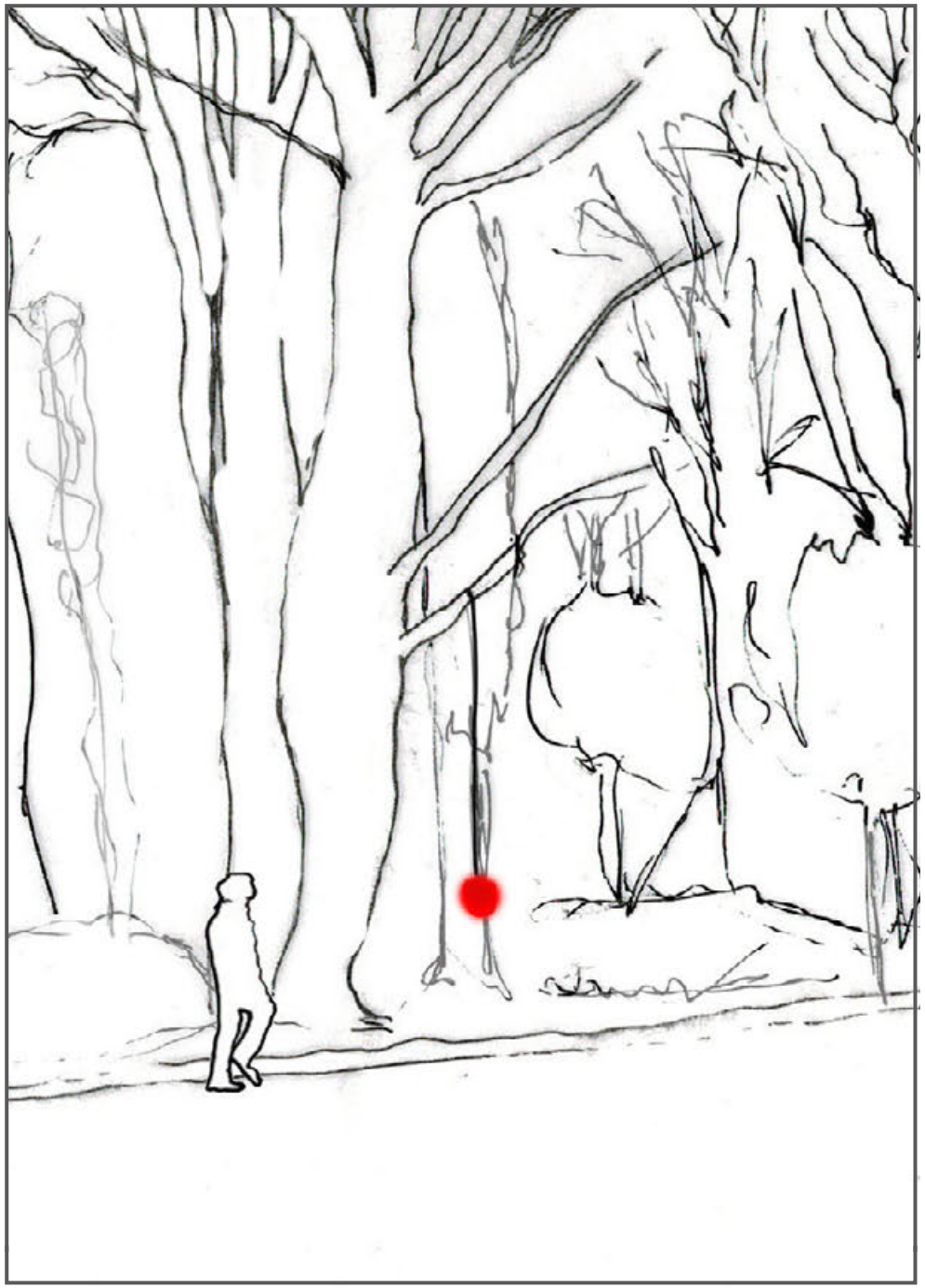
Tree of Knowledge
Neue Natur im Park an der Ilm



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1. Plenum

Analysis of Reference Project

Perception Task

Input ≫ Output

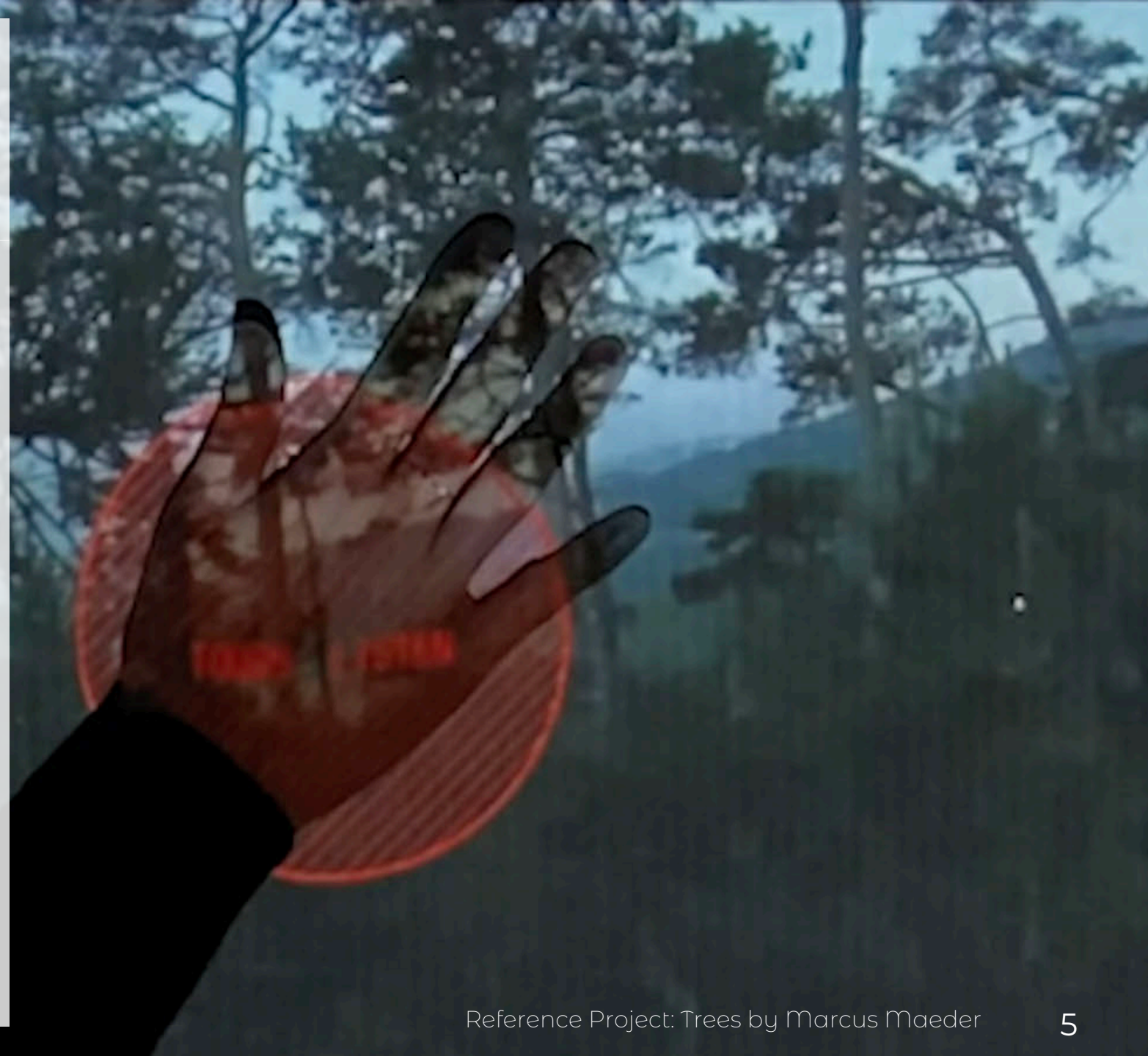
Measurement data	Sound character	Playback parameters
Daylight (RGB brightness)	Atmospheric synthetic sound	Amplitude, controlled by video brightness
Solar radiation (W/m2)	String-like, synthetic sound	Amplitude
Sun position (azimuth, elevation)	Same	Spatial position
Air temperature (°C)	-	Main volume
Rel. air humidity (%)	Water-like, synthetic sound	Pitch, amplitude
Rain (mm)	Field rec.: Rain	Amplitude, spatial position
Wind (m/sec., azimuth)	Field rec.: Wind	Amplitude, spatial position
Soil water potential (kPa)	Field rec.: Seeping water	Amplitude, placed on discretly driven spaekers near ground
Tree branch diameter (µm)	-	High pass filter, applied on sap flow sound
Tree sap flow (gH2o/h)	Floating water, transposed up and filtered	Amplitude, placed on discretly driven speakers
Tree ultrasonic acoustic emissions/cavitation pulses (dB)	Field rec.: Ultrasonic accoustic emissions, transposed down	Amplitude, placed on dicretely driven speakers

