ATMOSPHERE #STROBELIGHT

This experience recreates the sensation of being in the middle of an electric storm. Flashing lights and strong audio tracks are used to imitate the power of nature.

For this experience, audios taken during an electric storm in 2020 in Weimar, Germany were used.

DURATION	40 seconds
PREDOMINANT COLOURS	white
LIGHT	yes
SOUND	yes
REFLECTIONS	no



ELECTRIC STORM
COLOUR PALETTE STUDY
PROCESSING - 2021

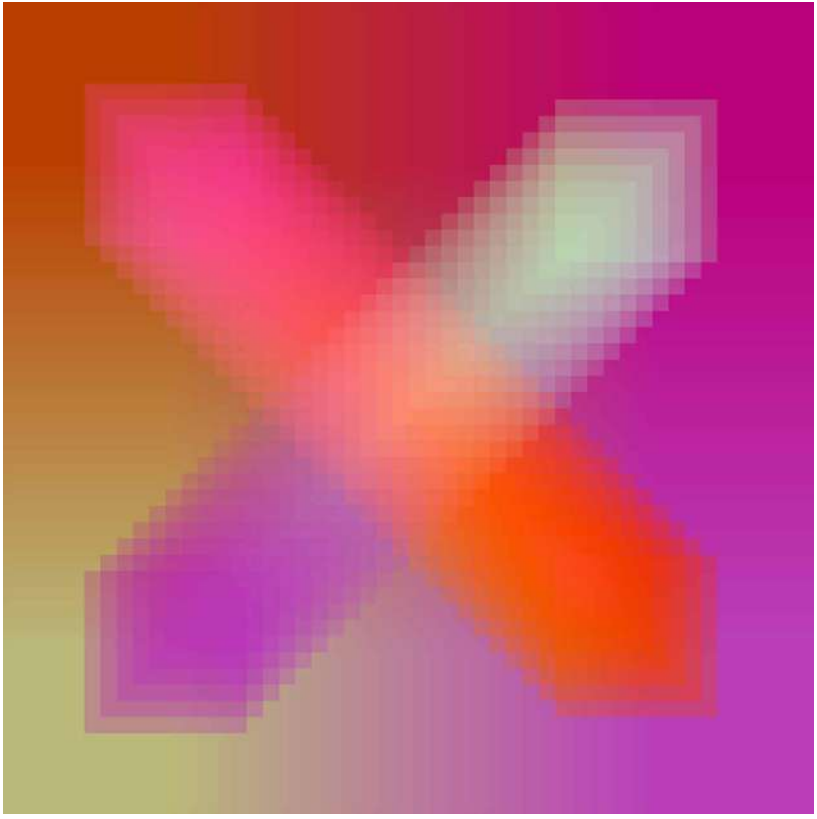
V. BUSY METROPOLIS

#DISTANTREALITY #ANIMATEDPALETTE

This experience recreates an evening in a busy street in a busy unknown metropolis, with all its ruckus, rhythm and crowded public space.

For this experience, pictures, videos and audios taken during a trip to Tokyo, Japan during the summer of 2019 were used.

DURATION	60 seconds
PREDOMINANT COLOURS	dark blue, dark green, white
LIGHT	yes
SOUND	yes
REFLECTIONS	no



