# - silent spectacle -

a [noise] pollution instalation

| semester logbook |

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**semester logbook**

„New nature in park at the Ilm"
Introductory Project-Module
Advisor: Dr.-Ing. Sabine Zierold

Bauhaus University Weimar
faculty of architecture & urbanism
Master Degree Program
MediaArchitecture

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## - silent spectacle -

The installation “silent spectacle” at the “Park an der Ilm” in Weimar seeks to create a new nature atmosphere, in which humans and nature co-live in balance. The installation therefore proposes a space where humans can realize their impact and distance themselves from our exploratory relation with nature. To achieve that, the “silent spectacle” turns natural data input of the park into a visible and interactive installation. In the project area, the Roman-House-Hill, a large difference in noise levels was observed at different points. The hill acts as a sound barrier, blocking the city’s sound pollution.

[Noise] pollution can deeply impact a balanced ecosystem, but this problem is almost always overviewed since it’s not very tangible in daily life. Therefore, our project wants to show the invisible effects of noise pollution by making it viewable through fog and light.

The amount of fog and light will be directly corresponding to the amount of sound pollution at the Roman-House-Hill, making the association clear and direct to pedestrians.
While the fog creates an ephemeral and romantic atmosphere, changing the pedestrians’ relation with the park, the light gives a playful and direct response to human impact.

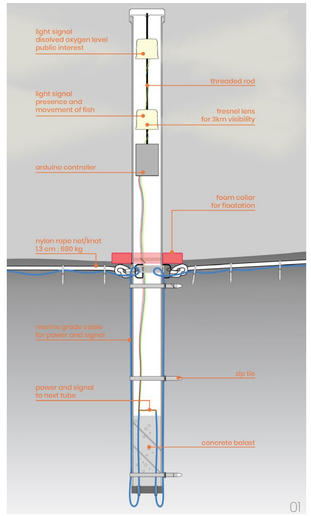
In addition to proposing this new relation with nature, “silent spectacle” proposes a response to the problem of global warming in the park as it creates a cool atmosphere for the plants that are already suffering with heat waves.

“Silent spectacle” as-a-result is an interactive installation that returns something back to nature and at the same time makes the human impact to the environment visible.

| 2. analysis |

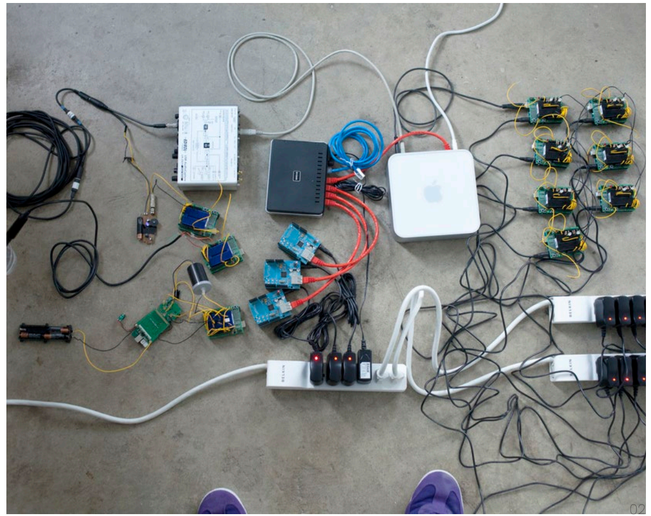


video presentation



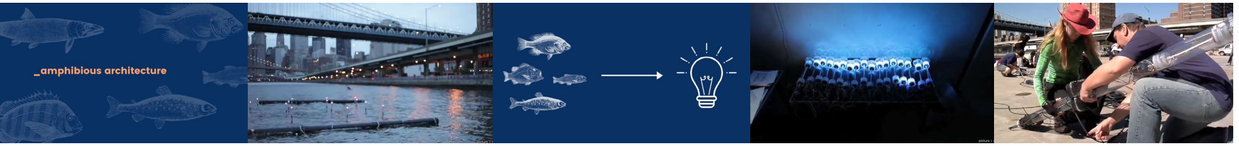

Natalie Jeremijenkos Installations are a great example on how art combined with science can form a better dialogue between humans and nature. “Amphibious Architecture” and “Mussel Choir” are both projects in which she gives forgotten co-living habitats a voice so that we as humans can hear them.

To give a brief introduction on mediaArchitecture, a movie about that topic was researched and developed. An overview is given on the next two pages.




“indirect dialogues”

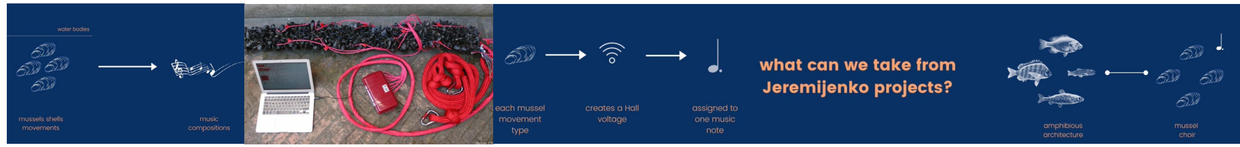
video presentation

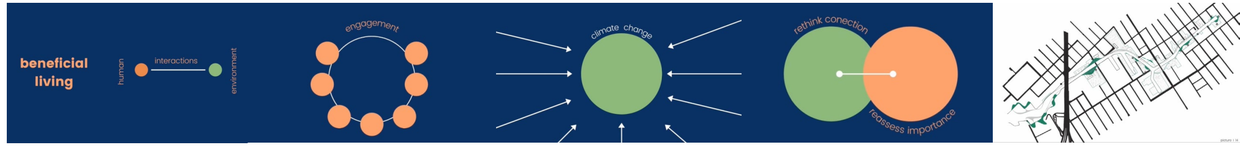



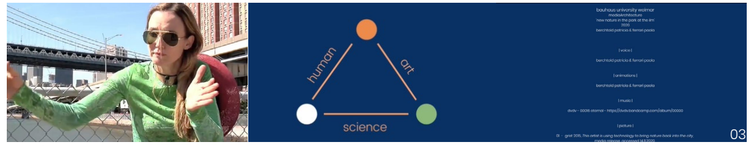








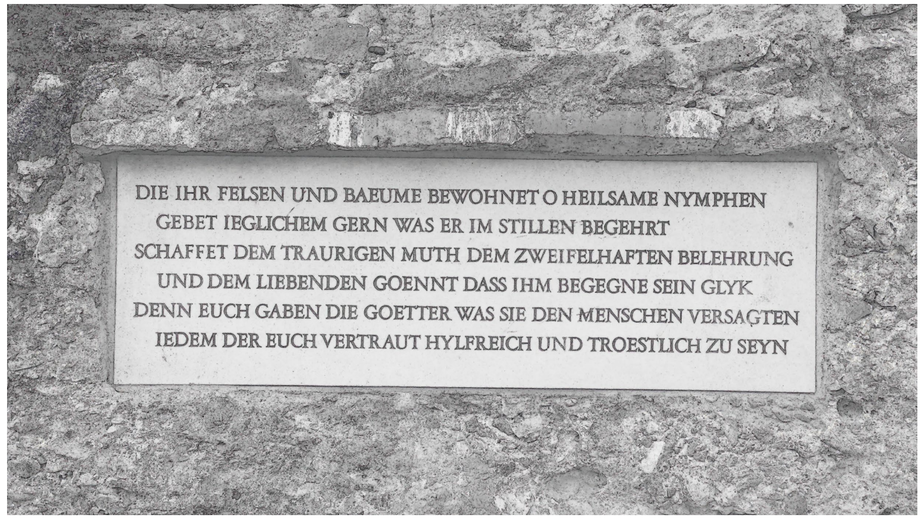




watch “indirect dialogues” here:

https://www.youtube.com/watch?v=MbxsO5PelyQ

“indirect dialogues”

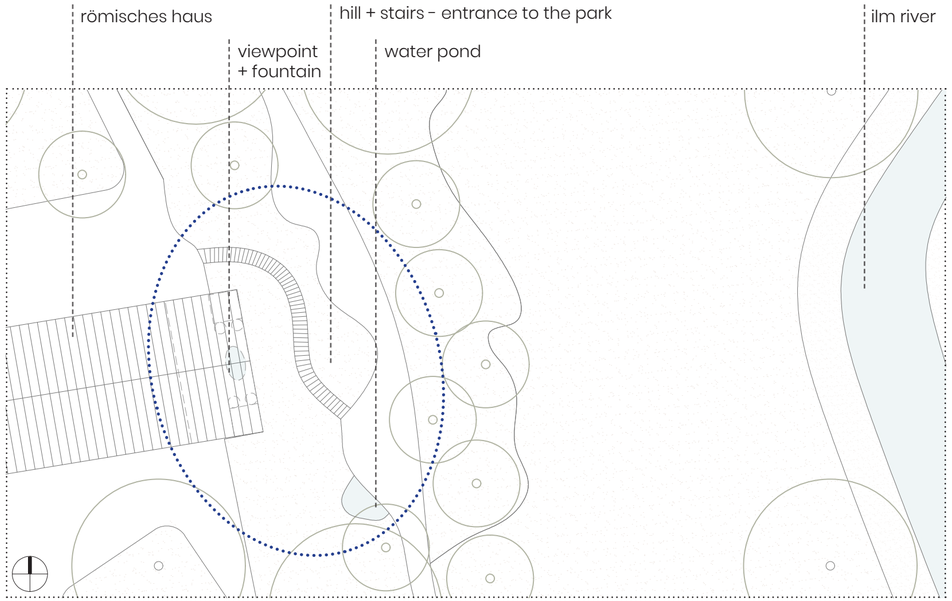



The 48-hectare park on the Ilm is a unique landscape garden on the edge of Weimar's old town. Duke Carl August and Johann Wolfgang Goethe realized their horticultural ideas here. They created a walk-in work of art with varied landscapes, park architecture and seating areas, which to this day serves for recreation, education and aesthetic enjoyment of nature.
Goethe and Carl August together planned the first grounds in the new English taste between the town, the palace and Goethe's garden house.
Starting in 1778, the design of the western Ilmhang with its wooded backdrops, walkways and park architecture was created.

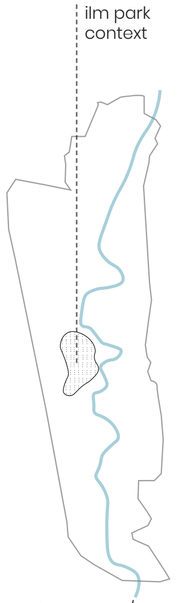


| 2. analysis | place in the park: context

The construction of the Roman House, completed in 1797, marked the high point of the park's development after the large-scale expansion of the park to the south and the integration of older palace gardens.
We chose the Park-facing side of the Roman House as our projects place, including the viewpoint over the Ilm valley and the hill in front of it. A Staircase forms its way down the hill functioning also as a sound barrier to the city noises and allows the visitor to gain a quieter entry to the park.
The Poem at the end of the staircase was written in 1790 by Goethe and shows how he imagined this place to let the people come to more observing stillness.



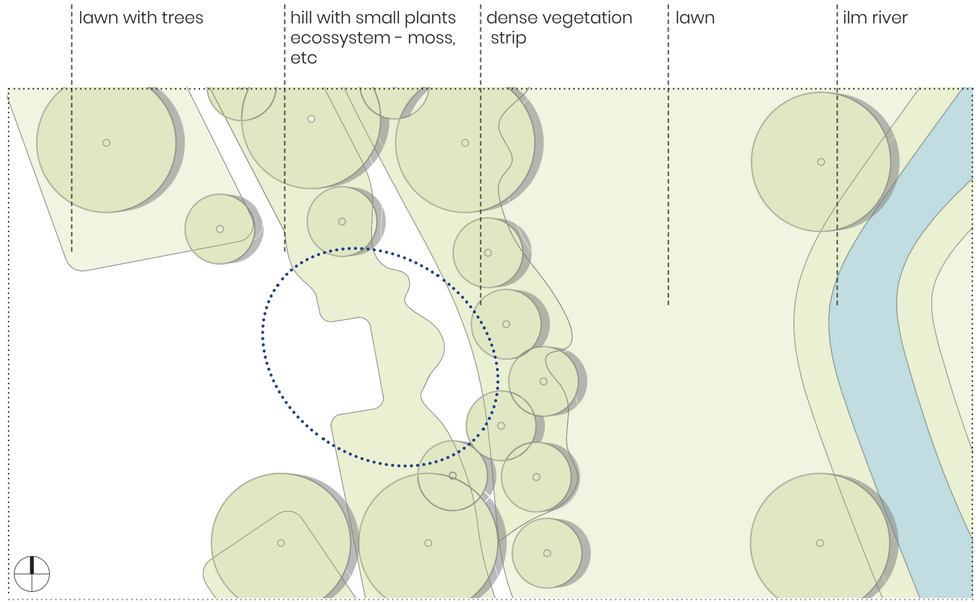

site plan 1: 300




site map n / scale








site plan 1: 400

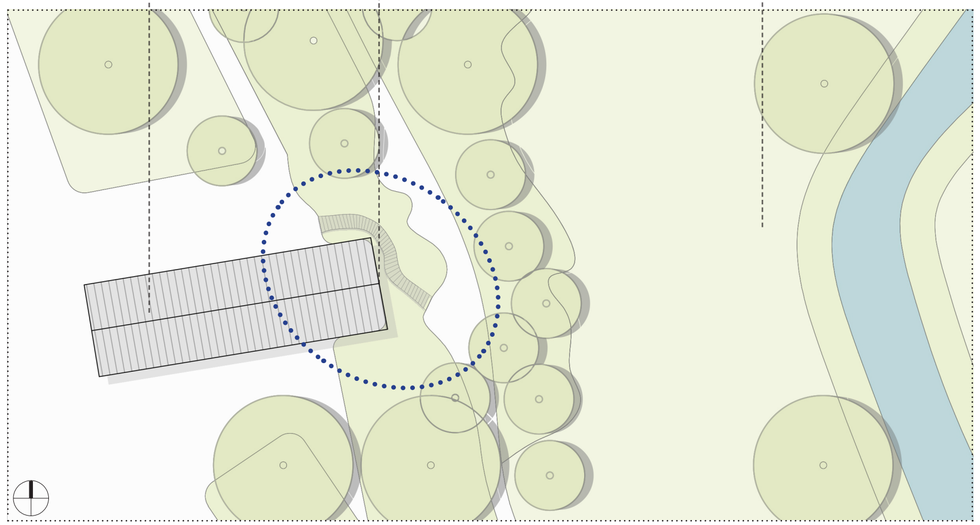
## nature layer

On our site, nature plays a huge role.
The view overlooking the hill in front of the house reaches from the dense vegetation strip delineating the pathways from the lawn, up to the valley of the Ilm river.
Small ecosystems like moss as well as huge trees can be found here and frame this compositional context.
Nature here was consciously planned and therefore defines specific areas for anticipated ways of use for both: architectural and park places.

römisches haus - 1792 - Goethe

hill + stairs - entrance to the park - 1792- Goethe

english garten landscape



site plan 1: 400

## human layer

The Roman House looks like it has been cautiously placed on top of the hill to get one of the best possible views over the park. It can be seen from afar from many other viewpoints of the English garden landscape around and forms a landmark that gathers visitors. The staircase in front of it creates a walking entrance experience to the park functioning as a transition pathway that creates more sensitivity for the natural context.