Marcus Maeder's Diagram

Our Interpretation

Creative Concept

- Projection - hands interact with videos/loops, pictures and text
  - Hands animate the different components
  - Performance is being recorded
- Voice-over is happening at the same time
  - narrating and further explaining processes as well as interacting with the performance
- Recording samples from the art-piece are used to create further ambiance



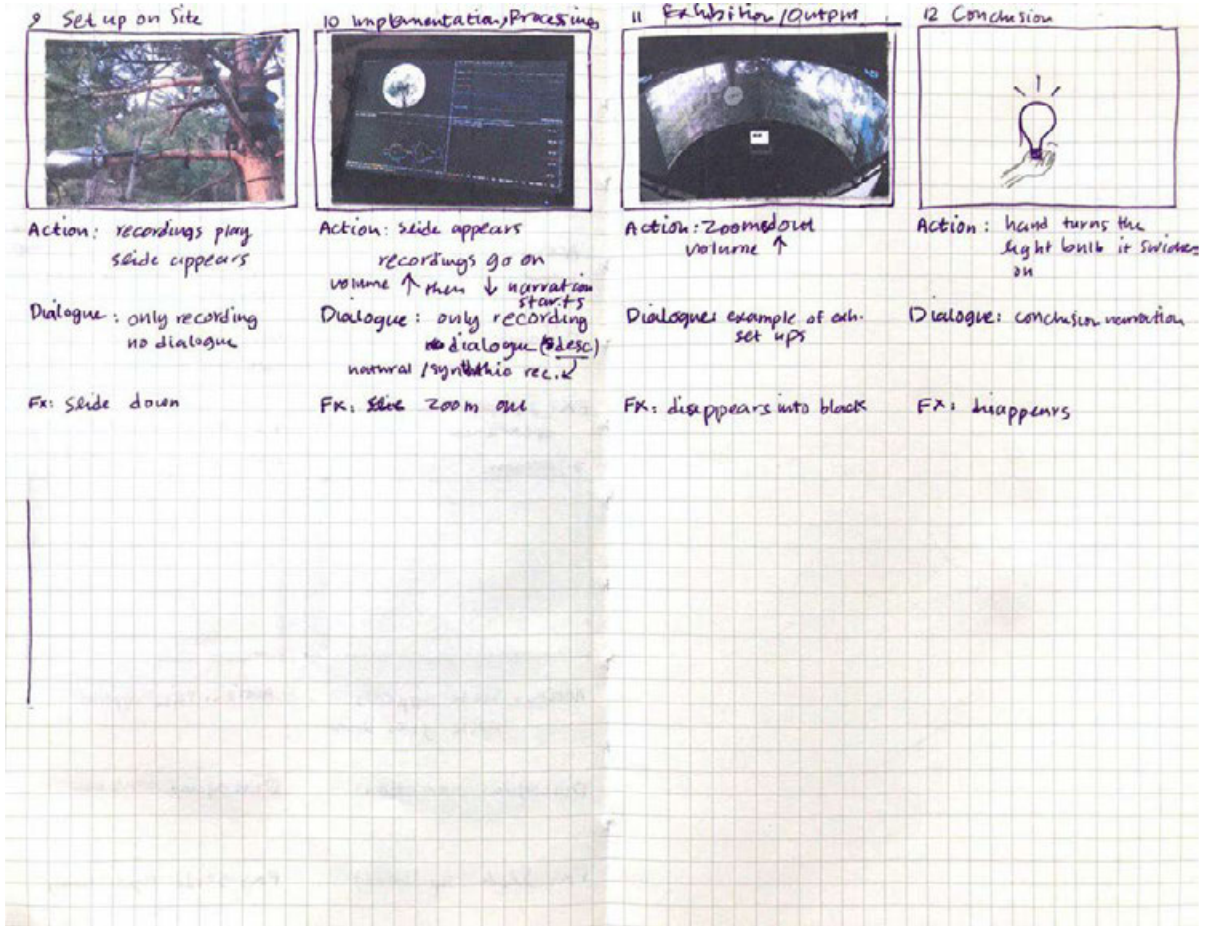
Reference Project: Trees by Marcus Maeder

Structure

1. The Relations of Art, Science & Nature as shown on the example of trees
    - Short introduction into terms used and historical development of virtual & immersive spaces and the relationship of humankind and nature
2. The Artist's Process
    - Short Bio linking to his way of work
3. Overview of the Project
    - What is happening? Why is it happening? Why at this place?
4. Setup on site
    - Compartments used for tracking different data
5. Implementation/Processing the Data
    - 3 Ways of processing it - how is it processed?
    - Cameras
    - How is it adapted for the visitor?
    - New challenge: making it immersive
6. Output/Exhibitions
    - Different exhibitions/exhibition setups
7. Conclusion

Storyboard

1 Beginning
Touch
Action: hand touches the projection on the wall
Dialogue: — just background recording of sunrise
FX: second shot appears from the center
2 title
Pinus Sylvestris by Marcus Maeder
Action: text appears slide to the left
Dialogue: —
FX: slide to the left
3 Human and Nature Interaction
Action: picture slides in hands slides to
Dialogue:
FX: disapearance and apearance
4) Sci-Art
Art
Science
Action: bubble appearance of art then science then zoom
Dialogue: narration of art and science overlap
FX: zoom into the overlap
5) Universial scholars
Action: zooms into the example
Dialogue: narration description
FX: slide left (hand)
6) concept/environmental art
Action: slide appears noise comes up
Dialogue: narration description
FX: slide left (hand)
7) process
Action: slide appears noise goes down
Dialogue: narration
FX: slide up (hand)
8) overview
Action: slide appears
Dialogue: narration
FX: slide right (hand)


9 Set up on Site
Action: recordings play slide appears
Dialogue: only recording no dialogue
FX: slide down
10 implementation, Processing
Action: slide appears recordings go on
Dialogue: only recording no dialogue (desc) natural / synthetic rec.
FX: slide zoom out
11 Exhibition / Output
Action: Zoomed out volume ↑
Dialogue: example of exh. set ups
FX: disappears into black
12 Conclusion
Action: hand turns the light bulb it switches on
Dialogue: conclusion narration
FX: disappears

Script

The Relations of Art, Science & Nature as shown on the example of trees

Nature has always been a Subject in Human culture.

We have interpreted our natural surroundings in Language, Mythology, Art and Religion. With the increased relevance of science and the sophistication of technology, new techniques were needed to display and contextualize observations that went beyond human perception. Thus, virtual Realities were created by people participating in art as well as in science.

The Artist's Process

One of these people is Marcus Maeder. He is a Swiss Artist, researcher and composer. The focus of his artistic works lies in sound art and electronic music. He studied Fine Arts as well as Philosophy and currently pursues his PhD in Environmental Systems Science at ETH Zürich.

Maeder's works started out experimenting with sound installations. As he continued his work, he began exploring his surroundings more and more, developing a special interest in displaying data of research in nature in an artistic way. Constant experiments in sonification of natural processes, especially within plants, is what led him to develop the project 'trees'.

Overview of the Project

Scots pines in Valais, Switzerland have experienced high mortality rates for some decades now: this phenomenon is believed to be caused by the effects of climate change – for example, longer drought periods. When exposed to drought and high levels of sunshine, the plant attempts to transpire, setting off caviational pulses. As there's not enough water at it's roots, the vascular vessels tear and abruptly fill up with gas. These sounds can be heard on an ultrasound level.

This project connects the sounds that occur in plants with ecophysiological processes and thus render audible phenomena and processes that are not normally noticeable in an artistic manner. Maeder and his team recorded it in two days in June 2015.

Setup on site

To record the Sounds and data - especially those of the cavitational pulses - Maeder installed acoustic sensors, as well as Self-Built Piezo Needle Sensors which gave more accurate data. He installed three cameras, filming alongside the tree branches. More sensors were added to measure the environmental influences

Implementation/Processing the Data

The sound is processed in three different ways: Unprocessed Field Records, Transposed Field Records and synthetic sounds.