BUSY METROPOLIS
COLOUR PALETTE STUDY
PROCESSING - 2021

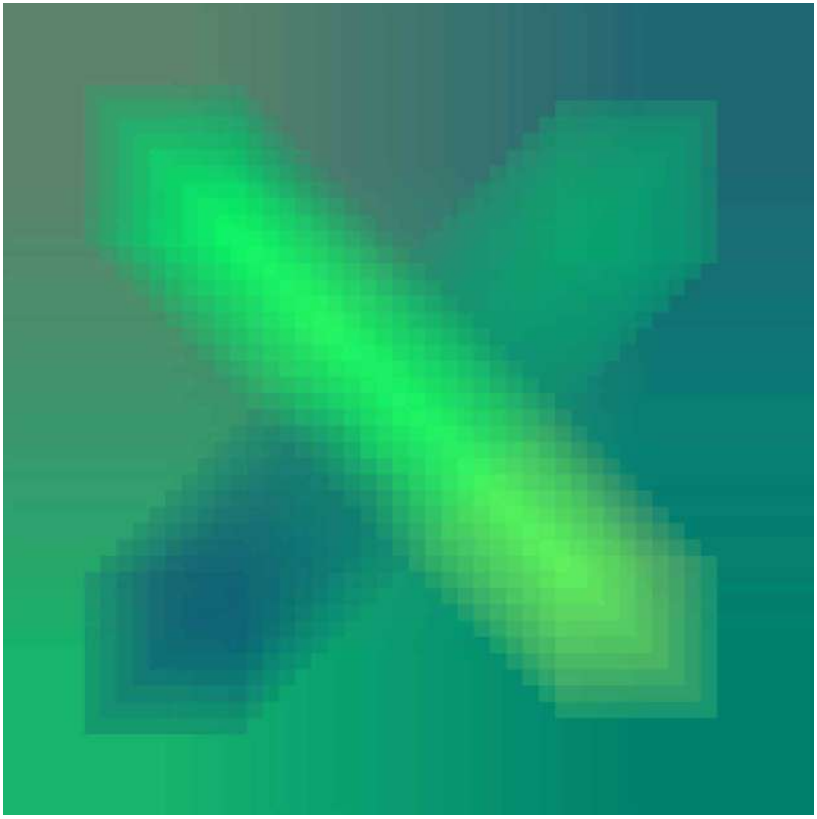
VI. WALK IN THE FOREST

#DISTANTREALITY #ANIMATEDPALETTE #REFLECTIONS

This experience recreates a walk through a dripping forest, walking close to a still river and between hight trees.

For this experience, pictures, videos and audios taken at different forests in Thuringia, Germany during the course of 2020 and 2021 were used.

DURATION	60 seconds
PREDOMINANT COLOURS	light blue, dark green, light green, white
LIGHT	yes
SOUND	yes
REFLECTIONS	yes



WALK IN THE FOREST
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TECHNICAL ASPECTS

In the development of the final prototype, several different technologies where involved in order to control the different atmospheric elements previously discussed. All the elements are managed using an Arduino board, a microcontroller that processes both the inputs (sensors) and outputs (actuators). Connected to this main board, that acts as the brain of the installation, there is a Raspberry Pi, another microcontroller board that manages the sound present on the installation.

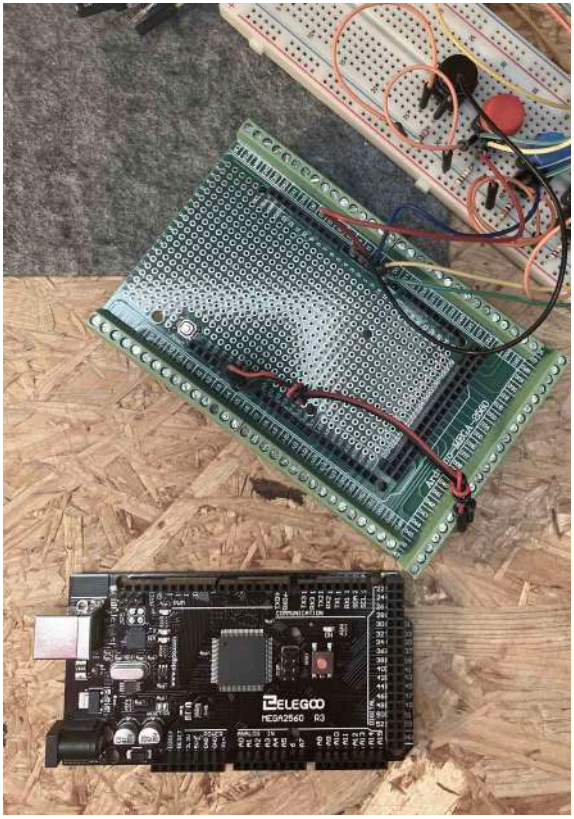
Two RGB LED strips produce the light needed inside the installation, and are directly wired to the Arduino board, that controls them separately. The morphing mirror, also connected to the main board, works with a servomotor able to bend its surface. The six shake sensors that trigger the different atmospheres are attached to the outer membrane of the vessel, and wired all the way up to the Arduino board placed inside the upper plate.

I. ARDUINO

The core of the installation is an Arduino[xxi] board, part of an open-source hardware and software platform that provides support for electronic projects. The board is able to read inputs (on this prototype, the sensors embedded in the vessel's membrane), and trigger outputs (light rings, audio and step motor connected to the morphing mirror). The board present pins where both inputs and outputs can be connected to, and a microprocessor, that can be programmed using the programming language C++. This board is able to control the whole process during the interaction, being able to read the signals provided by input sensors and to tell the different output actuators how to perform.

Due to the great amount of LEDs that needed to be controlled in the installation (over 700 single lights), a high performance version of the board was used. The Arduino Mega model provides more memory to deal with the data responsible for the animations in the LED strips, and also more pins to connect the sensors and actuators involved in the installation setup.