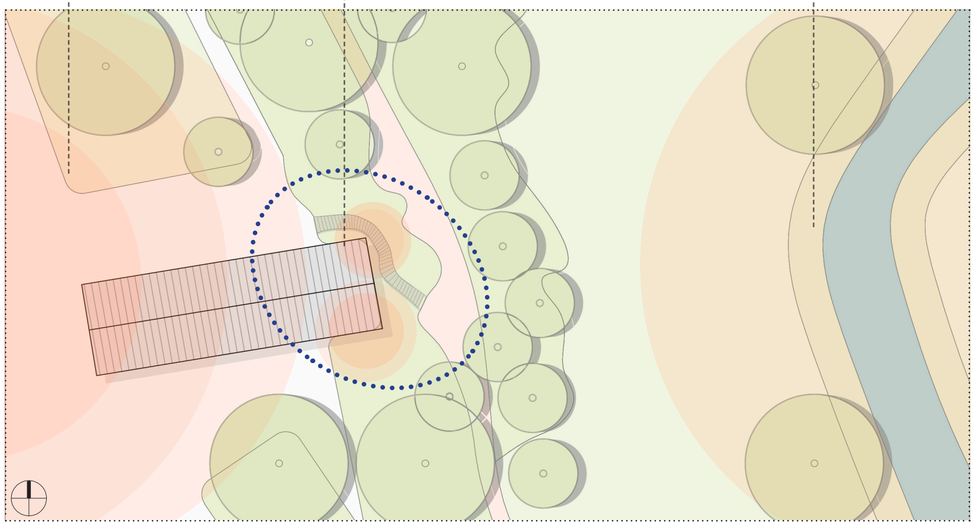


| 2. analysis | place in the park: context

traffic sound

human produced sounds - steps, conversation, etc.

river sounds



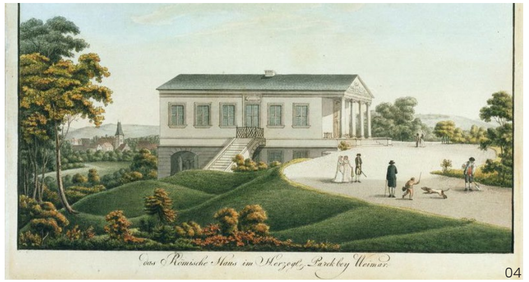
site plan 1: 400

## sound layer

This pathway also defines a sound barrier between the loud city and traffic noises of the street west from the building and the calming sounds of nature in the valley, such as river and bird noises. As the terrace of the Roman House also functions as a gathering place shielded to any weather, it enhances noise pollution on top of the hill. If attentive pedestrians then walk down the steps they can already hear a difference in sound intensity and enter the park more calm.

The garden house, charmingly situated in the landscape park on the Ilm was built by Duke Carl August at the end of the 18th century.
Since then, it has been his favorite residence: a retreat in the midst of nature Here, he not only recovered from the busy life at court. The country estate was also for concentrated work and even for official receptions - which were small, but all the more exclusive for it.
With its antique building elements and the imposing slope, it is reminiscent of a Roman country house - hence the name!

Johann Wolfgang von Goethe made it a "classicist model house" - the duke had entrusted him with the the construction management.
The second picture shows the original drawing of Goethe.



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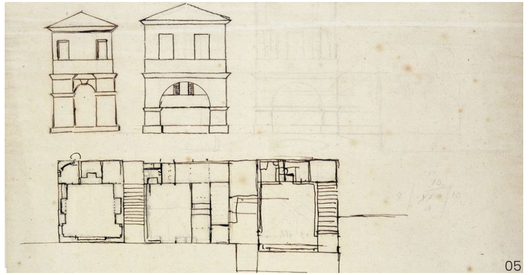
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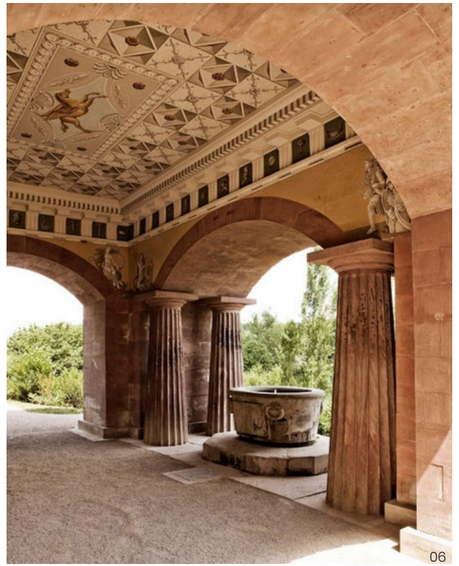
| 2. analysis | place in the park: römisches haus


06

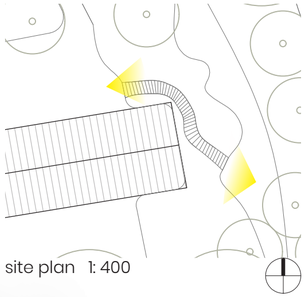

07


08

staircase upstairs:
entry to the park with
view over the ilm river
traffic sounds behind

birds eye view
over chosen area:
hill, staircase, Roman House

staircase downstairs:
arrival in the park-
quieter with poem
from Goethe



site plan 1: 400

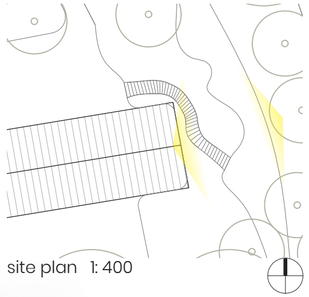
09





panoramic view:
taken from the stan-
ding point in front of
the pond

panoramic view:
taken from downstairs in front of the hill
viewing the whole hill and staircase
Roman House with pond on top



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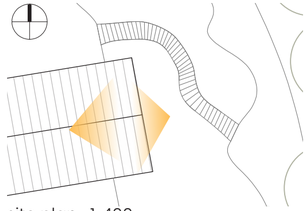


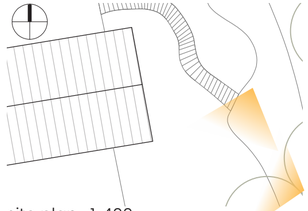
site plan 1: 400

Another interesting arranged topic around the Roman House is water. A fountain or small water well was placed at the shielded location between four columns from which point a beautiful view over the park is guaranteed. The sound you hear from there is now connected to the Ilm river in front of you.

Furthermore, the pictures on the right show a small pond at the end of the staircase. It collects the down streaming water of the hill, gathers it and sends it back to the river. This creates an invisible water path from the artificially created architecture to the existing river and therefore forms communication with nature.



| 2. analysis | place in the park: visual axis



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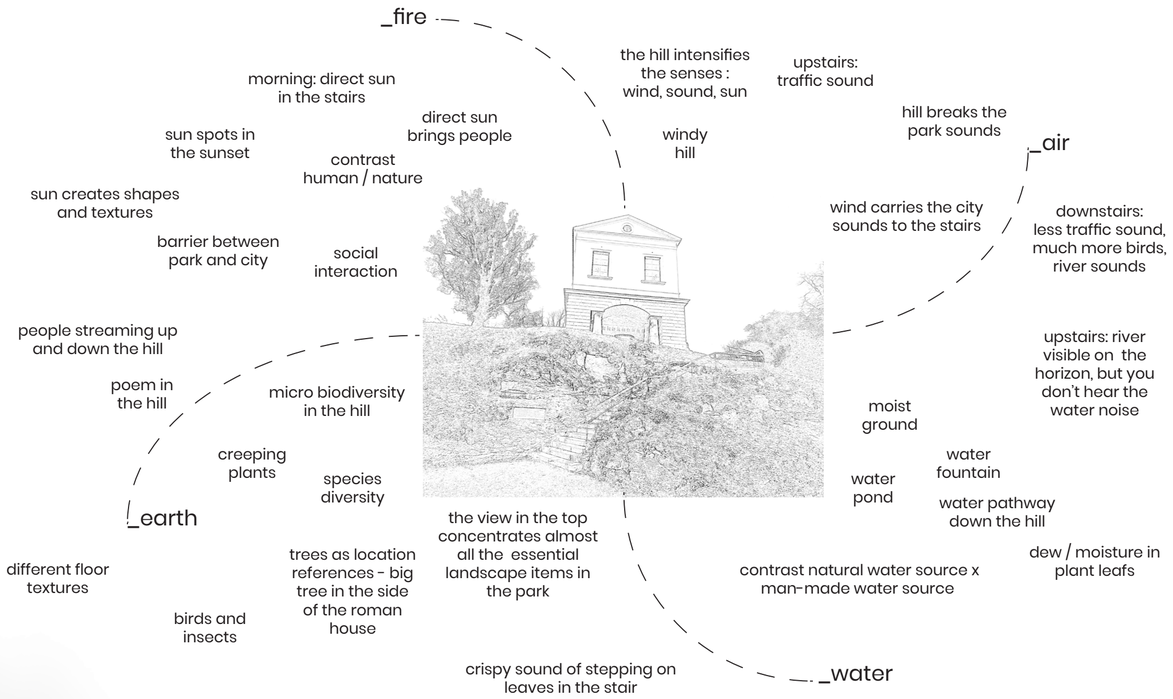


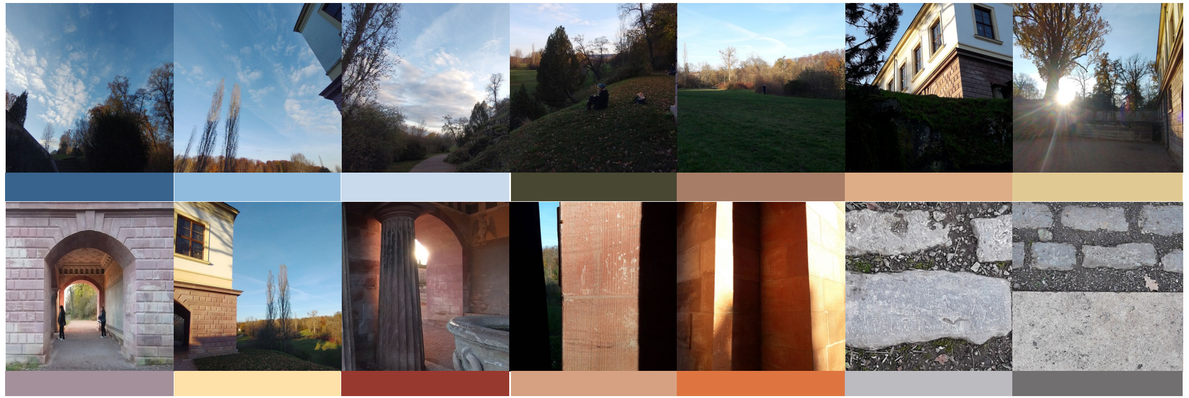



| 2. analysis | place in the park: individual perceptions, environmental conditions

## Sensorial diagram

To get a better feeling for our chosen place, different times of day were observed and the gathered information about our personal perception was visualized in a sensorial diagram.
The Roman House Hill communicates with all four elements. Fire is here understood as human made constructions, materials and colors as well as the sun shining on and framing the architecture during the whole day. Therefore, people are being drawn to the place and bring even more of that energy.
The air functions as a dialogue between nature and humans as it transports traffic noises and the wind gets intensified through the hill.
Water is an overall visible element: on top of the hill in a fountain and downstairs in a little pond, directing rainwater back to the river.
The fourth element earth, is connecting the place to the wildlife almost not visible to the average pedestrian. A micro biodiversity is spreading over the hill and connects human pathways to nature.

berchtold patricia I ferrari paola I silent spectacle I projekt modul " new nature at the park in the ilm I mediaArchitecture I WS 20/21 I bauhaus university weimar



Differant materials of nature and structure can be found to form a specific color range. They go from natural white, blue, brown and many green colours over grey stone to more human made orange, yellow and red tones.



| 2. analysis | place in the park: individual perceptions, environmental conditions

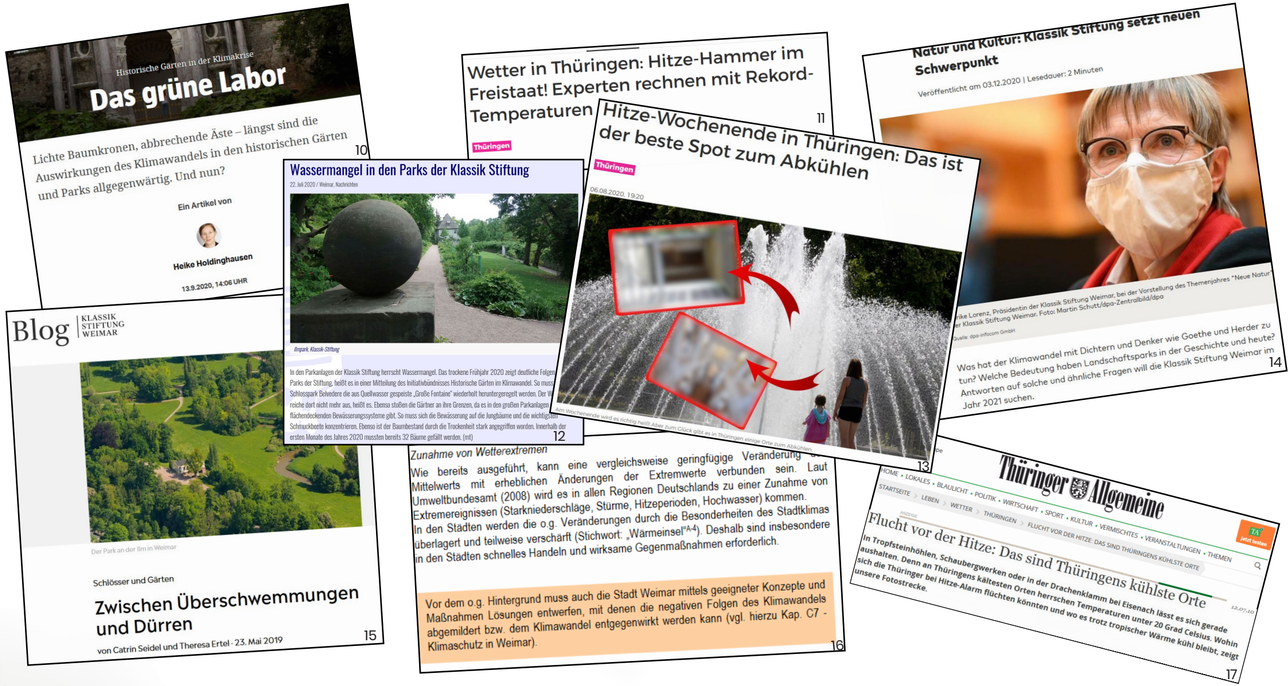
Increasingly, effects of climate change are becoming visible in historic parks and recently, corona-related exit and contact restrictions have also led to considerable overuse.
Current ecological and social developments, conflicts, and challenges are reflected and condensed in a special way in these places. The Ilm Park in Weimar is an example to this: Here, the valuable historic tree population is massively attacked and endangered by the persistent drought. Unpredictably, old trees are shedding large branches, thus compromising traffic safety.
Numerous trees have therefore had to be felled. Plants and meadows suffer, paths and riparian areas are undermined or washed away by heavy rainfall.
Impassable paths, construction sites and unsafe areas increasingly lead to the closure of entire parking passages.
New demands, and resulting conflicts of interest have recently led to substantial challenges for the responsible Klassik Stiftung in managing the park.