The different sonification modules are implemented in a set of Max/MSP patches that replay the measured data. For an adequate experience of the most important processes, the speed of the running system is increased up to thirty-six times the normal speed – shortening it to 10- minute intervals. A real-time playback would demand too much patience from listeners and certain processes would hardly be perceivable with a normal playback speed.

Output/Exhibitions

At the moment, there exist four versions of the installation: The stereo/IP cam version for two speakers and/or three headphones and three TFT monitors.

There's a larger spatial audio system which consists of an octagon carrying thirty-six self-built omnidirectional speakers with one touchscreen in the center. It is designed to be an accessible three-dimensional speaker array, where virtual sound sources are moved and placed within a defined space and listeners can walk around inside the system.

The adaptation for ICST's Immersive Lab, where camera footage is projected onto 3 touch sensitive surfaces with which visitors can interact through touch, while one surface shows the measurement data

And finally, the adaptation for ICST's FlowSpace, where the camera footage is projected on a pentagonal structure, which has 20 ambisonic speakers built in as well as a touch table to interact with the installation.

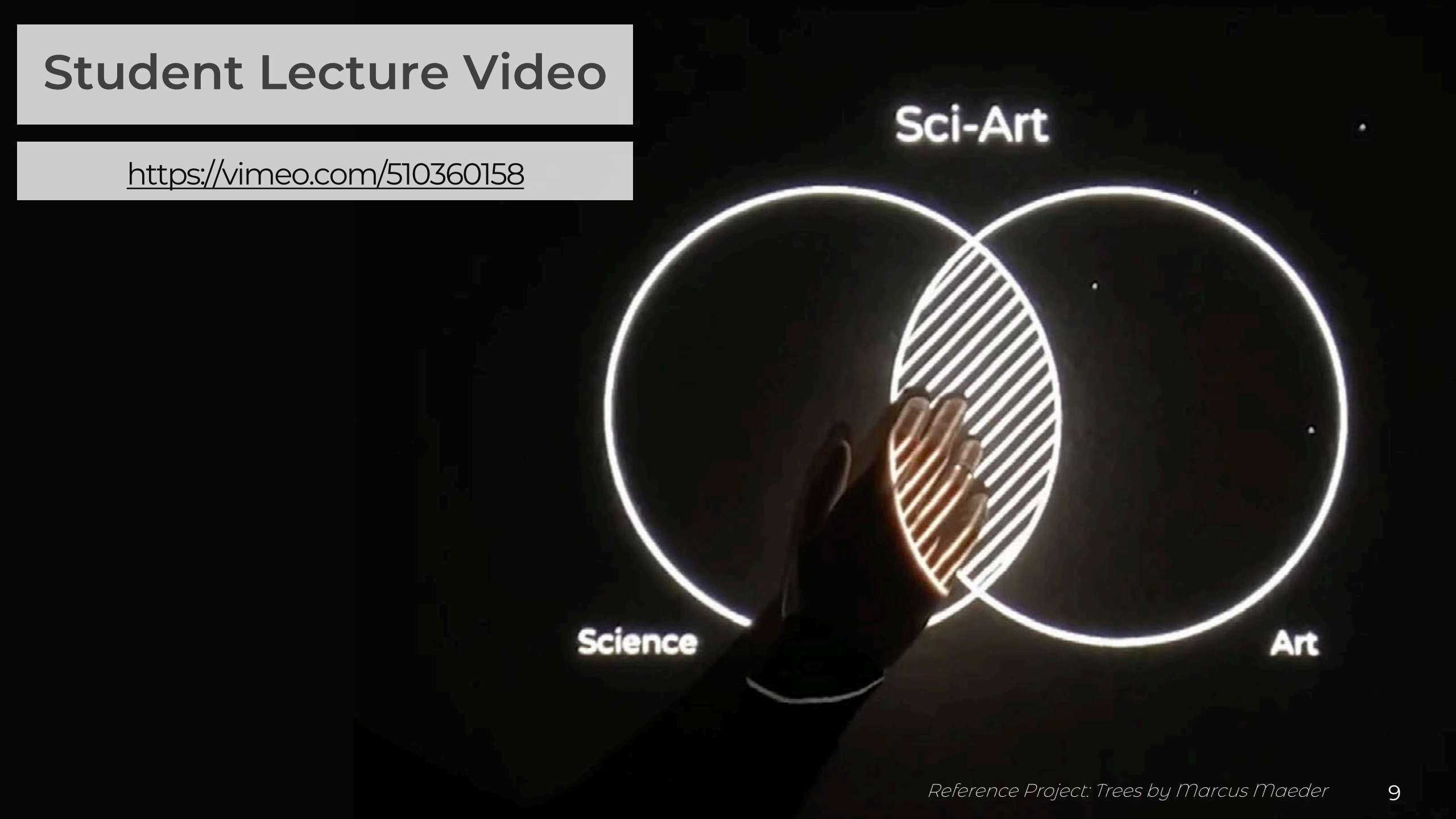
The same sonification algorithms are implemented in all versions but they are mapped differently onto the speakers/headphones, also different video footage is presented.

Conclusion

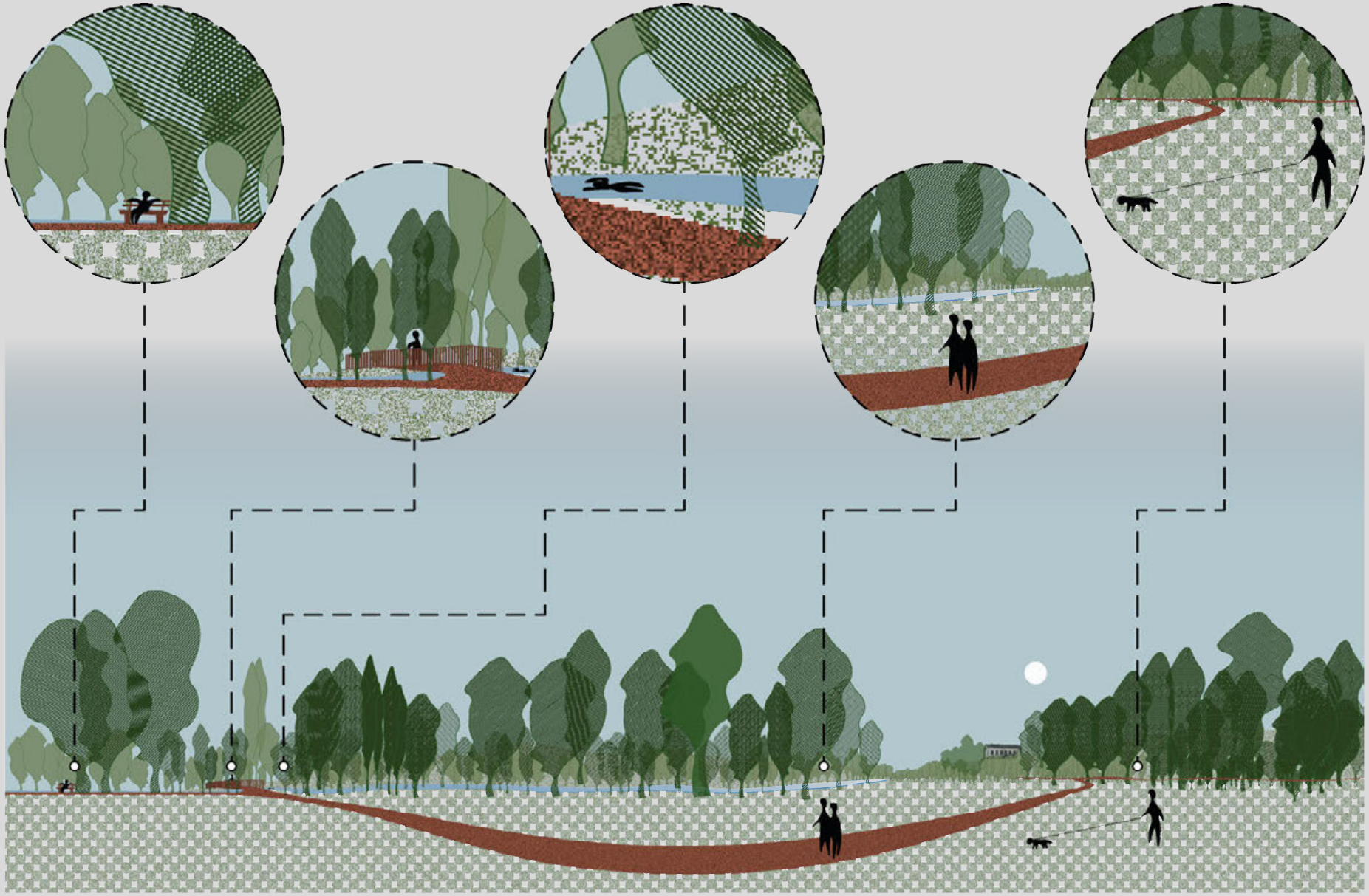
Maeder's work, especially retracing his process as an artist and researcher within the field of auditory perception of nature in the Institute for Computer Music and Sound Technology's treelab has been fascinating. It's also been interesting seeing him adapt his work to different exhibition formats and thus seeing how the perception of the visitors might vary.