To ensure a stable connection of the sensors, the LED strips and step motor to the Arduino microcontroller, the wiring is done using a shield that attaches to the top of the board and allows to firmly screw the different components.



ATMOSPHERIC SPACES
ARDUINO BOARD WITH SHIELD,
CONNECTED TO PROTOBOARD

II. RASPBERRY PI

Connected to the Arduino board, there is a second microcontroller; a Raspberry Pi[xxii] model 3. This is a more powerful board, able to natively manage soundtracks, allowing to directly connect a set of speakers through a minijack connector.

On this second board, a program written in Python (a general-purpose programming language), reads the signals sent from the main Arduino board connected through a usb cable, and triggers a specific sound stored inside a microSD card. The Arduino board reads the input from the shake sensors detecting movement on the curtains, and then sends this information to the Raspberry Pi board, which is directly connected to a speaker, triggering the correspondent sound.



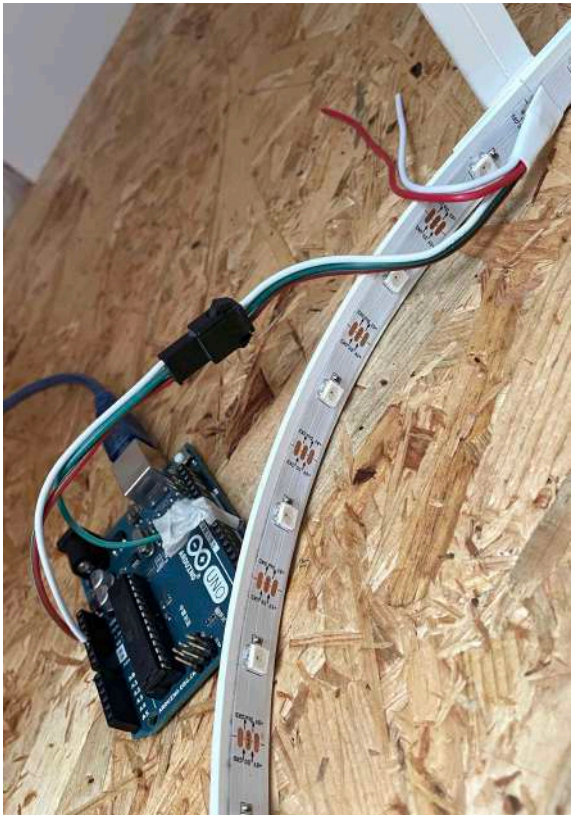
ATMOSPHERIC SPACES
RASPBERRY PI CONNECTED TO
ARDUINO BOARD AND TO SPEAKER

III. RGB LED STRIP

For the light rings, more than twelve meters of RGB LED strips are used, with over 350 LEDs on each ring. The type of LED strip used is a W2812B LED Pixel, broadly used for lighting projects along with microcontrollers such as Arduino. These strips consist of 60 independently addressable LEDs per meter, allowing a total control over the brightness and colour shade of every element. The strips runs on a 5V power supply and can be connected to additional strip sections or trimmed to achieve the desired length.

To control the animations and colour gradients displayed on the light rings, the Arduino library FastLed[xxiii] was used. An Arduino library offers extra functionalities, providing support for different pieces of hardware. In this case, the FastLed library makes easier to manage large amounts of LEDs, and provides a set of tools to create smooth animations and gradients within the Arduino programming environment.

The state (colour and brightness) of each LED that conforms both light rings is stored in the internal memory of the Arduino board using arrays of data, that can be updated and manipulated to achieve different light effects. The strips present three different connectors, two of them for the power (5V and ground), and one for the signal input, that carries the data that controls the state of each LED element.



ATMOSPHERIC SPACES
RGB LED STRIP CONNECTED TO
ARDUINO BOARD

IV. POWER SUPPLY

The power source used in the installation is a 5V 30A transformer, due to the high consumption of the six meters long LED strips. When all the 700 LEDs are lit up at the highest brightness level and with white light, they can draw up to 20A. Because of the high current needed to power up the strips, the power pins (5V, ground) are directly connected to the power supply, whereas the other components such as the servomotor are powered through the Arduino board. To ensure a stable and smooth performance, the ground connector of the Arduino board is connected to the ground connector of the power supply.

While the Arduino board is installed inside the upper plate of the vessel, the power supply is placed on the ground, and wired to both light rings placed on the upper plate and the base of the installation.