The necessary reorientation and adaptation of the park concept are therefore taken as an opportunity by the foundation to initiate a future-oriented discourse in the field of tension between man - environment - nature with a theme year under the title “New Nature”.

Johann Wolfgang von Goethe’s understanding of nature, is rooted in the theory of the English landscape garden, a paradigmatic conception of nature.
Is this a starting point for the search for a new nature?











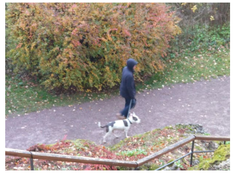




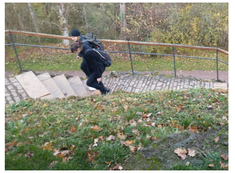

Human activity is a large factor to the sound experience. Strolling pedestriants, dogwalkers, joggers, couples that take a romantic walk and youth gathering around the pond are among them.



| 2. analysis | place in the park: human activity + sound










Apart from the city and traffic noises on top of the hill, the most present sounds are the dogs and birds in the morning aswel as conversations and steps with underlying llm river dabble,



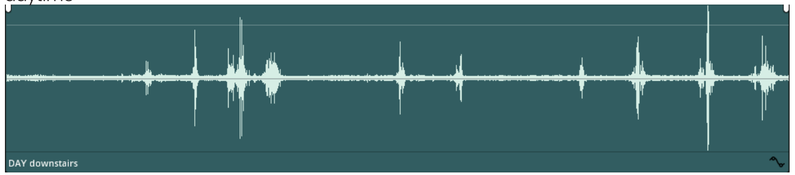


duration: 20 minutes

morning


a lot of birds
river sound
few joggers and dogwalkers on the pathways
barks of dogs
only few stair-sounds
a chirchbell sound

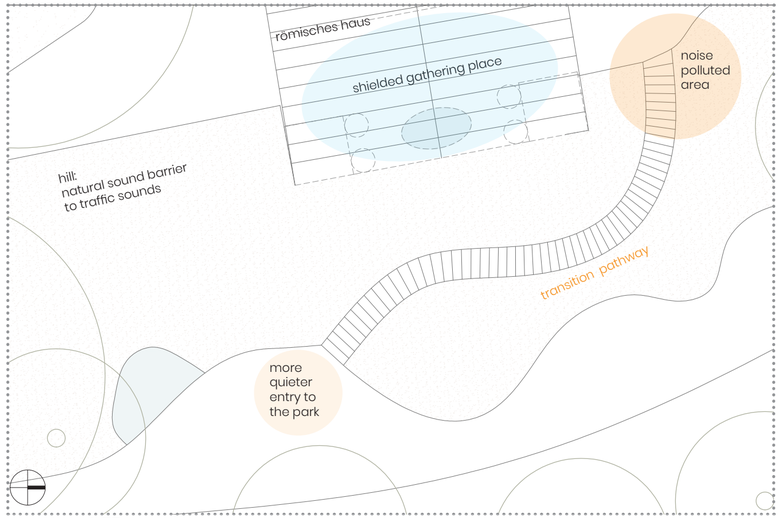
daytime




many steps of strollers and joggers, on the pathways and stairs
conversations of people passing by, meeting and staying
few dogwalkers
bikes and cars
a plane and landmower
few birds and wind

night


river sound
soft wind
highway from the distace
some clicking noises




site plan 1: 75

daytime upstairs

daytime downstairs

unopposed traffic and wind sounds
--> overshadowing the natural noises
--> hill as a sound barrier



| 2. analysis | place in the park: site plan + noise pollution

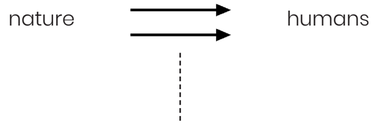

Noise reduces the recreational value of the landscape and lowers the quality of life. Not only for humans, but also for animals noise is harmful in the long run. Many birds avoid busy roads and other noisy habitats
In extreme cases, noise leads to the local disappearance of animal species
Major efforts are therefore needed to reduce noise pollution and the associated negative effects on humans and animals.
Bats for example use ultrasound to orient themselves and stop hunting for insects in the presence of strong disturbing noises.

Many animal species communicate with each other acoustically. Calls are important for finding mates, delineating territory, and establishing contact between parents and young.
Sudden noises put animals on alert and can trigger violent flight reactions. Unforeseen disturbances have a particularly strong effect in regions with low noise levels.
Important factors in assessing the disturbance effect are the loudness, duration (one-time or continuous, regular or irregular), and time of exposure (day or night). The type of noise and the superpositions from different noise sources are also important.
In the future, the criterion "civilization noise" must be given special importance in evaluation procedures.
After all, apart from the high mountains or some coastal regions, where can we still find larger landscapes that are not affected by noise emissions from traffic, business, agriculture or recreational use?
More quiet zones are needed and an awareness of the sound we cause is a goal for our installation.

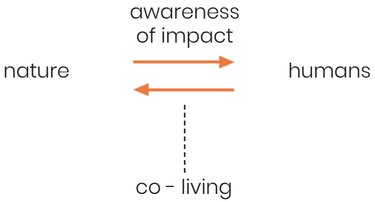
| 3. concept development |



I today"s human relation with nature I




I what could a new nature could be I




what could a new nature be ?

humans are using the park

better
co - living
conditions
for all

aware of their impact in nature

what could a new nature be ?



| 3. concept development | new nature : what we mean by it

How do we impact nature?

Do we notice all the changes we make in the natural environment by only doing our daily routine? The “silent spectacle” installation aims at discussing the constant impact we have in nature, and that we are not aware.

The project believes that being aware is the first step towards a “new nature”, one in which humans and nature create a egalitarian environment, where humans are not only using natural resources, but also using knowledge and technology to return to nature.

“Silent spectacle” seeks to show that co-living can be the key factor in protecting the environment and, therefore, our society.

Giving nature a “voice” through the installation, showing environmental data in a visible and tangible installation, could be one of the ways of constituting this co-living environment, where nature is also heard and comprehended.

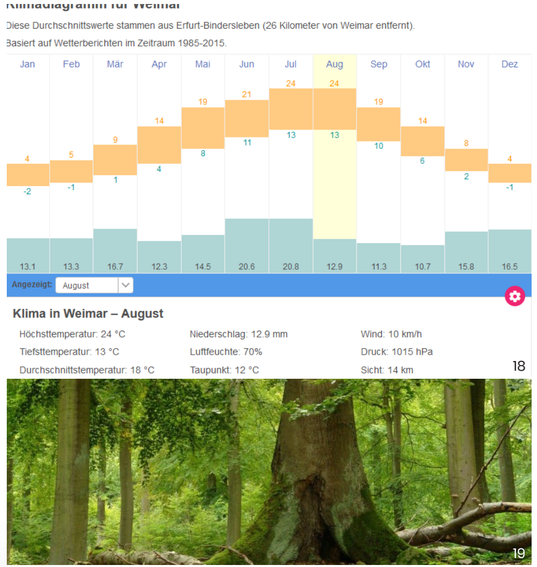
what could a new nature be ?

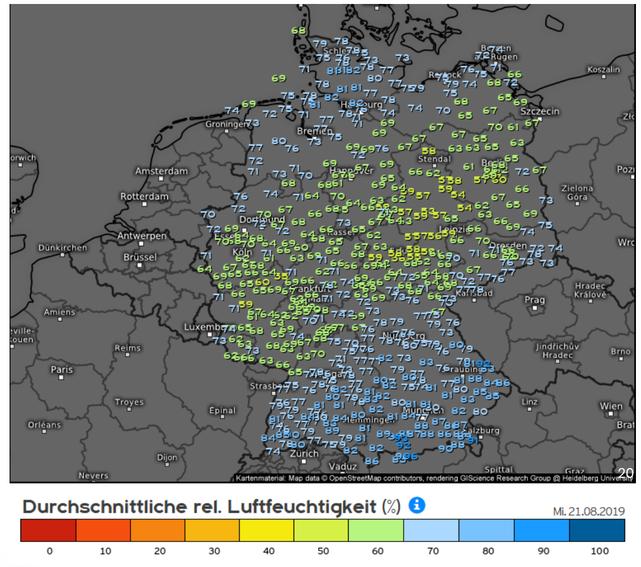
Dry air slows plant growth

Plants use carbon dioxide to build their leaves. In fact, greenhouse gas emissions have promoted plant growth. But this trend is reversing.
Dry air has a high saturation deficit that affects plant growth.
"The saturation deficit is directly linked to temperature and thus a direct consequence of the human-found temperature rise."
Dry air harms plants. The reason for this is the stomata.
"Stomata are small openings in the surface of leaves and regulate the plant's water balance. Now, when conditions are dry, these pores close, and at the same time, plants can also take up less CO2." Dry air is actually even more problematic than a lack of rain.
A comparison of light reflectance in the red and infrared regions provides a vegetation index that indicates how healthy plants are in a given area.
This vegetation index initially increased in the second half of the 20th century, due to increased CO2 levels, because this gas acts as a fertilizer for plants. But this positive trend has now reversed.
Dry air inhibits the productivity of trees, it makes them more susceptible to other stress factors, and last but not least, it also increases the risk of forest fires. The table on the right depicts the average temperature (orange) aswel as the average rainfall (blue) based on the numbers from 1985 - 2015.
It shows that in August a high temperature and low amount of water causes dryness.
An countermeasure would be most needed in that month.

The map on the right depicts the average air humiditi on an example date in August.
Weimar has had a average of 55% and would have benefitted from an installation that creates more humidity.





"The severity of extreme weather conditions brought on by climate change are conditioning quality of life, economic development, and well-being in today's cities.
Conventional measures have been shown to be insufficient for tackling climate change and must be supplemented with ecofriendly approaches.
Hence, the scientific community's endeavor to develop natural cooling techniques that lower energy consumption while delivering satisfactory comfort levels.
For its simplicity and low cost, evaporative cooling has gained popularity in recent years. The substantial cooling power to be drawn from evaporative mist cooling, makes it an attractive alternative to conventional systems.
Research conducted to date on the technique has focused on producing cold air, whilst cooling the water involved has been neither assessed nor experimentally validated. No readily applicable simplified model for the system able to use operating parameters as input variables has been defined either. [...]
The findings confirmed the cooling power of the technique, with declines in water temperature of up to 6 C, and with it the promise afforded by this natural air conditioning method."

The pictures to the right show such mist spray nozzles of the company cool-cloud-systems. The microscopic droplets coming out of the fogging nozzles extract heat from the ambient air, evaporative cooling is generated. The finer the mist, the faster it evaporates, the sooner sweaty people can retreat to the newly created, cooling comfort zone. In addition to cooling, this also creates a pleasant humidification of the air - air that is too dry is infused with moisture.
In the southern states of the USA and in Southern Europe, mist showers have been in use for decades. More and more cities are using them to transform open spaces in public areas into oases of well-being. Vienna has discovered the blessing of fog showers after the hot summer of 2018, even wants to create a "cool mile" in the city center.
The german city Brunzlau as seen in the second picture, is also one of the customers.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## olaffur elliasson


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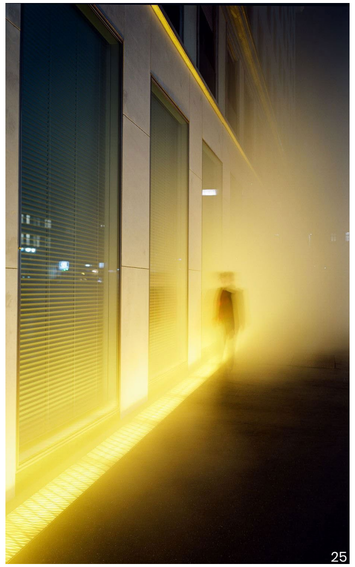

25

For Olafur Eliasson, fog is a tool for making spatial connections and distances tangible.
"Yellow fog" thematizes the transition from day to night and subtly draws attention to the change in the rhythm of the day.
"Fog assembly" produces a continual outpouring of swirling mist that dissolves the boundaries and outlines of the objects it encounters. It invites visitors' active engagement and participation.
"Vær i vejret" (Weather the weather), 2016, Whenever the wind changes direction, the ring releases a puff of fog into the garden.



| 3. concept development | research: reference projects


26


27

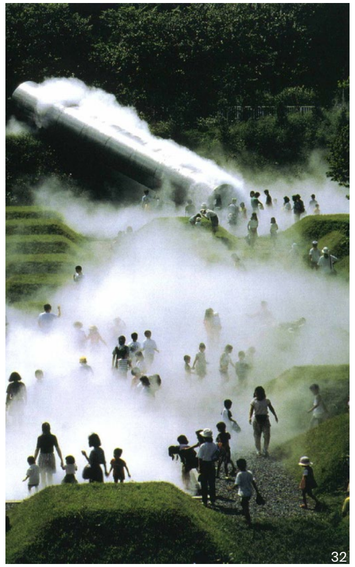

28


29

fujiko nakaya


30


31


32

Nakaya has been creating her signature fog works at sites around the world for almost 50 years. She started her career as a painter and later moved into sculpture; her choice of material was perhaps influenced by her scientist father, who invented artificial snow.
She collaborates with Mee Industries, to produce the fog she wants by pushing very small droplets of water through a patented type of nozzle. The smaller the droplet (and these are only 20 microns), the more fog-like it appears; it will also disperse faster, which reduces the sensation of getting wet.



| 3. concept development | research: reference projects

Nakaya's sculptures only use water that dissipates naturally, and the mechanism for generating the fog is integrated into the installation.