Student Lecture Video

https://vimeo.com/510360158



Reference Project: Trees by Marcus Maeder



Perception Task

- Site Analysis
- Activities of Passers by
- Types of Trees
- Field Recordings
- Photography

Am Brunnen vor dem Tore; Da steht ein Lindenbaum: Ich träumt in seinem Schatten; So manchen süßen Traum.

Ich schnitt in seine Rinde; So manches liebe Wort. Es zog in Freud und Leide; Zu ihm mich immer fort.

(Der Lindenbaum, Wilhelm Müller)

The bench

During bad weather, as well as for a short rest, this bench invites visitors of the park for a short break, it's situated underneath a giant Linden tree.

The passers by

The position of our site allowed for a lot of walkers and bikers to walk by our spot as it's one spot to walk to the southern parts of the park.

The crows

We couldn't spot a lot of wildlife, as most of the birds would have left for warmer pastures and critters would have started hibernation. However crows are daily ocurrance.

The roman house

Our allows for a great view on the roman house, as it's one of the most popular sites in the park.

By the water

Our site is a popular bathing spot, even so popular, that we've noticed a person bathing during our visits. Stonesteps were fitted into the riverbank.

The green bridge

The green bridge connects to the other side of the river, thus allowing access to Goethes Gardenhouse. It allows for an amazing view on the rapids along the river.

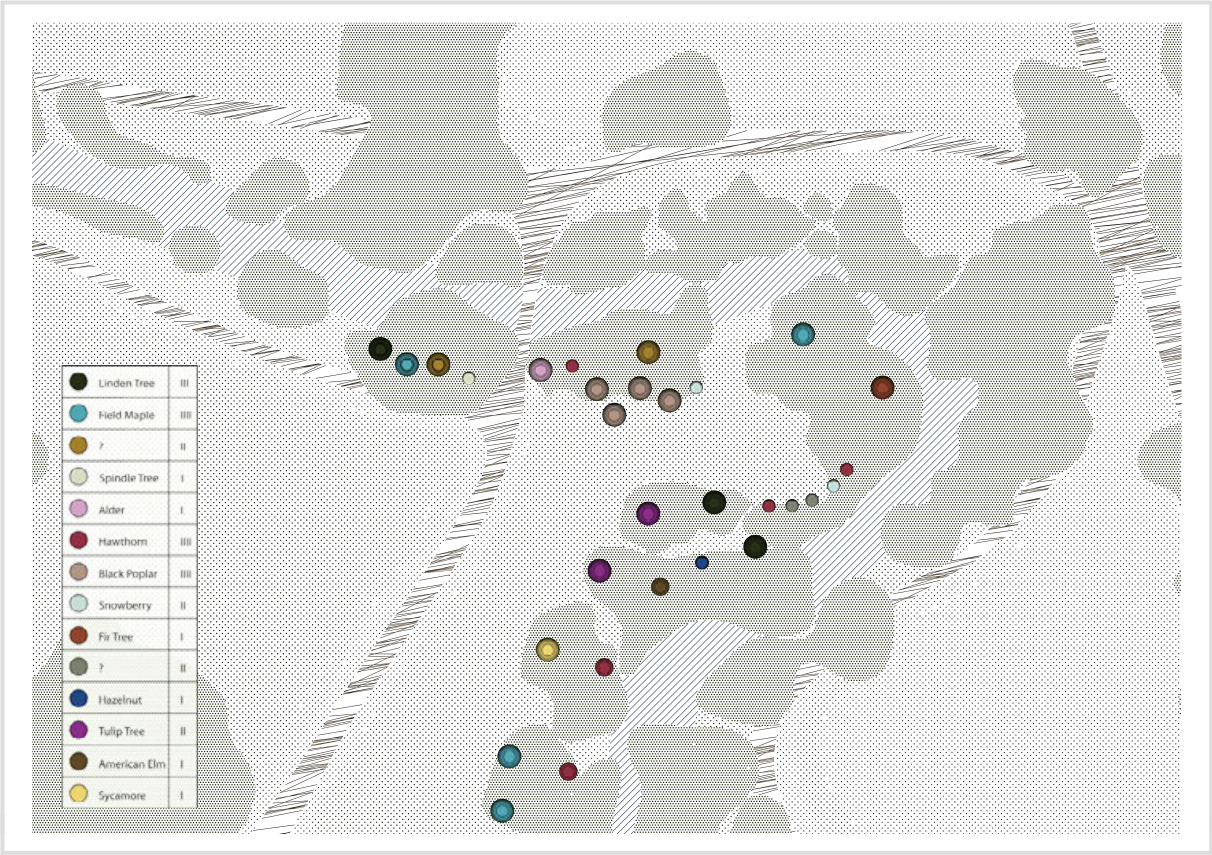
The green bent

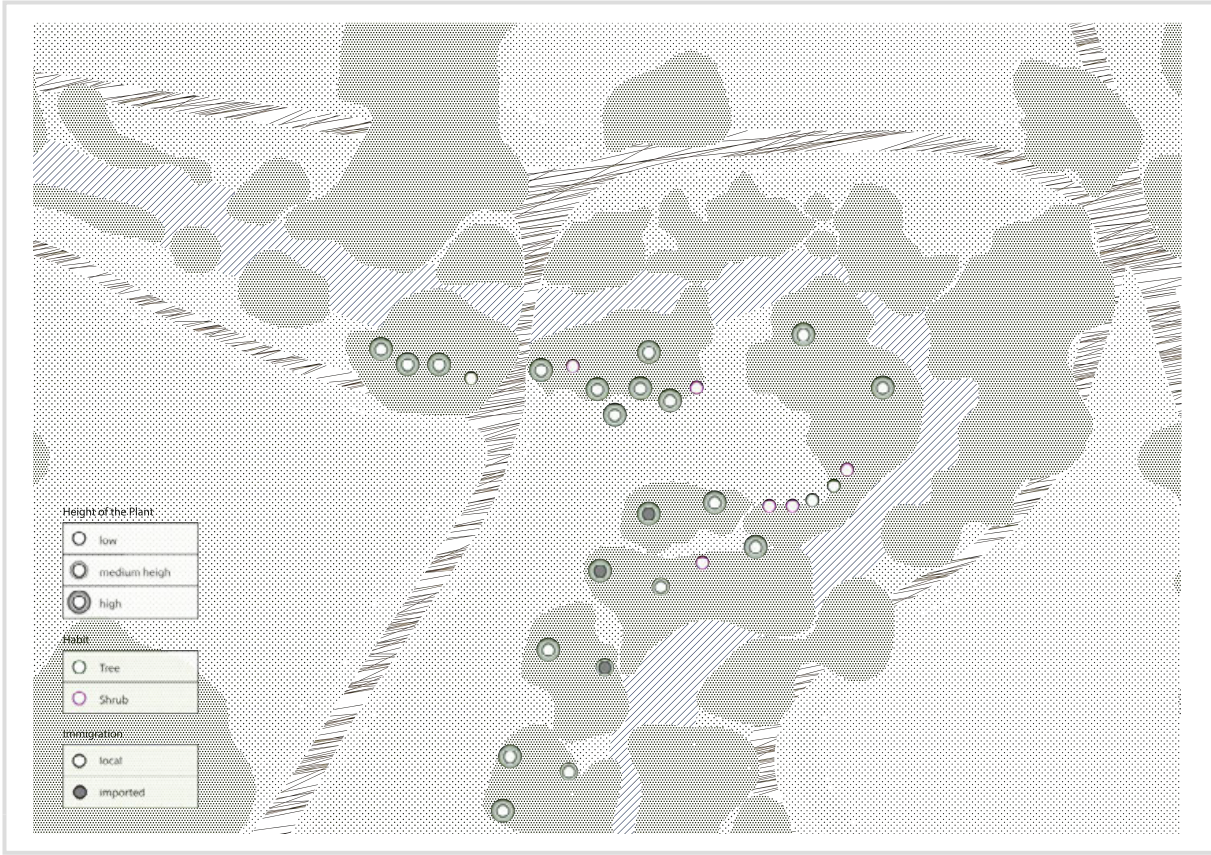
A beautiful feature on our site is, that the river Ilm makes a bent around our site. It is dotted with trees.