ATMOSPHERIC SPACES
POWER SUPPLY AND RGB LED STRIP

POTENTIAL OUTCOMES

The use of immersive experiences, able to replicate distant locations and realities, could be helpful in processes of relaxation and meditation and may also open new possibilities on how we understand and relate to physical and virtual space.

Chromotherapy has been widely used, and has proven to have therapeutical effects, helping heal mind and body. According to some researches, it has the power to change the mood and improve the overall wellbeing on the patient.

> *"[…]Color therapy is one of the non-pharmacological therapy that can reduce stress. […] The effect of color affects the work of the sympathetic nerves parasympathetic, and improves mood. Color therapy provides an element of relaxation, which from various studies of relaxation can reduce anxiety or anxiety in individuals…"*[xxiv]

These colour-based therapies have been used already in virtual reality experiences, allowing a more portable and convenient setup, since already existing chromotherapy rooms are usually expensive and not really accessible to the main public. Instead, some researches are trying to translate this physical experiences to virtual reality headsets;

> *"[…]Chromotherapy rooms are comfortable spaces, used in places like special needs schools, where stimuli are carefully selected to cope with stress. However, these rooms are expensive and require a space that cannot be reutilised. […] We recreated a chromotherapy room stress relief program using a commercial head mounted display (HD). […] Our preliminary results validate our approach as an inexpensive and portable alternative to chromotherapy rooms for stress relief."*[xxv]

In a similar way, sound could also be used to treat health problems and awake really strong and powerful feelings in the listener, according to some speech and sound therapy researches. These studies try to determine whether sound frequencies can produce physical changes on our body, and also can they affect our emotional state and the way we react to other external elements.

> *"[…]can sounds both cure and kill? Can hearing problems be behind depression, dyslexia, and autism? Is there a "brown note" that can cause people to lose control of their bowels?"* [xxvi]

According to multiples researches carried out by occupational therapists, immersive experiences and multi-sensory environments are also being currently used with individuals with autism[xxvii] and dementia[xxviii], providing spaces for therapy and treatment. Similar setups have been also implemented in Alzheimer's[xxix] therapeutical and

behavioural interventions, showing a significant reduction in cases of agitation, anxiety, aggression and even depression.

Colour and sound as design elements could be used then together to create immersive experiences and multi-sensorial environments that make use of their benefits to treat health conditions. Designing experiences accessible both economically and technically, could bring the perks of chromotherapy and sound therapy closer to a larger number of people. The design of immersive experiences mixing these therapies with the idea of traveling and self-discovery could also be used to deal with stress, relieve anxiety and even to offer solace in times where actual traveling is not possible, either because of physical reasons (distant and/or disconnected locations), health issues (immobility, state of emergency), or any other potential matter.

CONCLUSION

Over the course of this work, I had the chance to experiment and carry out many tests with different atmospheric elements and technologies. Regardless of the final built installation, I learned mostly from the *"failed attempts"* and the long prototyping process, which made it possible to reach the final results as shown in this work. Many of those attempts, as well as some of the investigations that are present on the final prototype, provided really interesting and unexpected results, and will surely be a source of great inspiration and ideas for my future works and research.