35


34


36

how can we propose a new nature ?

concept

make sound pollution visible

create a "silent spectacle"

input

pedestrian / human activity sounds

output

fog

pollution awareness (sound & climate)

output

light

sound awareness





interaction

human noise

fog

cooler climate for plants and humans

fog intervention nozzles + sensors

during summer

light

light human disruption sensation

light spectacle LED net + sensors

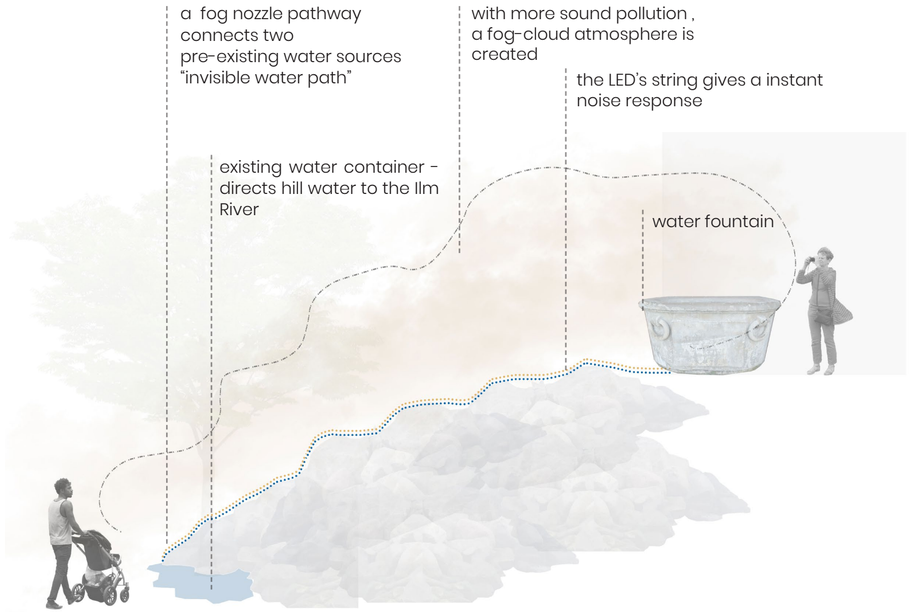
daytime

pedestrian sound

nighttime

how is the interaction in this new nature ?

"silent spectacle"









37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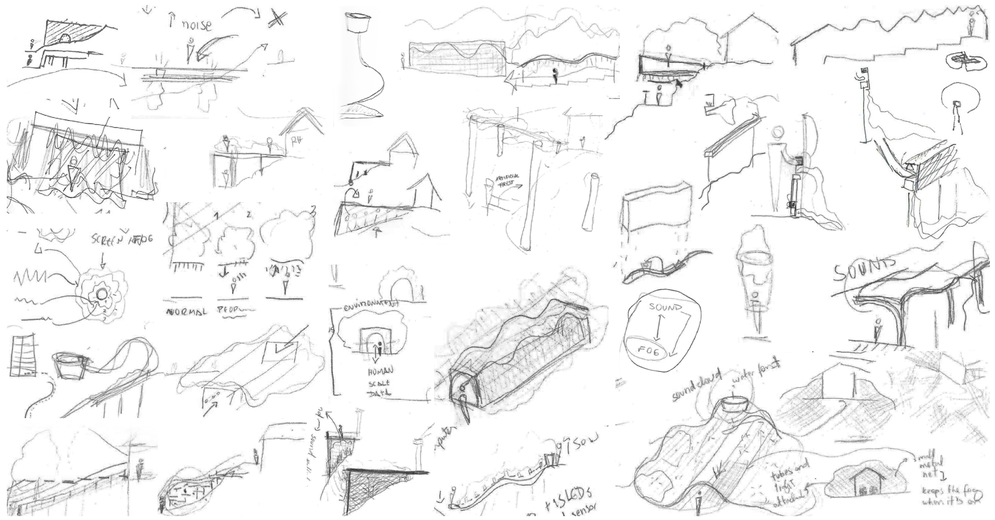
39

to make [noise] pollution visible

| 4. design concepts |



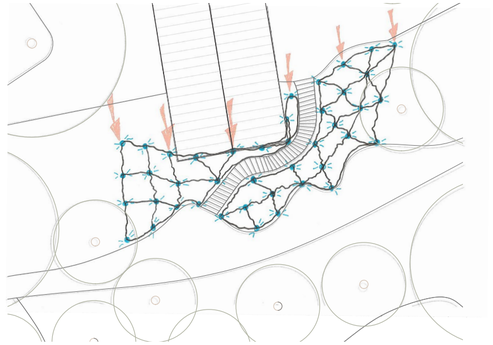


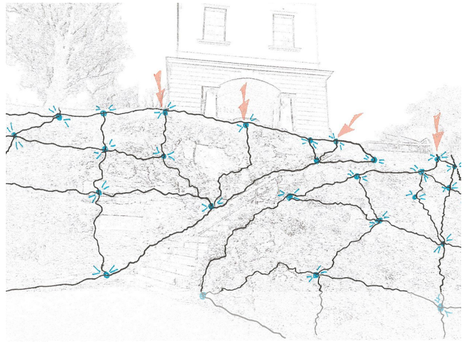

## Ideas

During the next steps the idea of a sound responsive fog pollution installation was put into different architectural design strategies.
Various approaches on how such an installation can be implemented were created and discussed.
The main goal was to create a fog atmosphere with mist-nozzles through a place which is not too imposing with its own structure and connects the Roman House with the entry to the river valley.

In the first approach a net of fog nozzles spreading over the hill was proposed.
The main goal was to enhance the hills plant growth and moss production.
The more noises created by the surroundings, the more water was given to the plants.
This direct responsiveness idea was later discarded because would have triggered even more loudness.
Also plant growth would have only been able to reach with constant watering going against our concept of a very lightweighted fine mist cloud that is cooling the area but not watering it directly.









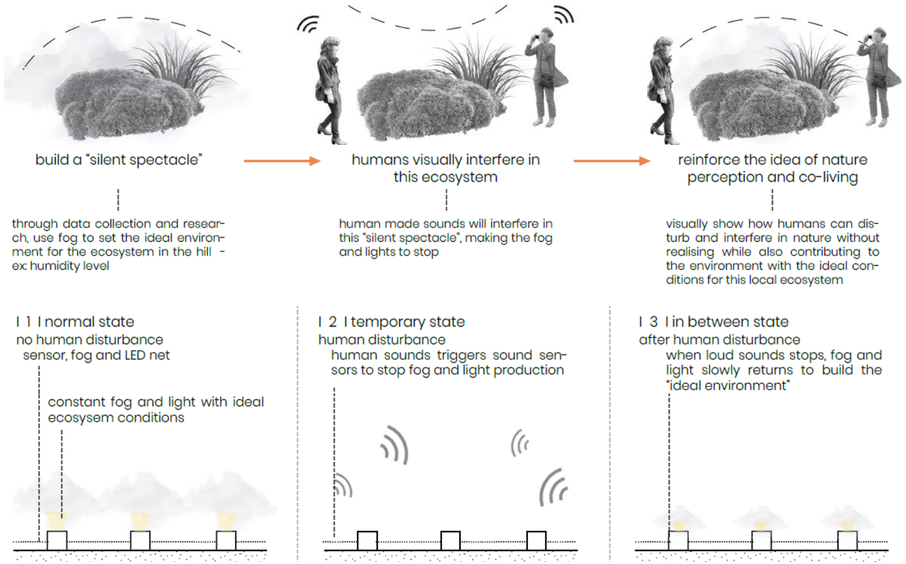


In a next step an architectural context was given to frame our fog cloud. A mesh of metal was formed surrounding the staircase as a tunnel or built as a fog filled terrace to the Roman House.
Those structures give a more permanent approach to our concept for which afterwards was decided to provide a temporary summer installation.
A fog cloud is already a visual element that forms itself differently in each weather condition that is better visible if not fenced in a structure. After that we searched for a construction to more underline than frame.



| 3. design concepts | “the mesh”

To do the idea of a floating cloud of thinly distributed fog justice, the interaction with it was reversed.
A "silent spectacle" is created by having an ideal normal state of fog and a natural flowing light concept. While humans interfere with the installation, the fog and light spectacle will stop, forcing the visitors to be quiet again in order to view the created atmosphere.
This idea was later adapted into creating a stable state of installation that is not stopping but responding to noise and raising the fog pollution again in direct relationship to human noise pollution.



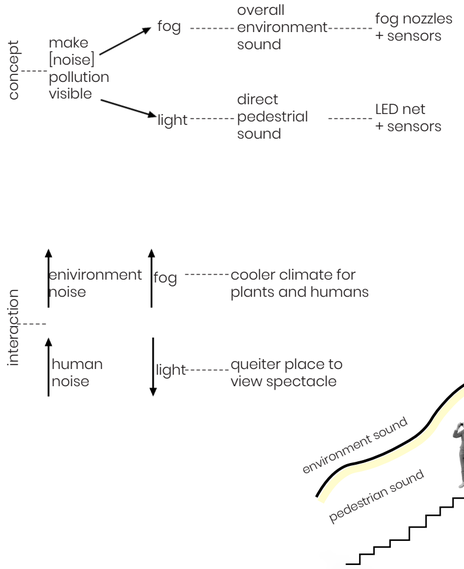


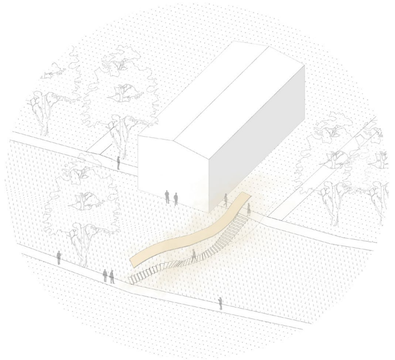


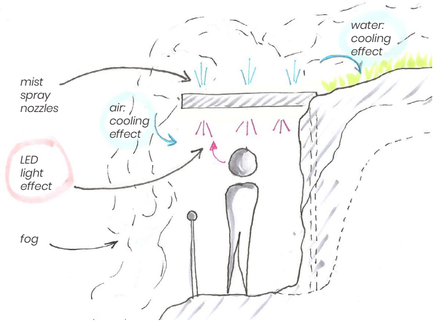

Another way to create a cloud atmosphere was to form "chimneys" emitting the fog cloud. The lights were integrated into columns to visualize the interference.
Though this Idea had a large figurative approach on pollution and global warming through greenhouse gases, it could also have been an art installation to be placed anywhere in the world.
In the next steps a solution was to be found in which a communication with the chosen location is given and a visualization of why exactly this transition pathway of the hill is the stage.

In “the ribbon” concept a floating roofing to the staircase would function as a weather shielding, light spending face to the pedestrians pathway and as a cloud emitting roof that cools down the air and spends water to the plants.

This creates two scales of interaction: the environmental scale in wich the fog cloud on top grows bigger the more environmental sound is happening, and an human scale in wich the light spectacle gets disrupted by pedestrian sounds, forcing them to be more quiet to enjoy the spectacle.





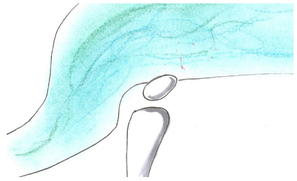




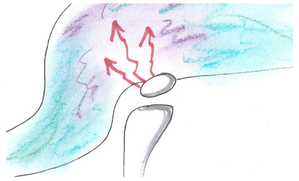

environmental scale interaction



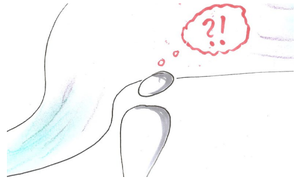
human scale interaction



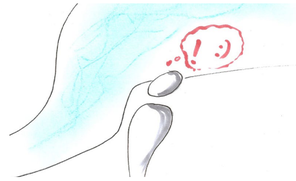
visualized noise flows naturally down the stairs



human sounds distract the spectacle

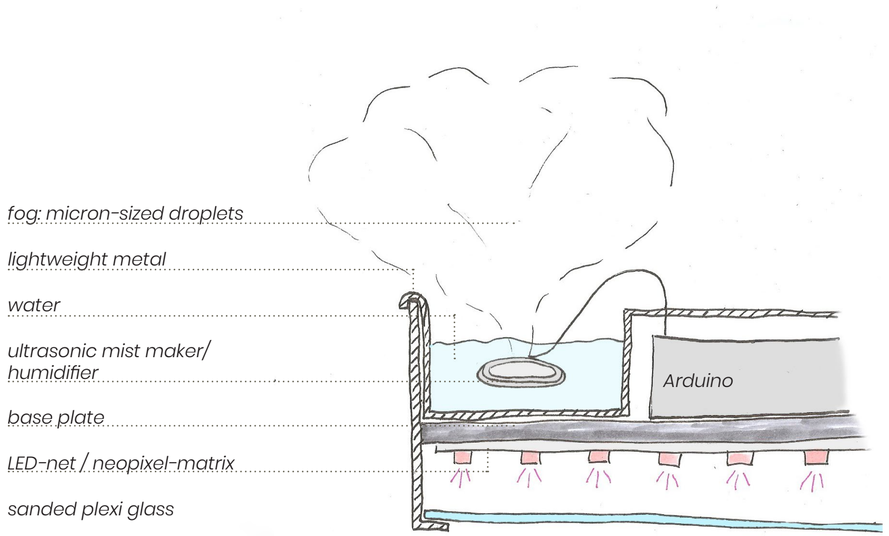



visualization fades away from the disturbance




sound spactacle retuns as humans view quietly

First drafts to the down scaled prototype were made for which ultrasonic mist makers are proposed. Though the suggested spray nozzles are perfect fitting solution for the real installation, together with their air and water pressure system, the costs would not have been in relation to a prototype scale.
For this a section of the installation is created.
The concept of the flying ribbon proved itself later to still be too heavy for the main idea we wanted to transport and was recycled.