Autumn

We've spend a lot of time watching the leaves fall the trees, exploring the fruits and seeds of the trees and bushes.

Height and types of the trees





Beaked Hazel

Feeds the birds

American Elm

Adaption to soil PH, moistrure, heat and wind

Field Maple

Pollen for honeybees

Sycamore

One of the oldest generations, grow big

Big leaves cause shade and sound proofing

Tulip Tree

Ornamental tree

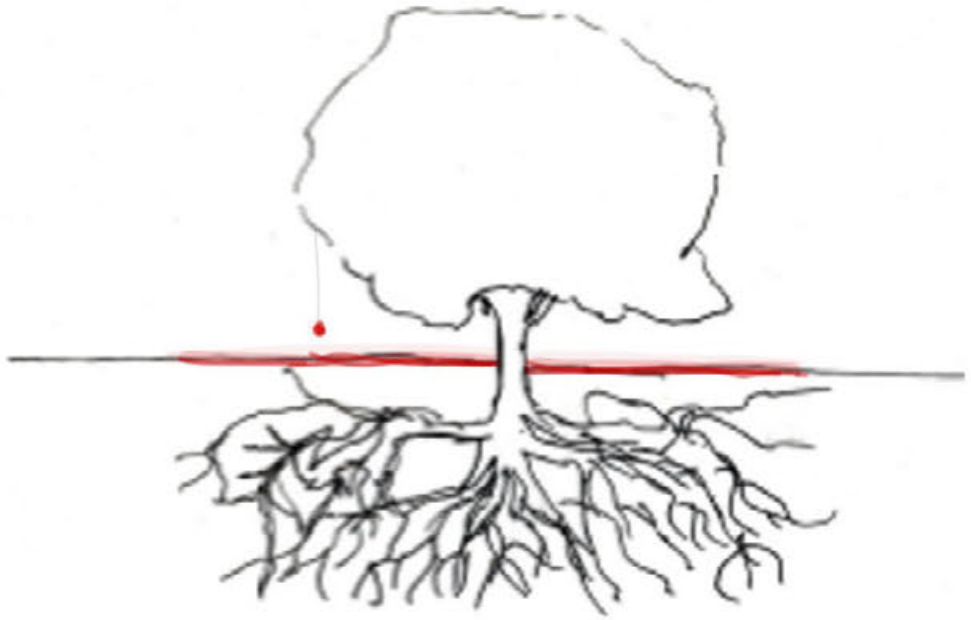
Colorful leaves and flowers

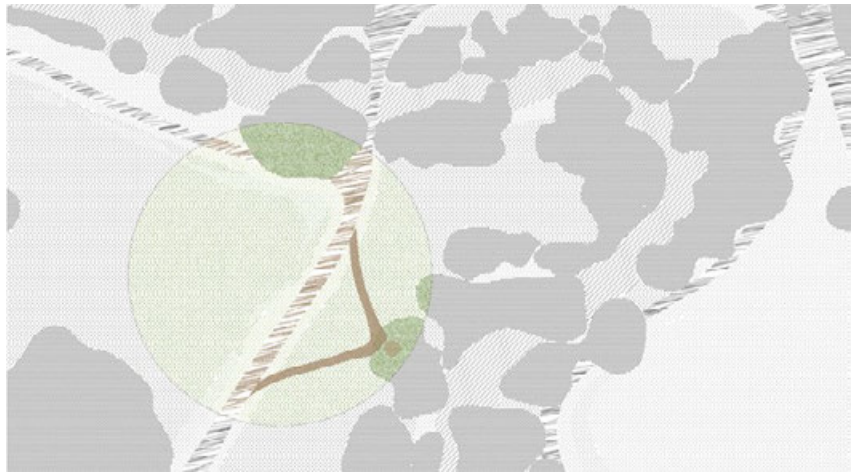
2. Plenum

Concept

Story

Case Studies





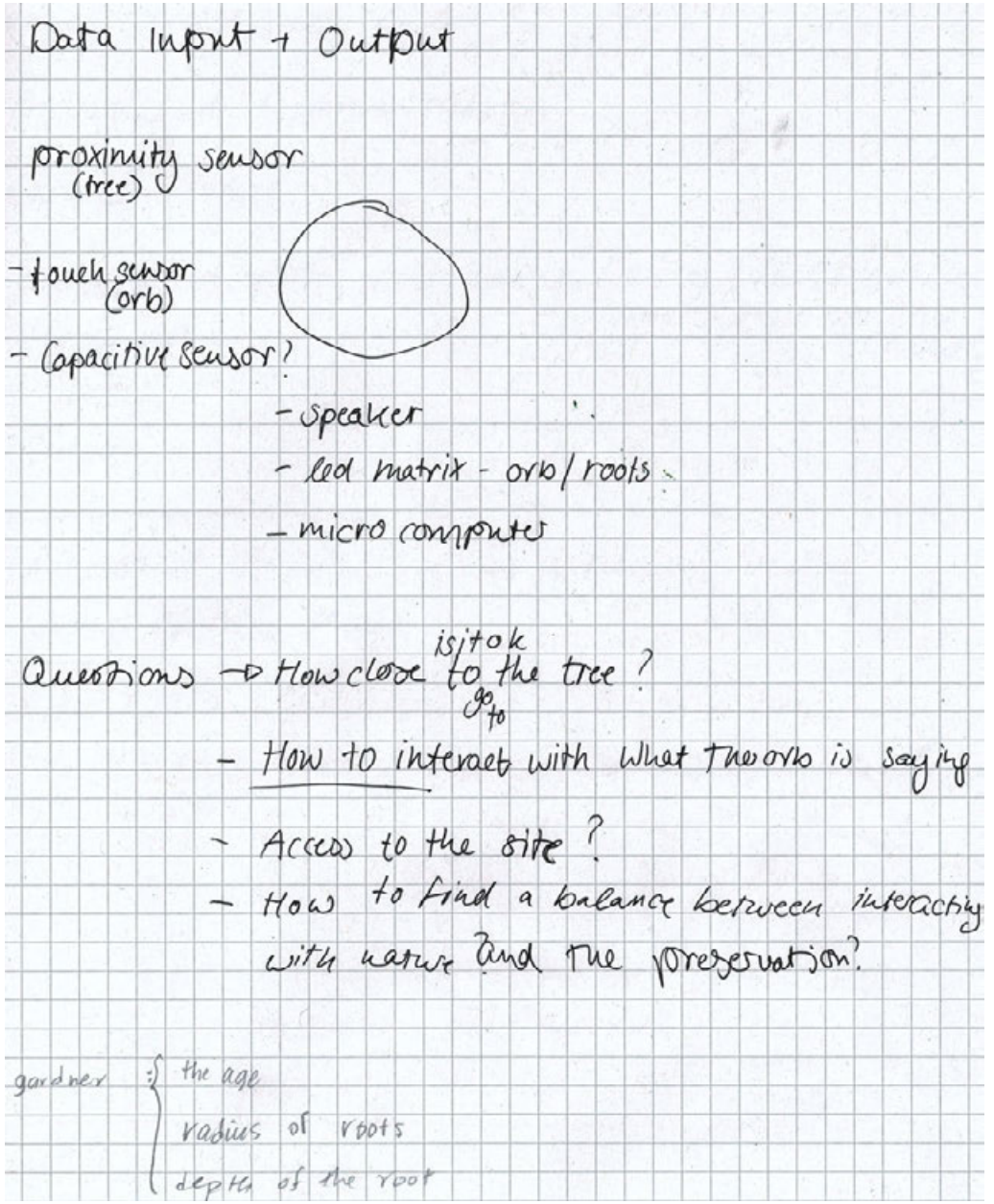
Design Proposal

Aiming to raise awareness of the sensitivity of the old trees in the Ilm Park and the harm caused by pressure on their roots, we proposed colored LED-stripes projecting the roots of the tree above the ground surface in combination to a glowing orb as an object for interaction which gives information about the tree.