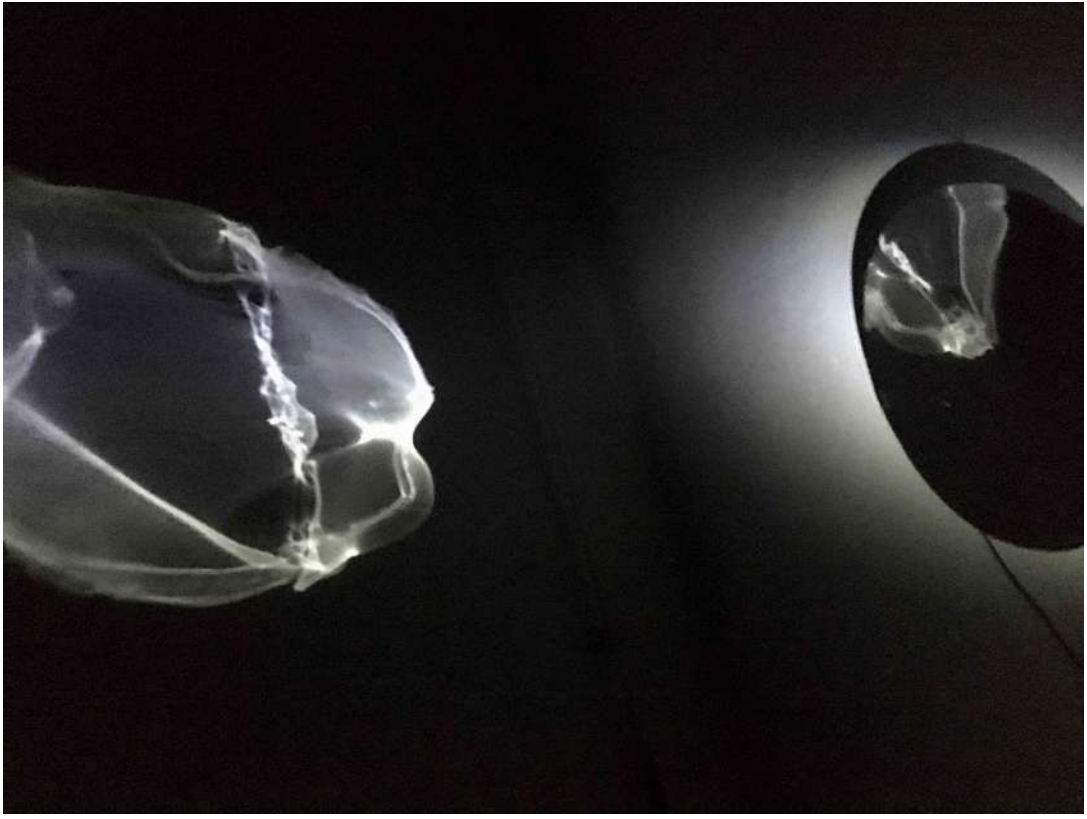
I personally found the experiments carried out with the morphing mirrors and their morphing reflections specially interesting, and have already in mind some other setups where they could be used. Also, the results I got using artificial fog along with light seemed quite promising, filling the space with colour and making almost possible to touch the colour. As much as I would have liked to include this atmospheric element on the final prototype, the lack of ventilation on the space used to build the installation sadly turned it unviable.

Using light and sound as main elements to rebuild fully-experienceable locations turned out to be a quite powerful tool. While some of the elements present on the actual distant locations are not present in the *atmospheric reconstruction*, this reinterpretation is able to convey their essence. Giving the user just some hints in the shape of colour and sound,

makes it possible to trigger their imagination, encouraging an active role in the perceptive process. What is perceived while experimenting the *atmospheric reconstruction* might not be an exact image of the actual distant location, but rather a personal interpretation of it. After all, is not everything that we perceive *in real life* nothing but the result of our own personal construct?

Developing this thesis was especially challenging due to the global pandemic outbreak that started right before this project was born, and keeps its course at the time this thesis will be handed in. Getting materials, testing the prototypes with users and even staying motivated turned out especially difficult, but did not keep me from working and finally finishing this work. I would like to thank everybody who supported me during these thought times, and all those whose work made mine possible.

Since the aim of this work was to create a device that people could use to experience remote locations, the final built prototype was meant to be exhibited and used by people. Due to the current situation this was not possible, but I am pretty confident that once everything has passed, some travellers will be able to experience the atmospheric spaces presented here.



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FOOTNOTES

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[iii] "Crystal Universe", TeamLab, ArtScience Museum, Singapore, 2015

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[v] Untitled, Anish Kapoor, MET Museum, New York, 2007

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[vii] "Plug-in City", Peter Cook - Archigram, 1964

[viii] "Fun Palace", Cedrick Price, 1961

[ix] "Centre Georges Pompidou", Renzo Piano + Richard Rogers, Paris,1977

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[xii] "Borderless", TeamLab, Tokyo, 2018

[xiii] "Planets", TeamLab, Tokyo, 2018

[xiv] "Hylozoic Soil", Philip Beesley, Espacio Telefónica, Madrid, 2011

[xv] "The weather project", Olafur Eliasson, Tate Modern, London, 2003

[xvi] "Beauty", Olafur Eliasson, Tate Modern, London, 1993

[xvii] "Your blind passenger", Olafur Eliasson, ARKEN Museum of Modern Art, Copenhagen, 2010

[xviii] "Blur Building", Diller Scofidio + Renfro, Swiss Expo, Yverdon-Les-Bains, Switzerland, 2002

[xix] "Wiederholte spiegelungen", Carlos García Fernández, Kultur Satelliten - Bauhaus-Museum Weimar, 2020

[xx] "Phenakistiscope", Alphonse Giroux, Paris, 1833

[xxi] Arduino company, open-source electronic prototyping platform and hardware. Somerville, US.

[xxii] Raspberry Pi company, small single-board computers developed by the Raspberry Pi Foundation in association with Broadcom. UK.

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— IMPRESSUM —

atmospheric spaces
vessel for distant and imaginary realities

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