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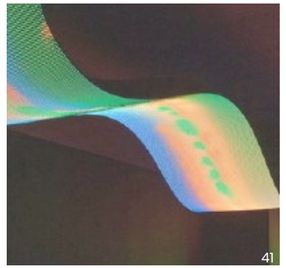
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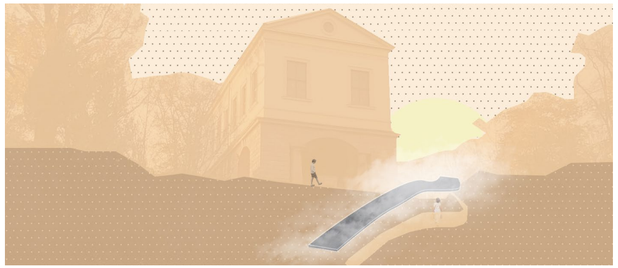
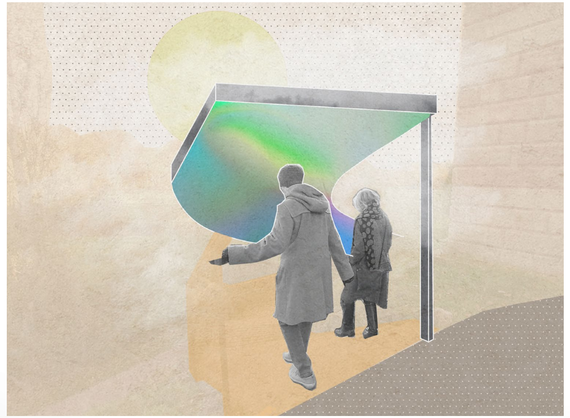
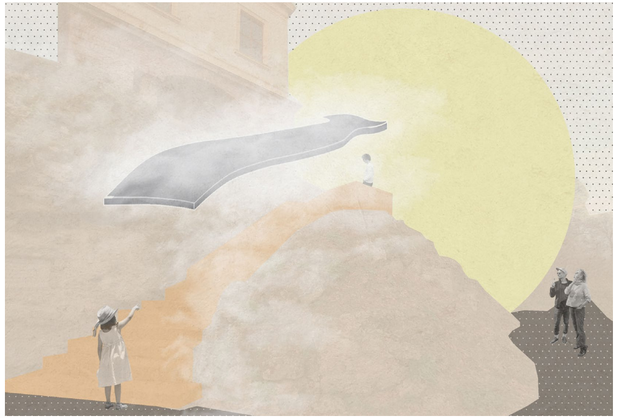
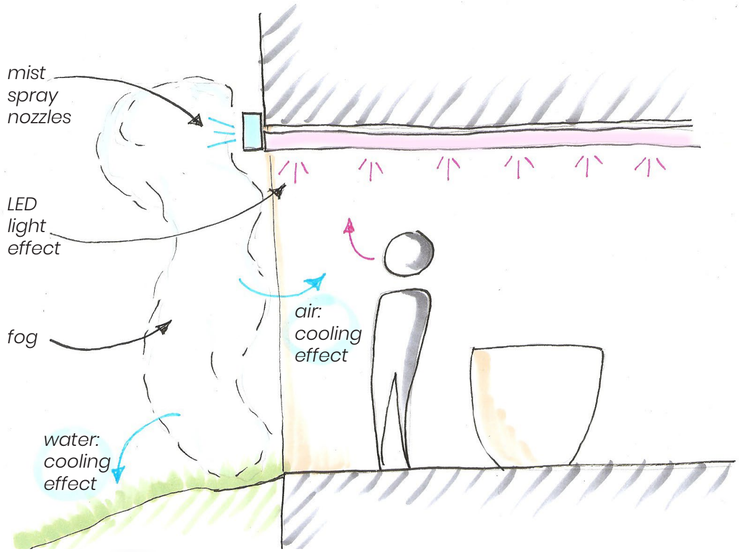




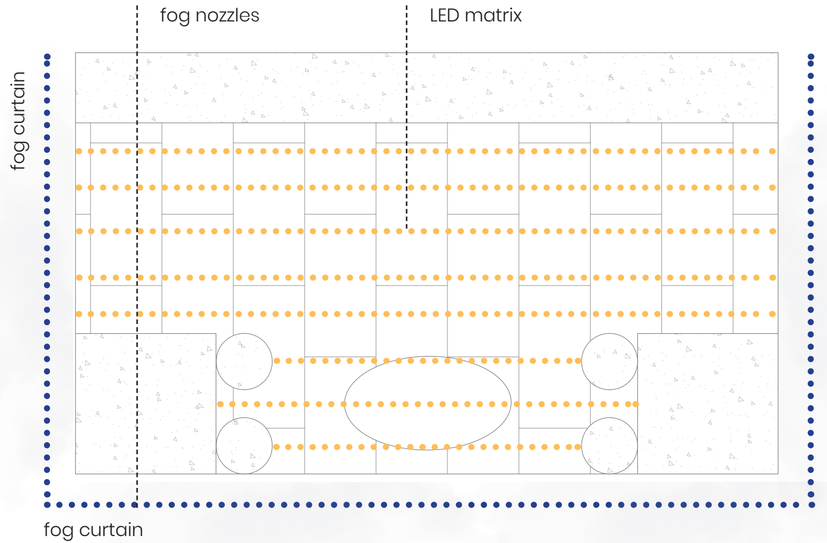


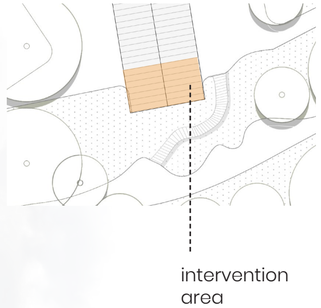
In this proposal a fog curtain was created that could block the view over the Ilm Park as people interfere with the installation. Inside the Roman House Terrace a light spectacle ceiling is suggested to show the direct sound response and create an atmospheric gathering place.
This approach scrapped because of going back and creating an isolated area that lost the connection to nature that was already created in earlier drafts.





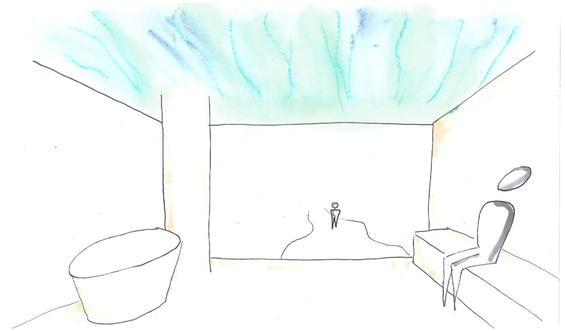



romisches haus terrasse plan 1:50

the silent room



light spectacle in base-state:
- natural colours of the Ilm Park
- slow stream of movements

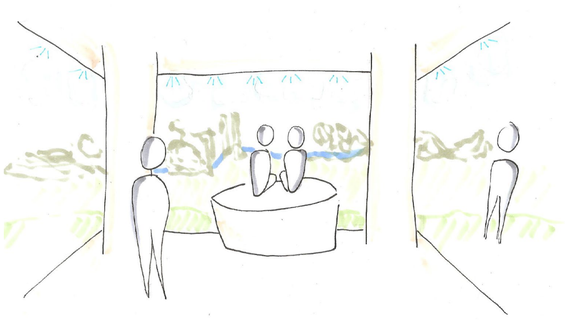
light spectacle in interfered-state:
- human made colours of the römisches Haus
- disrupted shaking movements

- experience more present during nighttime
- “quiet spectacle” effect for humans & environment

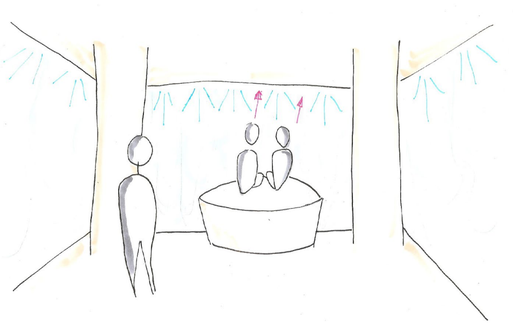




the courtain



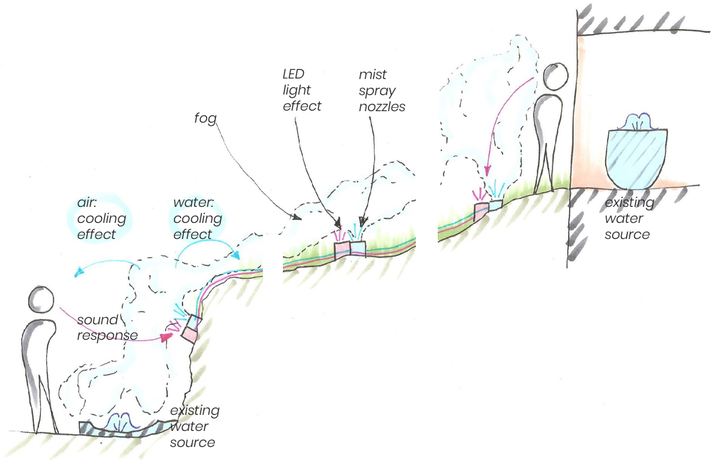
smaller amount of “fog pollution”
creates a cooled space to watch the nature during summer



raising amount of “fog pollution” activated by human sound
creates a fog curtain - disrupts the view

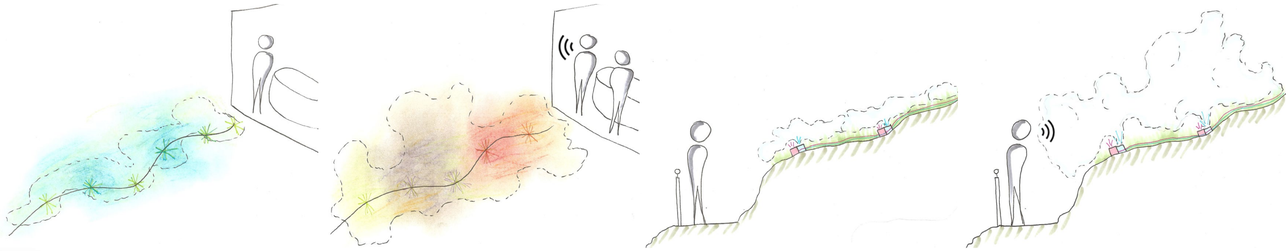
- experience more present during daytime
- cooling effect in summer for humans & environment

Our final approach was creating a water pathway connecting the two already existing water sources of the place and therefore creating a direct communication with the location.
The fog nozzles are arranged together with LEDs in a line going down the hill.
It will be further described in the following section of our final design proposal.





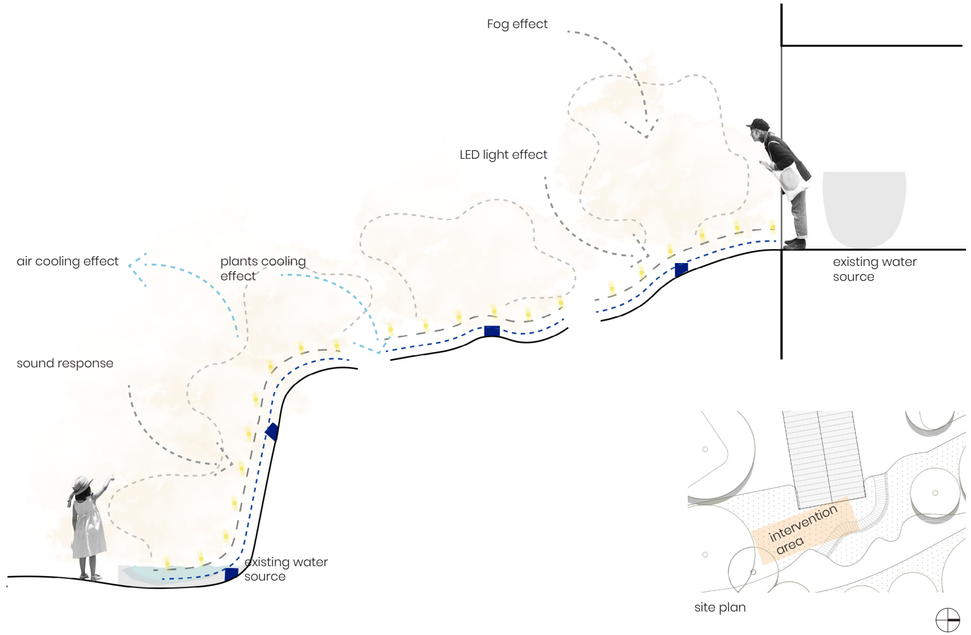

| 3. design concepts | “the water pathway”

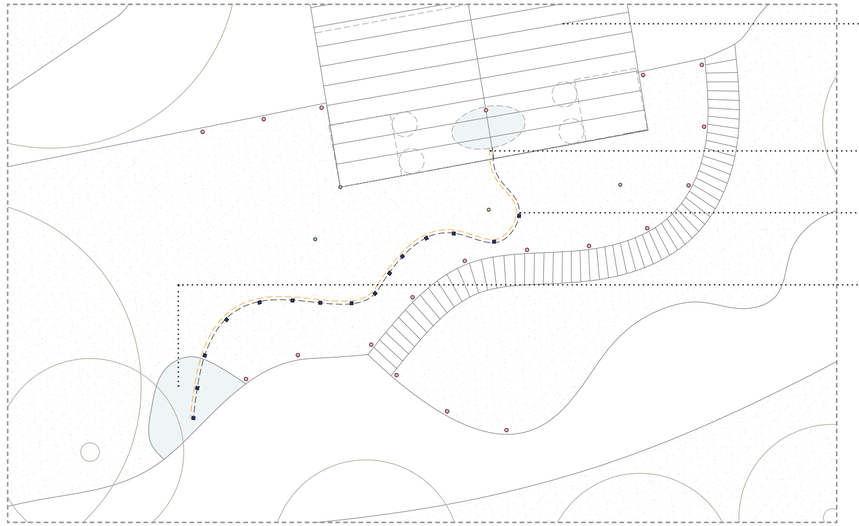


# | 5. final design |



The final concept of "silent spectacle" connects the pre-existing water sources of the Roman House: the fountain on top of the hill and the water pond on the bottom. A line of fog-nozzles create a cooling effect for both nature and humans. The combined LED-line forms a direct sound response and invites the pedestrians to stop and re-evaluate their own emission of sound pollution.