Design Idea

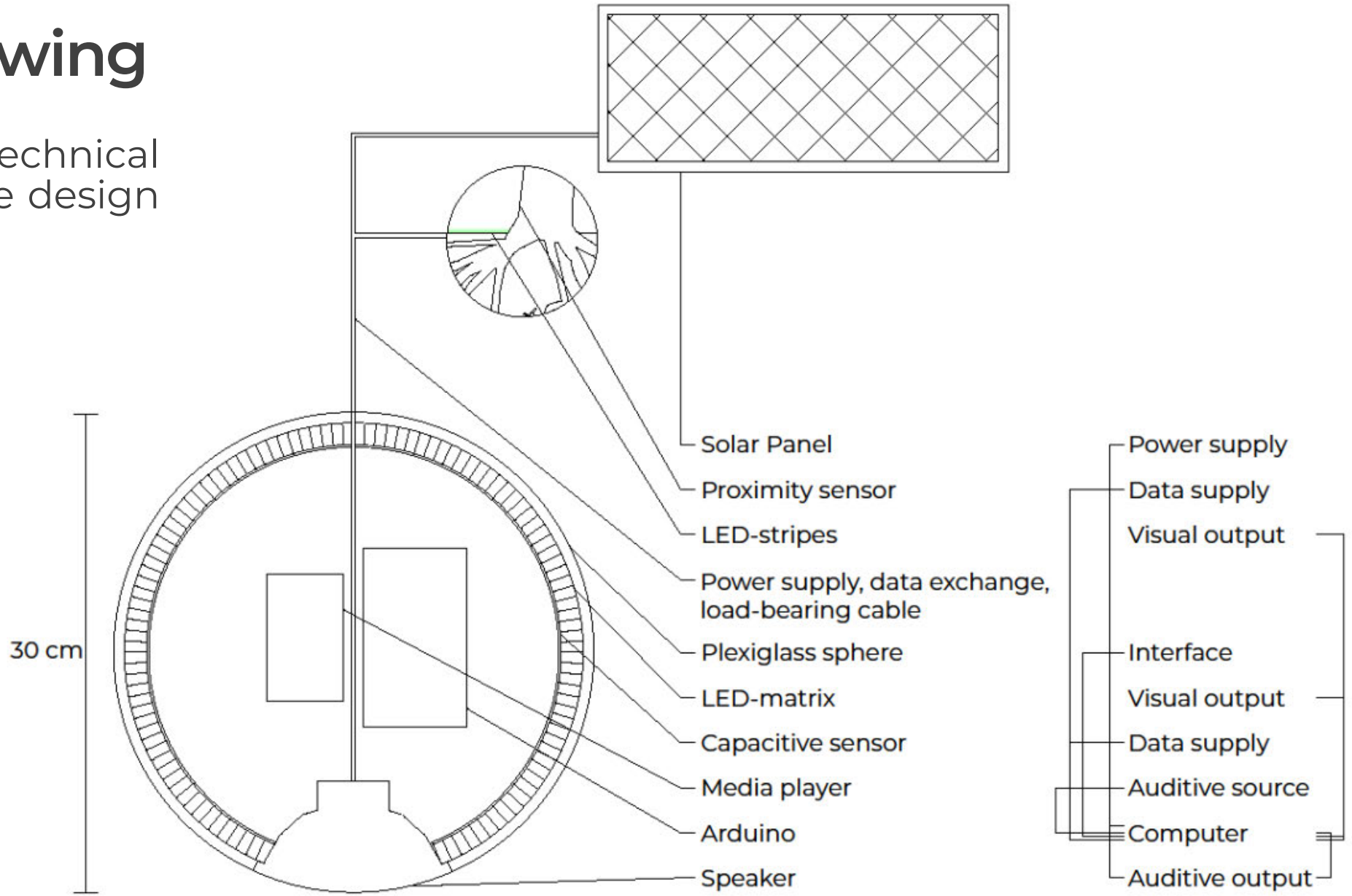
One Image that stuck with us through working on our reference project was the round ‘button’ at Marcus Maeder’s ISCT’s Installation. We enjoyed the though of touching something and it then talking to you. Turning this touching sensation into a 3D-Sphere was a logical step. This then opened up the ability to house and thus protect the technology within the sphere.

To allow for more attention by the visitors, we decided to make it glow or even project visuals.



Technical Drawing

First draft of the technical drawing based on the design proposal.



Touch

The visitor starts the Interaction with the Orb by touching it. As soon as the visitor touches it, the orb ‘comes alive’, starting to play a sound file of the tree talking as well as portraying different colorful visuals.

The visitor touches the orb again, and the next sound file plays.
Different gestures might be considered.

Historical Context

- Beforehand there was a lot of agriculture happening, such as fruit trees growing
- 1832 conversion of the Tempelherrenhaus
- 1902 Construction of the Liszt Memorial
- 1945/46 construction of the sorviet cementary of honour
- During second world war, architectural elements, such as the Tempelherrenhaus, got destroyed, as well as some plants
- Nowadays, most of the trees are over 100-200 years old, as new trees can't grow naturally, but have to be planted manually
- New, young trees are slowly swapped in

In the Context of the Artwork

- Planted for viewing pleasure
- Imported, wouldn't normally be part of the ecosystem

Ecological Context

- Climate
  - more Extreme Weather events such as thunderstorms will happen
  - longer Drought Periods and high temperature over long periods
  - More Effort going into the care of the trees, such as extra watering and cutting back the crowns
  - Less Leaves because of drought
  - As the Sun hits the tree trunks for too long, with the tree not being able to transpire, the bark rips open
- Consequences
  - Trees are more prone to illnesses and fungi
- Trees as part of the ecosystem
  - Housing Bats
  - Cleaning the air of pollution
  - Drowning the noise from the city
- Symbiosis
  - Symbiosis with Fungi to help with Water Storage
  - Symbiosis with Lichen and Ivy for solar protection
- Environment
  - Ground with a high clay concentration
    - Keeps water well
    - Doesn't allow for good Ventilation

General:

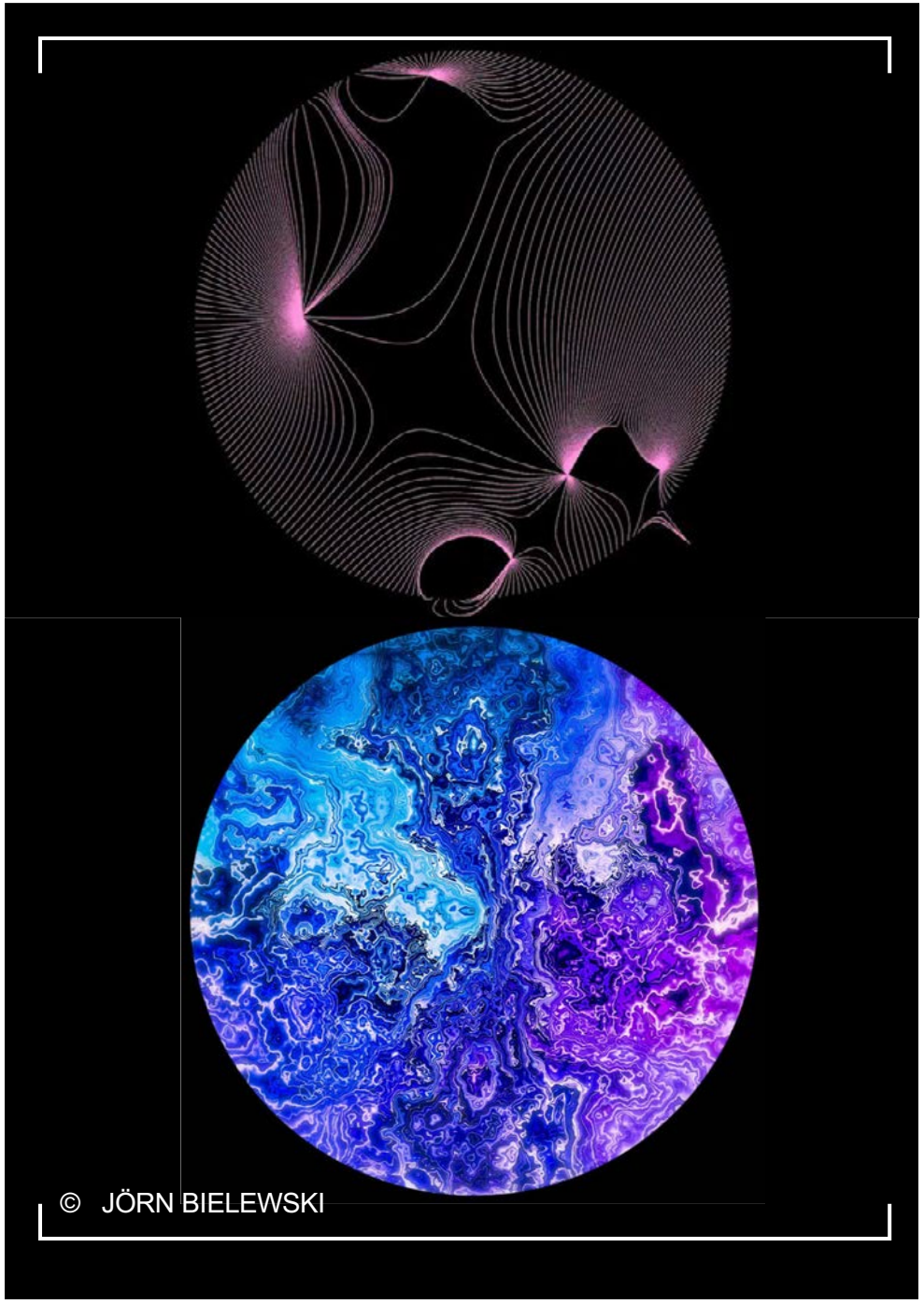
- Nature always finds a way to adapt

Sound

As the visitor touches the orb, a sound file starts to play of the Tree telling it's story.
Different sound files will play in a shuffle mode.