water and energy
connection to the house

water fountain

15 fog nozzles
180 cm array

water container, collects
and directs water to the
Ilm river

LED strip

Fog Nozzle

Humidity sensor

Sound sensor

romisches haus terrasse plan 1:75

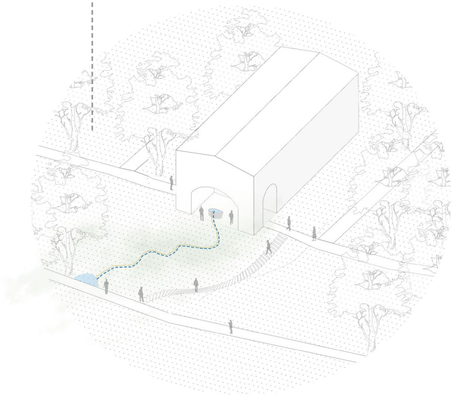




normal condition
small amount of sound polution

fog: small amount for plant cooling

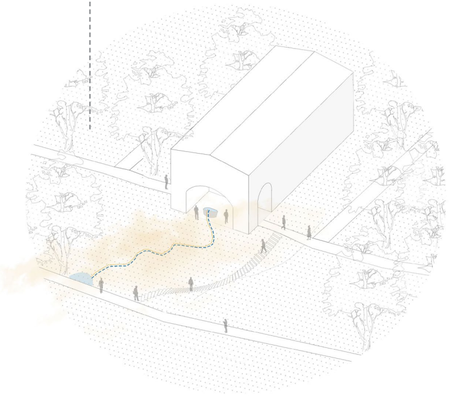
light: "silent spectacle"



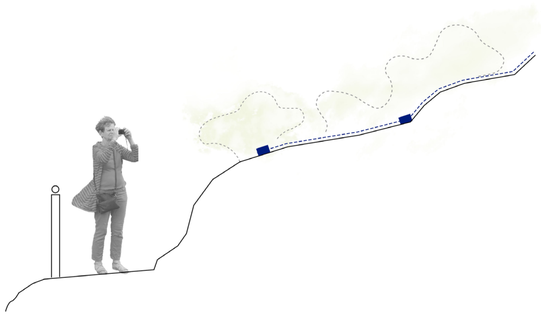
loud condition
high amount of sound polution

fog: "cloud atmosphere"

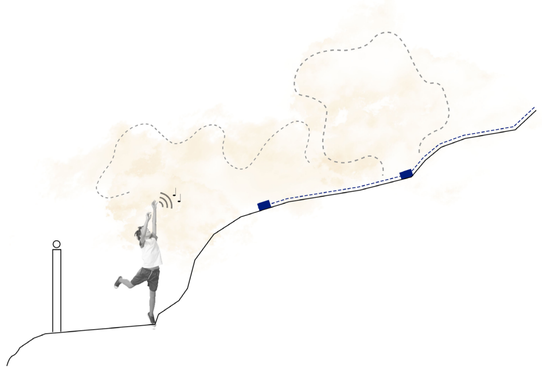
light: disrupted



the cloud atmosphere



smaller and stable amount of "fog pollution"
creates a cooled space for the nature during summer



raising amount of "fog pollution" activated by human sound
creates a fog cloud - disrupts the view, cooling effect rises

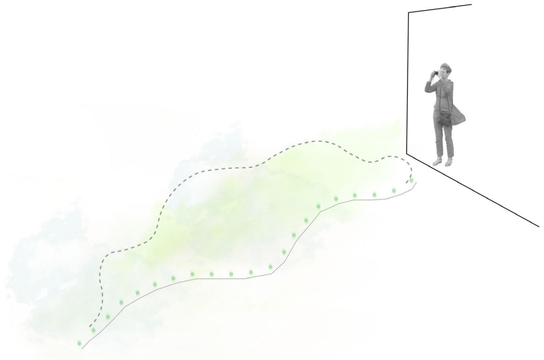
- experience more present during daytime
- cooling effect in summer for humans & environment

fog

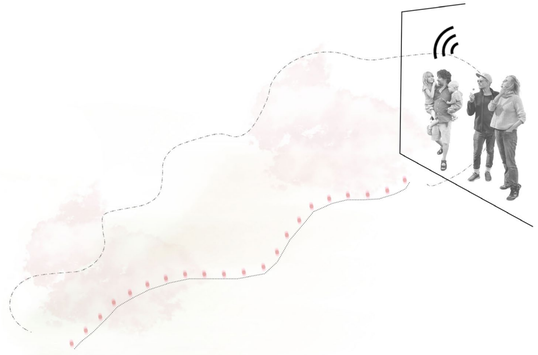




the silent spectacle



light spectacle in base-state:
- natural colours of the Ilm Park
- slow stream of movements

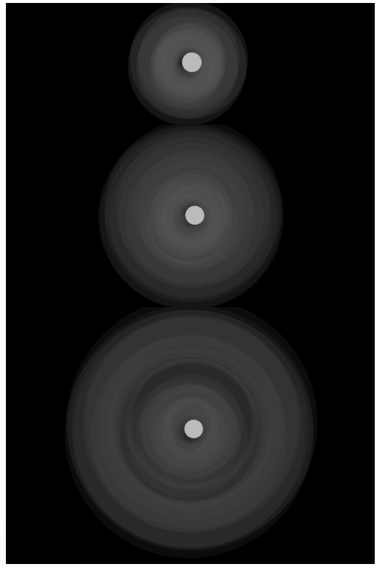


light spectacle in interfered-state:
- human made colours of the römisches Haus
- disrupted shaking movements

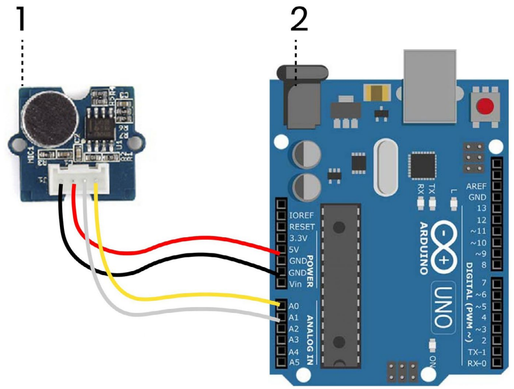
- experience more present during nighttime
- "quiet spectacle" effect for humans & environment

light

## the cloud atmosphere



Since the projects proposes to turn sound pollution visible with fog nozzles, we wanted to use Processing to simulate the fog nozzle responsiveness to sound input. Therefore, the aim of this sketch is to provide an animated simulation of how the fog nozzle would respond to sound input.
To test the Processing possibilities, we developed two different types of code. The sketch on this page, uses an analog sound sensor input attached to Arduino to provide the sound input.
It then calculates the sound average and provides a visualization of the 3 different pollution stages.




Arduino physical setup components

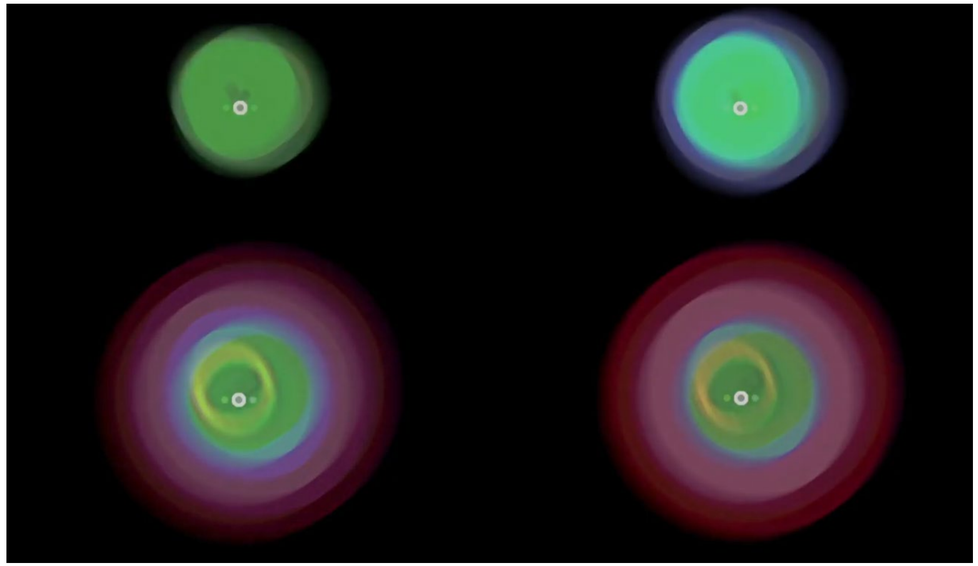
1 - Grove - Sound Sensor
2 - Arduino UNO





## the silent spectacle

This sketch uses a recorded sound file of the park to generate the input. It then changes the colour of the fog from more natural to more "human interfered" colours like the ones found in and on the roman house.
Without working with the original fog nozzles, the Processing sketch was a valuable tool for simulating the spray-nozzles responsiveness we wanted to create for demonstrating the sound pollution in the park. With a rather simple sound sensor, it is possible to map the sound input from the environment and provide an interesting visual response.

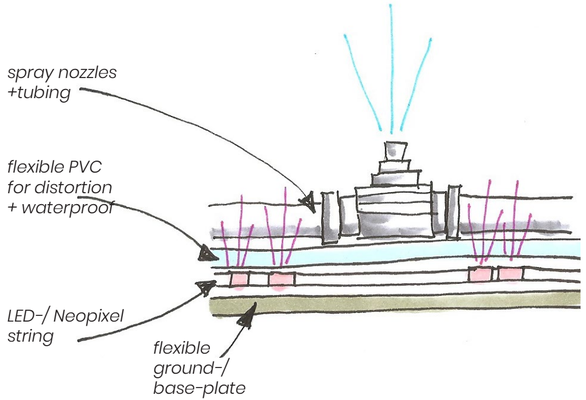


| 6. real implementation |

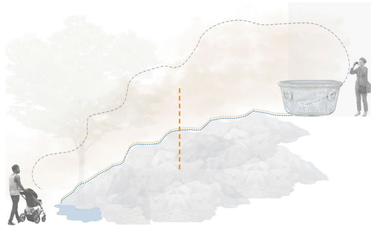


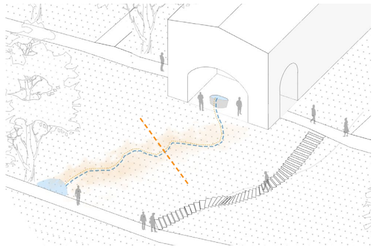
system components

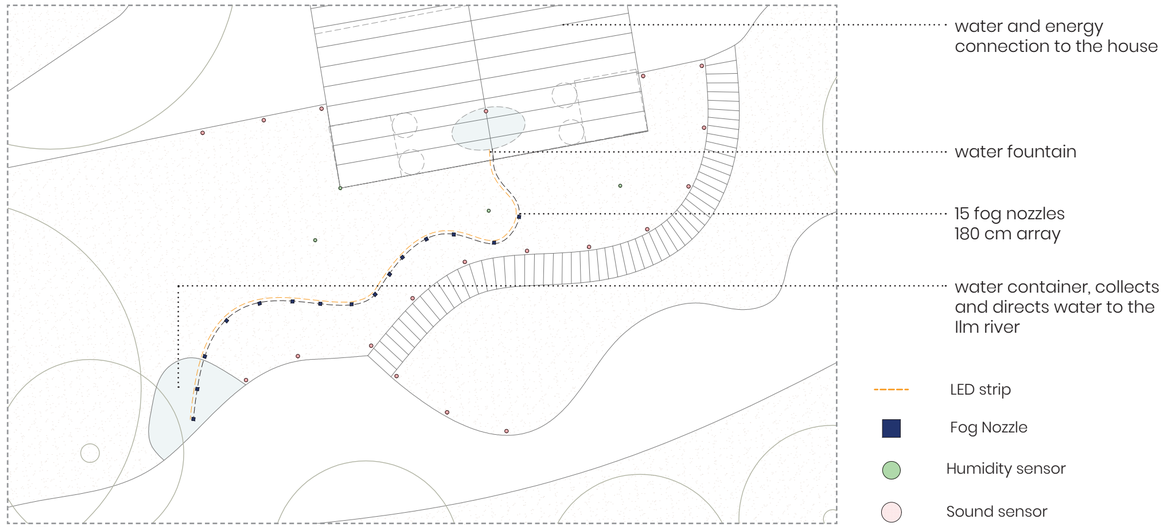
For the real installation, we proposed a string system, formed by ultra fine mist fog nozzles, LED RGB strings, and intermediate materials to impermeabilize and not interfere directly on the soil. The string system will be connected in existing water and energy outlets, and the fog nozzles pressure will be controlled by an outside pumping system. The fog and light quantity will be created in response to the audio input, sensed by sound sensors, and regulated according to humidity sensors, that can shut off the fog if the humidity can damage the local ecosystem.




In conclusion, it's a 36-meter string system that follows the hill topography to create this almost unseen string, that creates an ephemeral atmosphere with fog and light.








romisches haus terrasse plan 1:75



| 6. real implementation | sensors

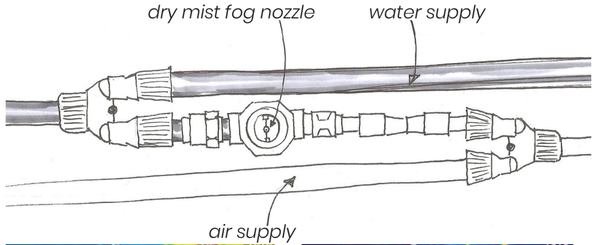
The use of live data sensors are essential to create the responsiveness of the installation, reacting to the sound pollution of the environment, while also measuring the local humidity in order to allow the fog to be turned off when necessary for the plants. The sound sensors will be located throughout the pedestrian paths in the hill - stairs and park paths - which allows everyone in the area to contribute to the installation and notice it's sound pollution impact. On the other hand, the humidity sensors will be located directly on the hill to monitorate the humidity of the existent ecosystem, formed by mosses, ground vegetation and some bushes.

## the cloud atmosphere

The fog nozzle system is inspired by the Panasonic system "45 Green AC Flex" Solution, that uses a two-fluid mist nozzles solution in order to create a fine dry water mist without need to use other fog production methods, such as warming or ultrasonic sound. This innovative system has been used in artistic installations and also in cooling down cities that are facing heating waves, and therefore seems like the ideal solution for our installation proposal.

cooler climate for humans...

...and nature



thermo viewer without mist


with mist

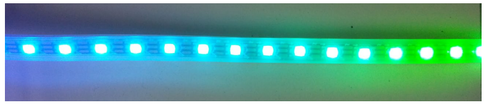
fog





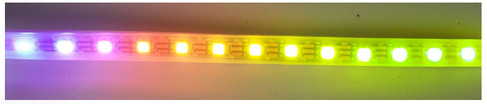
## the silent spectacle

01_Light State : low sound pollution = natural colors

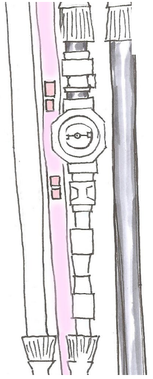


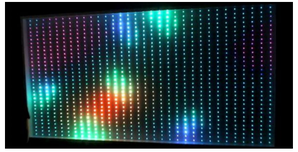
02_Light State : medium sound pollution = disturbed natural colors

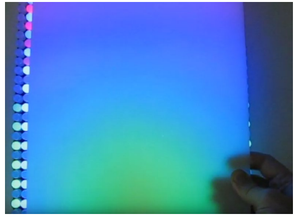
03_Light State : high sound pollution = disturbed/ human made colors



The LED String system is responsible to provide different light patterns and colors according also to the sound input captured by the sound sensors. It's a waterproof string, which allows it to be near the fog system without being damaged. The LED string is composed of individual LEDs that can be addressed by code. For this project, a code was developed in Arduino to distinguish the sound input in 3 amount phases - low, high, medium - and create a correspondent light color pattern, that also symbolizes our project concept of new nature and human interference, the first one being represented by natural colors, such as green and blues, and the last one by more human-made colors, also present in the Romisches Haus, such as red and oranges.





light






For having a real and measurable perception of how the fog system and LED would work in it's outdoor context, we turned to commercial products which could allow a first perception of the components behaviour. We tested a LED RGB String to see how visible it was in daylight, and had positive responses, as seen in the pictures on the side. In addition, we tested a commercial version of the fog nozzles, used for garden irrigation, to see how the fog would react in the real environment, and in the experiment we noticed the different patterns and atmospheres that the fog can create.

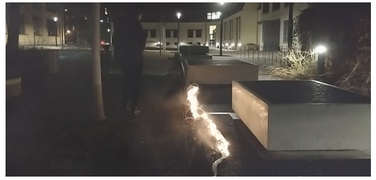


| 6. real implementation | testing scale










| Techinical component | Quantity | Provider | Costs? € | etc |
|---|---|---|---|---|
| Nebel Düsenanlage | 15 Nozzles + Tubing + air&water pressure system<br>---<br>1 nozzle / meter | CoolCloud | 3.000 | Renting possibility - in contact with company |
| LED String Adressable | 95 euros / meter<br>---<br>--- 40 meters in total | Adafruit | 678 | |
| Eletrical instalations conection to the house energy outlet | 20 meters | Nexans - Amazon | 128 | |
| Rented computer to run softwares | 1 month | Grover | 50 | |
| Humidity Sensors | 3 units / 39,95 each | Reichelt - LoRaWAN temperature & humidity sensor | 119,85 | |
| Soundsensors | 20 sound sensors/ 122 each | | 2440 | |
| Instalation estimated cost - in euros | | | | 6.416 |





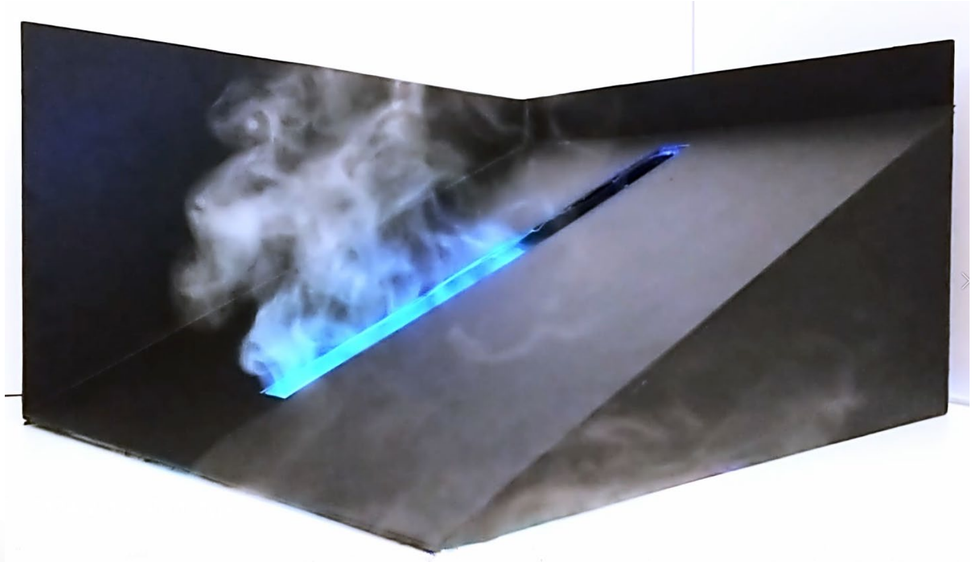
what are the next possible steps in the project development?

- Improve the sound analysis in the code
  - Differ sound income, sound range/pitch, sound producer
- Develope code to measure the humidity in the hill and adjust according to the plant needs
- Develope collaborations with fog nozzle system

The development of the "silent spectacle" required us to conduct real life experiments and research to adapt the project outcome to the best solution that represents our new nature concept and atmosphere ideas.
Some challenges were faced while developing the prototype and code, but that were important to create a direct and clear installation concept. We can already see some further developments of the project that could optimize and sophisticate it's potential.
The first development point concerns further writing the code so it can distinguish different sound range input, such as natural sounds or human sounds, and create an installation that responds only to human sound pollution.
Another point would be creating a code that can measure the local humidity and assess the perfect condition for the local ecosystem and plants, in order to not danificate them.
Finally, for real implementation, it would be ideal to develop a partnership with fog nozzle producers, in order to implement the best and more suitable system and spreading the possibilities of this system use.

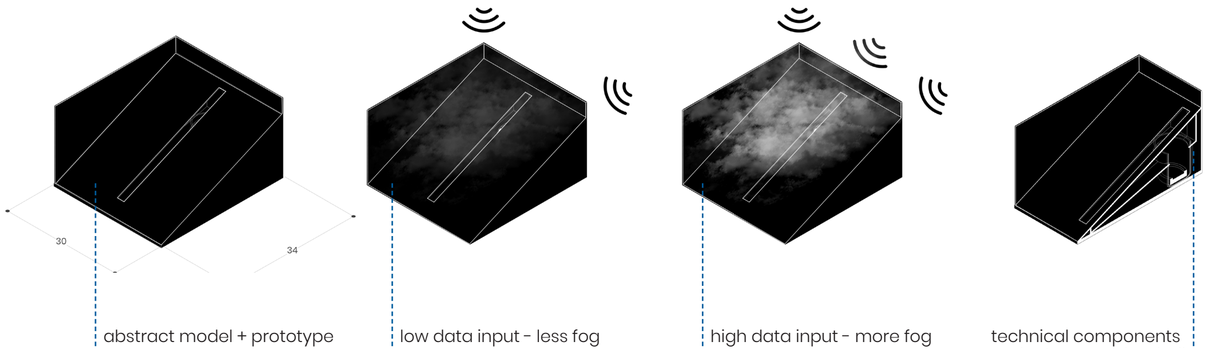
| 7. prototype |





The prototype was developed to allow the testing of components that would be used in the installation, such as the sound sensor, fog production and LED String.
Furthermore, we wanted to create an abstract model of how the fog and LED would look in real life. A inclined shell, therefore, was created for covering the components and allowing the fog to spread as it would in the Romisches Haus.
This allowed us to test the components while also evaluating the real life impact of the output that we proposed, fog and light.

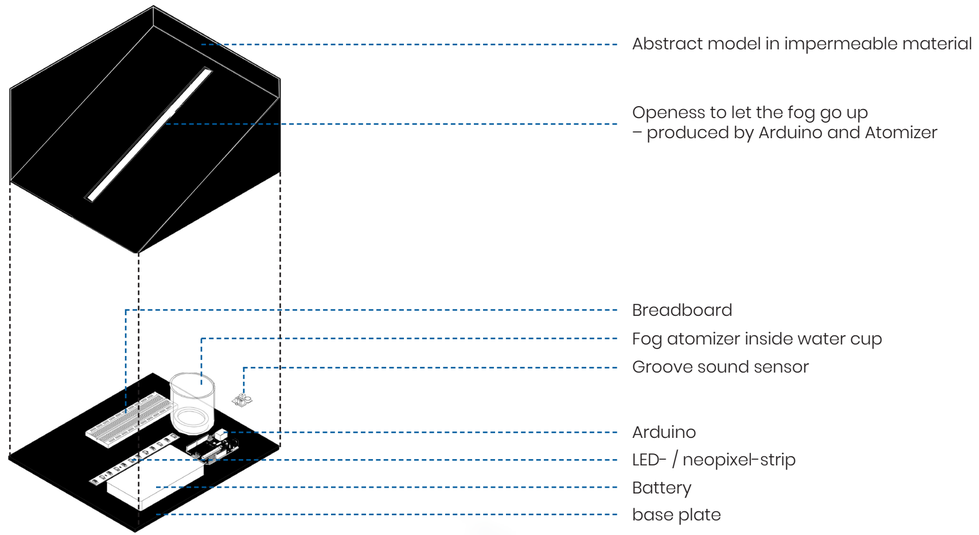
downscale: prototype



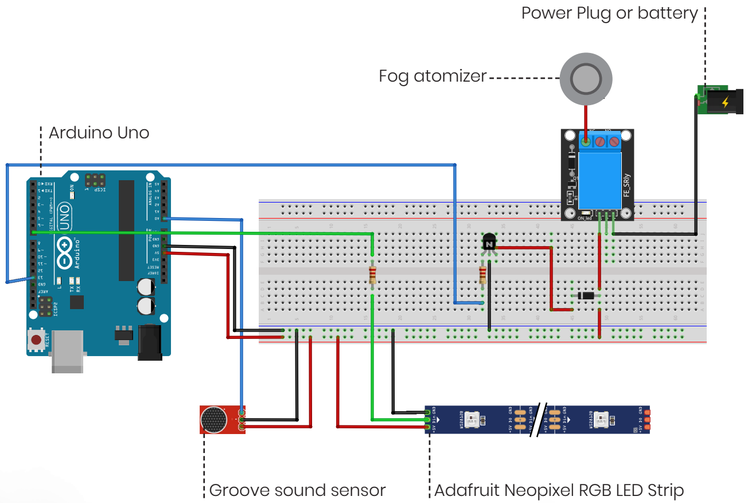


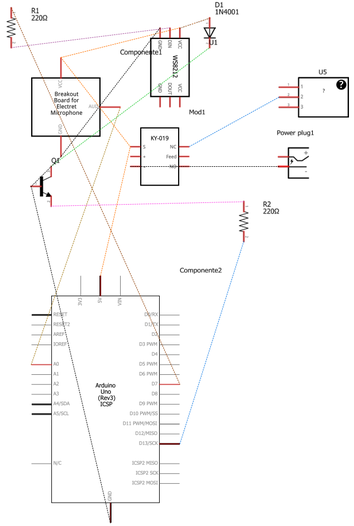



downscale: prototype



## arduino schematics

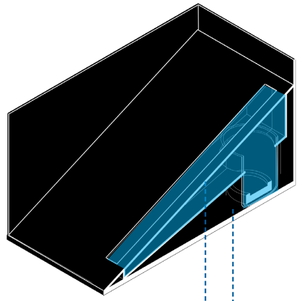






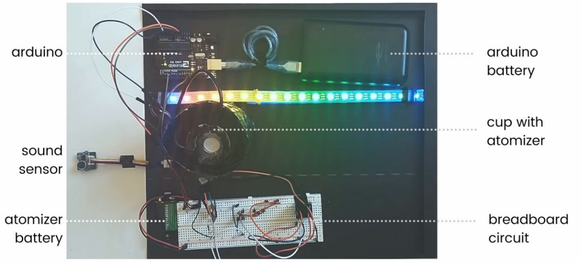

## shield components

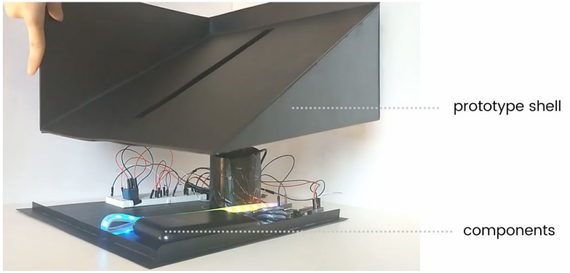


waterproof chamber in wich atomizer & fog are

technical components under topography shell

For the prototype it was necessary to develop impermeabilisation that allowed the electrical components and fog production with water to be in the same place. A sealing chamber was created for the fog atomizer, so that the condensed water would not spill on the other electrical components. All the prototype walls were waterproof with black acryglas and black silicon, which sealed the model joints. Furthermore, the use of batteries was proposed so that the model could stand itself with no need of being connected to power or computer, since the code is also encrypted in the arduino, located inside the model.