We're not sure yet, what kind of voice it should have. We are currently considering the voice of an old person, as the tree is also very old.

We would like to offer an english, a german and a child-friendly variety.



Visual Stimuli

The visuals displayed on the Orb will interact with the audio.

We are considering using different generative Methods - Experimenting with both TouchDesigner and Processing in the process.

The generative Visuals aim to create a second nature within the orb, hinting at the hidden processes happening within both us and our surroundings.

Interaction

Visitor touches Orb

↓

Orb glows and starts playing the sound file

↓

Visitor may leave their hand resting on the Orb, the Orb will continue to talk & interact

↓

Visitor continues their walk

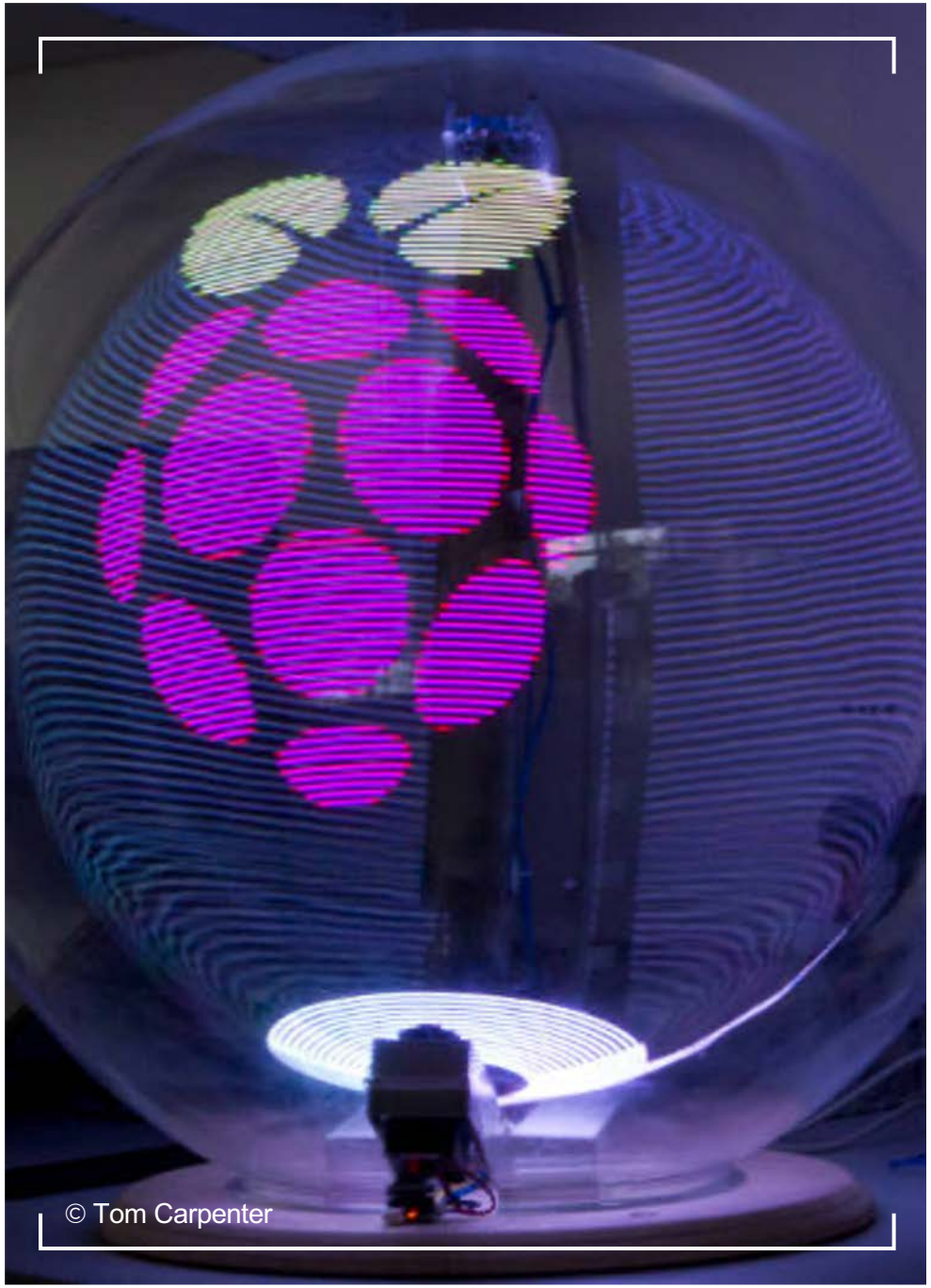
Reference: Nanopixel-Ball

Pros:

- Fairly easy to build
- Highly portable
- Easy to map

Cons:

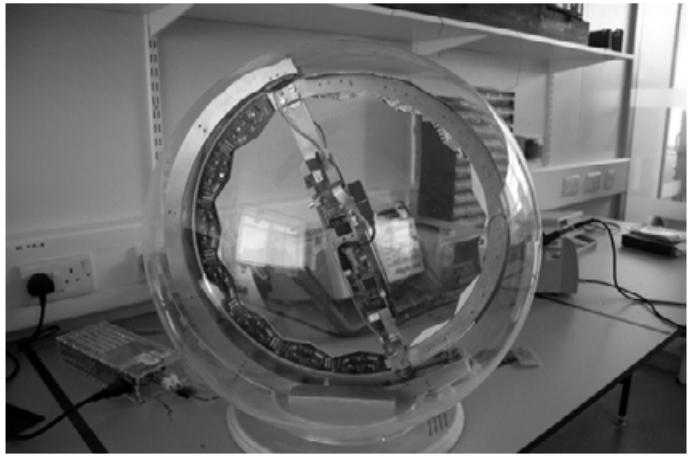
- Consisting of many different neopixles
  - might be too “pixely” - so it won’t supply a high resolution image



Reference: Persistance of Vision Globe

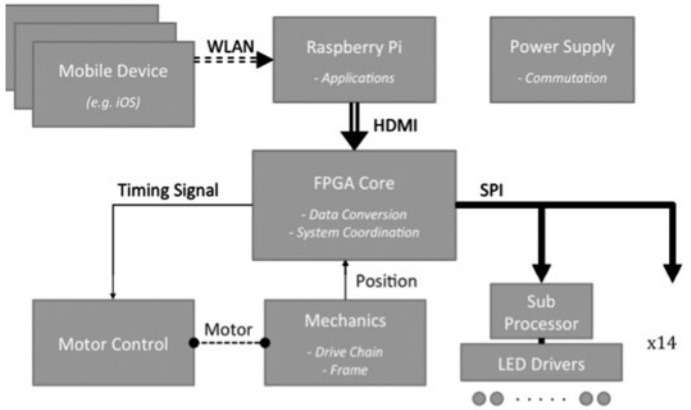
Pros:

- Easy to map
- Still quite portable



Cons:

- slightly more difficult to build
- may not be bright enought
- quite fragile



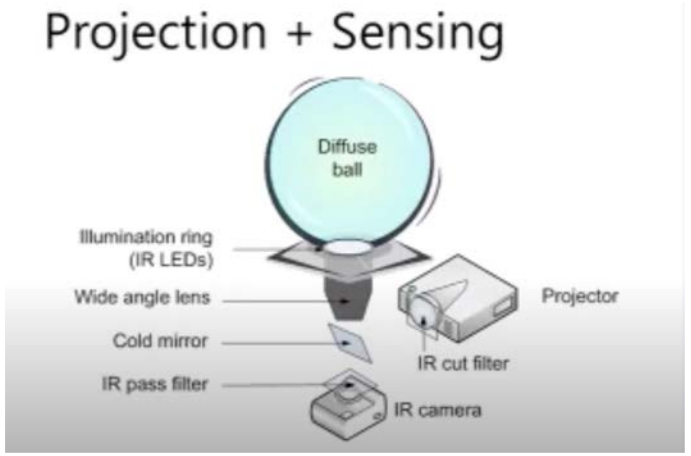
Reference: Sphere - Multitouch Interactions on Spherical Display by Microsoft