arduino code structure

```
//=======================================
// ----------LIBRARIES--------------
////NEOPIXEL
#include <Adafruit_NeoPixel.h>
#ifdef __AVR__
  #include <avr/power.h>
#endif
#define PIN 6                          // the LED Input Pin on the Arduino-board
Adafruit_NeoPixel strip = Adafruit_NeoPixel(30, PIN, NEO_GRB + NEO_KHZ800);
                                       // Parameter 1 = number of pixels in strip
                                       // Parameter 2 = Arduino pin number (most are valid)
                                       // Parameter 3 = pixel type flags, add together as needed:
                                       //   NEO_KHZ800  800 KHz bitstream (most NeoPixel products w/WS2812 LEDs)
                                       //   NEO_GRB     Pixels are wired for GRB bitstream (most NeoPixel products)
// --------INTS & CONSTANTS ---------------
const int numReadings = 10;            // For the average sound Input Define the number of samples to keep track of.
                                       //  The higher the number, the more the readings will be smoothed,
                                       //  but the slower the output will respond to the input.
int readings[numReadings];             // the readings from the analog input
int readIndex = 0;                     // the index of the current reading
int total = 0;                         // the running total
int average = 0;                       // the average
int inputPin = A0;                     // the Sound Input Pin on the Arduino-board
const int pinAdc = A0;
const int atomizer =  13;              //Atomizer Input pin
const long soundInterval = 1000;       // interval at which to capture sound data (milliseconds)
const int NcycleInterval = 2500;       // number of millisecs between Neopixel Natural Cycle
const int DcycleInterval = 2500;       // number of millisecs between Neopixel Disturbed Cycle
const int HcycleInterval = 750;        // number of millisecs between Neopixel Human Cycle
const int NfogInterval = 2000;         // number of millisecs that Atomizer is on in Natural
const int DfogInterval = 1000;         // number of millisecs that Atomizer is on in Disturbed
const int HfogInterval = 500;          // number of millisecs that Atomizer is on in Human
```





arduino code structure

```
//------------ VARIABLES--------------------
unsigned long currentMillis = 0;        // stores the value of millis() in each iteration of loop()
unsigned long previousInputMillis = 0;  // will store last time Input reading was updated
unsigned long previousNcycleMillis = 0; // time when Natural cycle last checked
unsigned long previousDcycleMillis = 0; // time when Disturbed cycle last checked
unsigned long previousHcycleMillis = 0; // time when Human cycle last checked
unsigned long previousNfogMillis = 0;   // time when Natural fog last checked
unsigned long previousDfogMillis = 0;   // time when Disturbed fog last checked
unsigned long previousHfogMillis = 0;   // time when Human fog last checked
byte atomizer_State = LOW;              // used to record whether the atomizer is on or off  LOW = off

//=======================================
//=======================================
void setup() {
 ////SOUNDSENSOR
  Serial.begin(115200);                         // initialize serial communication with computer
  for (int thisReading = 0; thisReading < numReadings; thisReading++) {
    readings[thisReading] = 0;
  }                                             // initialize all the readings to 0
  Serial.println("Grove - Sound Sensor Test...");
 ////NEOPIXEL
  strip.begin();                                // Starting Neopixels
  strip.setBrightness(50);                      // Defining brightness of LEDs
  strip.show();                                 // Initialize all pixels to 'off'
 ////ATOMIZER
  pinMode(atomizer, OUTPUT);
}


//=======================================
//=======================================
```

arduino code structure

```
//=========================================
void loop() {
  currentMillis = millis();     // capture the latest value of millis()
 ////SOUNDSENSOR
  readSound();                  // call soundsensor function
 ////NEOPIXEL
  cycle();                      // call Neopixel functions
 ////ATOMIZER
  fog();                       // call Atomizer functions
}



//=========================================
//=========================================
////SOUNDSENSOR
void readSound() {
  if (currentMillis - previousInputMillis >= soundInterval) {   // check to see if it's time to capture the input; that is, if t
                                                                // between the current time and last time capturing is bigger th
                                                                // the interval at which you want to capture. (e.g. one secound)
                                                          // save the last time capturing
    previousInputMillis = currentMillis;                  // store the time of this change
    total = total - readings[readIndex];                  // read Input with average: subtract the last reading
    readings[readIndex] = analogRead(inputPin);           // read from the sensor
    total = total + readings[readIndex];                  // add the reading to the total
    readIndex = readIndex + 1;                            // advance to the next position in the array
    if (readIndex >= numReadings) {                       // if we're at the end of the array...
      readIndex = 0;                                      // ...wrap around to the beginning
    }
    average = total / numReadings;                        // calculate the average
    Serial.println(average);                              // send it to the computer as ASCII digits
  }
}

//=========================================
```





arduino code structure

```
//=========================================
////NEOPIXEL
//    CYCLE
void cycle() {
    if (average <= 300){                              // determine the sound range of stage 1
    naturalCycle();                                   // start natural cycle
    }
    if ((average > 300) && (average <= 450)) {        // determine the sound range of stage 2
    disturbedCycle();                                 // start disturbed cycle
    }
    if (average > 450){                               // determine the sound range of stage 3
    humanCycle();                                     // start human cycle
    }
}
```

arduino code structure

```
,
// -----------  01   NATURAL  ------------
void naturalCycle() {
  unsigned long currentMillis = millis();
  if (currentMillis - previousNcycleMillis >= NcycleInterval) {
    previousNcycleMillis += NcycleInterval;
    uint16_t i, j;
    for(j=0; j<256*1; j++) { // 1 cycles of green&blue colors on wheel
      for(i=0; i< strip.numPixels(); i++) {
      strip.setPixelColor(i, Wheel(((i * 256 / strip.numPixels()) + j) & 255));
      }
    strip.show();
    }
  }
}
uint32_t Wheel(byte WheelPos) {
  if (WheelPos > 126) {
 return strip.Color (0, min (255, 2 * abs (127 - WheelPos)), min (255, 256 - (2 * abs (WheelPos-127))));
  }
 else {
  return strip.Color (0, min (255, 2 * abs (127 - WheelPos)), min (255, 255 - (2 * abs (127-WheelPos))));
 }
}
// -------  02  DISTURBED ------------
void disturbedCycle() {
  unsigned long currentMillis = millis();
  if (currentMillis - previousDcycleMillis >= DcycleInterval) {
    previousDcycleMillis += DcycleInterval;
    uint16_t i, j;
    for(j=0; j<256*1; j++) { // 1 cycles natural&human colors on wheel
      for(i=0; i< strip.numPixels(); i++) {
        strip.setPixelColor(i, Wheel2(((i * 256 / strip.numPixels()) + j) & 255));
      }
      strip.show();
    }
  }
}
```





arduino code structure

```
uint32_t Wheel2(byte WheelPos) {
  WheelPos = 255 - WheelPos;
  if(WheelPos < 170) {
    WheelPos -= 85;
    return strip.Color(0, WheelPos * 3, 255 - WheelPos * 3);
  }
  WheelPos -= 170;
  return strip.Color(WheelPos * 3, 255 - WheelPos * 3, 0);
}
// -------  03  HUMAN ------------
void humanCycle() {
  unsigned long currentMillis = millis();
  if (currentMillis - previousHcycleMillis >= HcycleInterval) {
    previousHcycleMillis += HcycleInterval;
    uint16_t i, j;
    for(j=0; j<256*1; j++) { // 1 cycle of human&less natural on wheel
      for(i=0; i< strip.numPixels(); i++) {
        strip.setPixelColor(i, Wheel3(((i * 256 / strip.numPixels()) + j) & 255));
      }
      strip.show();
    }
  }
}
uint32_t Wheel3(byte WheelPos) {
  WheelPos = 255 - WheelPos;
  WheelPos -= 170;
  return strip.Color(WheelPos * 3, 255 - WheelPos * 3, 0);
}

//=======================================
```

arduino code structure

```
////ATOMIZER
//    FOG
void fog() {
    if (average <= 350){
    naturalFog();
    }
    if ((average > 350) && (average <= 600)) {
    disturbedFog();
    }
    if (average >600){
    humanFog();
    }
}
// -----------  01   NATURAL  ------------
void naturalFog() {
  unsigned long currentMillis = millis();
    if (currentMillis - previousNfogMillis >= NfogInterval) {
       previousNfogMillis = currentMillis;
       if (atomizer_State == LOW) {
       atomizer_State = HIGH;
       }
       else {
       atomizer_State = LOW;
      }
   // set the LED with the ledState of the variable:
    digitalWrite(atomizer, atomizer_State);
   }
}
```



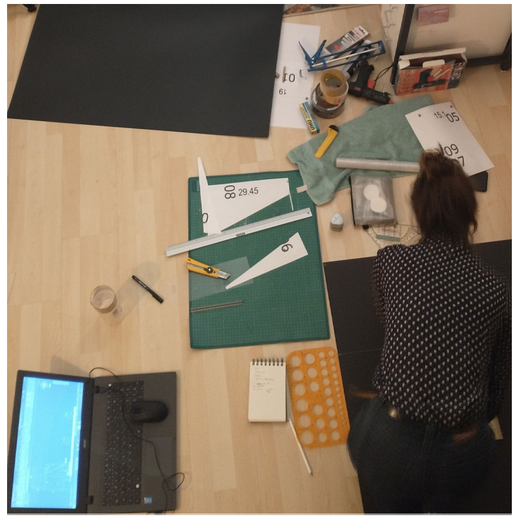
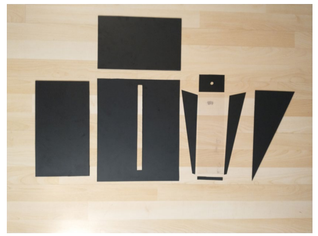


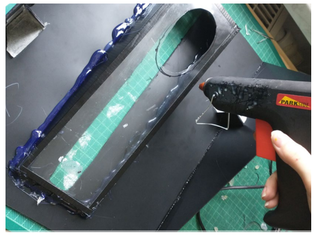
arduino code structure

```
// -------  02  DISTURBED ------------
void disturbedFog() {
unsigned long currentMillis = millis();
    if (currentMillis - previousDfogMillis >= DfogInterval) {
       previousDfogMillis = currentMillis;
       if (atomizer_State == LOW) {
       atomizer_State = HIGH;
       }
       else {
       atomizer_State = LOW;
      }
   // set the LED with the ledState of the variable:
    digitalWrite(atomizer, atomizer_State);
   }
}

// -------  03  HUMAN ------------
void humanFog() {
unsigned long currentMillis = millis();
    if (currentMillis - previousHfogMillis >= HfogInterval) {
       previousHfogMillis = currentMillis;
       if (atomizer_State == LOW) {
       atomizer_State = HIGH;
       }
       else {
       atomizer_State = LOW;
      }
   // set the LED with the ledState of the variable:
    digitalWrite(atomizer, atomizer_State);
   }
}

//=====================================
//=====================================
```



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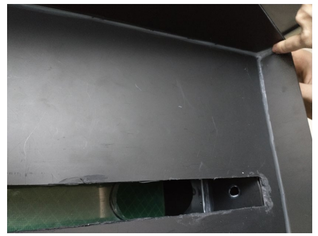
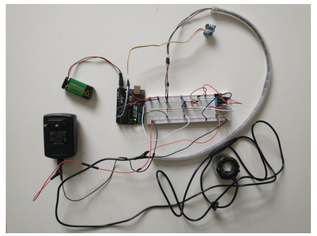
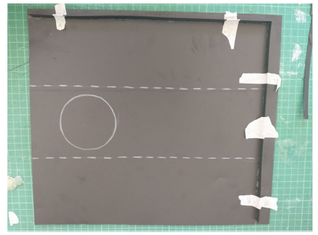

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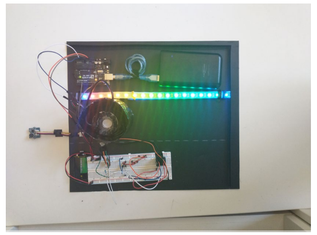
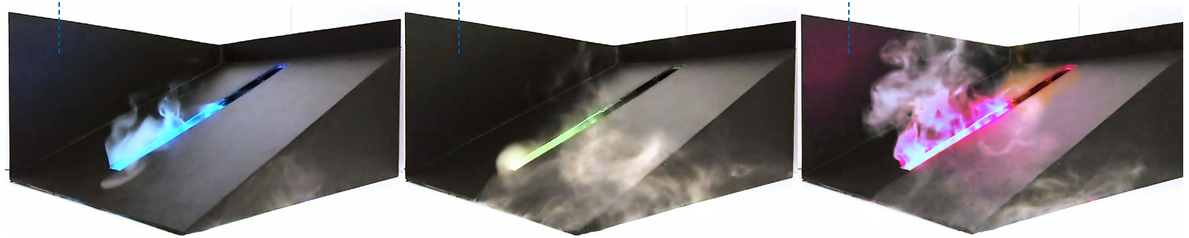


low sound pollution input

medium sound pollution input

high sound pollution input



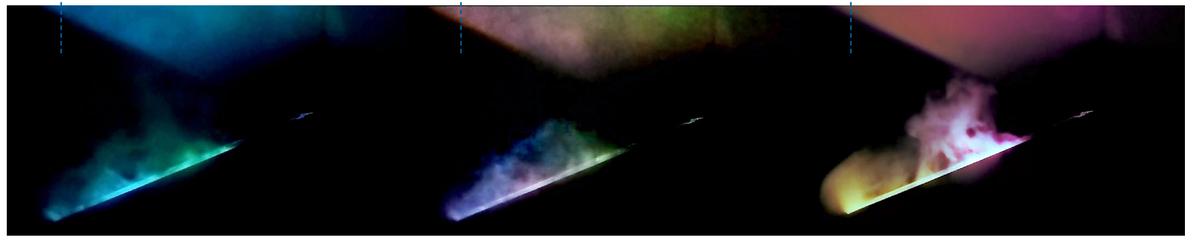


| 7. prototype | results

low sound pollution input

medium sound pollution input

high sound pollution input



| 8. atmosphere |





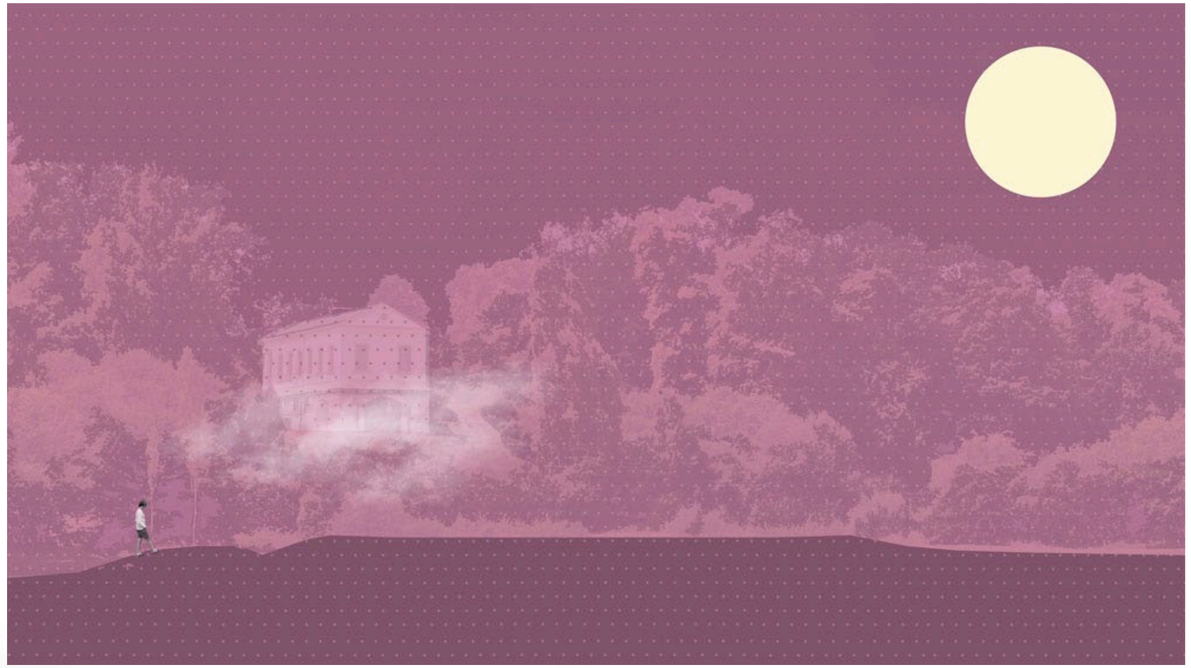














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