Pros:

- High resolution
- High intractability
- Ability to work with gestures

Cons:

- Not very portable - can't hang
- Distortion needs to be adressed



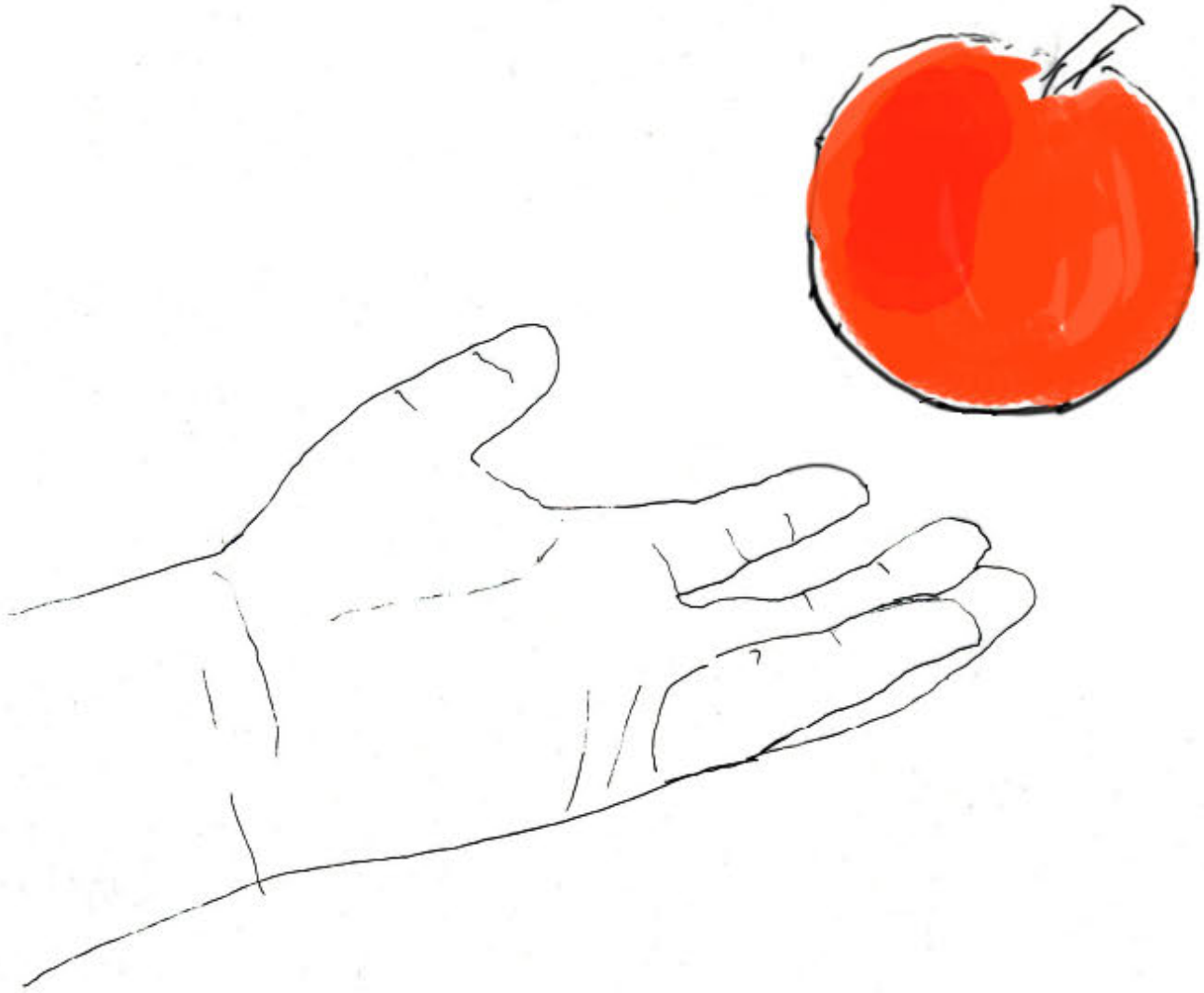
https://www.youtube.com/watch?v=lNCPY4gBam

3. Plenum

Context

Design development

Interface Design



What is Nature?

"Greek - *phusis*: "growing, producing", - *phuein* (derived from the Indo-European root *bheu*, ancestor of the English verb "be")"

Ducarme, F., Couvet, D. What does 'nature' mean?. *Palgrave Commun* 6, 14 (2020)

Changes in the Project

- We decided to not do a complex visual exterior, but rather use a simple red LED as our visual output

  Why red?
  - Most commonly associated with the color of the apple
  - Contrasting color to nature
  - Red is the color that doesn't compromise your night vision

- Cutting the project down to the basics has helped us to focus on the actual idea
  - Now we feel more confident exploring different paths, that really help evolve the narrative further

- Expanding the Project throughout different trees in the park
  - Creating a tour
  - Allowing for a data base of different measuring stations

- Giving it more spatial/architectural context

Impression

Researching Park an der Ilm, we've found out that the way the park looks isn't a given. It's always been a task of working with nature - trying to keep it molded towards a certain picture.
As the trees in the park grow older, they are becoming more weak and a heightened understanding is needed when interacting with them.
In order to underline the patient, giving nature of the tree - it's offering a fruit to the visitor.
The visitor may choose to touch it in order to interact with it.

Narrative

During the development of out concept, one thing that really struck out was that the Ilmpark seems to be a true heterotopia, distancing itself from nature's and society's laws and therefore creating an utopian space.
Mystical elements, such as the Sphinx-Grotto, the Nadelöhr and the careful placement of trees underline this notion through creating a romantical atmosphere.
Being referred to as the ultimate metaphor for ethereal beauty, Garden of Eden has always served as the ultimate aspiration for landscape design, aiming to replicate its immense grandeur.
Following that trajectory, as well as doting on the uncertain future of the park's most important exhibits, the trees, we aim to create an installation where humankind and nature can interact.
The colourful fruit hanging from these trees are to be seen as the direct visualization of the vividness and the progress constantly happening in nature.
Especially the apple has always been a symbol of change and enlightenment. The often recited biblical story of the end of paradise might be seen as a lecture about sin and immoral pleasure. But even more it defines the start into an era of human self-determination and the beginning of society's civilization.
Our installation seeks to initiate a discussion on rethinking nature's relevance. For too long, it has been taken for granted, with no obligations of maintaining this fortune. The events of the last couple of years have strongly shown the necessity to prevail and protect, by informing ourselves and to face the concerning truth. With our installation we want to bring back more people into the discussion,as it simply should not be an abstract topic, but an accessible one allowing all those passing by to participate with no exceptions. It truly is a universal issue affecting each and everyone of us.
Following nature's ever generous and forgiving character, our installation is supposed to be seen as a gesture of reconciliation. The low hanging fruit offers the opportunity to regain knowledge and start off into a new understanding of nature.

Text Tree Speech I

Too hot

It’s waay too hot today!

I‘m a mountain maple. My Ancestors come from the mountain regions, which have a more humid and cooler climate. It‘s always been a bit too hot and dry for me here. And it is getting worse every year. Isn‘t there something you can do about it?

wish you people would take it easier on me.

Did you ever think about how you would feel if people kept stepping and running on your feet every day? Well, it hurts!

Every year, I fear that it might be my last year. That‘s why I‘m shedding lots of seeds, but gardeners keep removing them.

Some of my old buddies are already gone. They were replaced with these kids that you see around here. I wonder what will happen to my spot when I‘m gone. Will there be another member of my family? Or will they choose a local tree over us?

Despite all the difficulties, I‘ve managed to grow 32 meters high.

It‘s hot in here today, my bark doesn‘t protect me well and because I stand by myself here, no other trees cast shade on my trunk and roots to protect me. The grass drinks away much of my water. I am thirsty.

Please don‘t leave the path or try to climb on me. When I was young, I took it pretty well, but as I got older, it‘s become harder for me to heal injuries.

So, how do you like the park? All the trees you see here have been planted specifically in favor of looking beautiful to your eyes. Even today, the park is maintained so that the views created look the same as they did over 200 years ago.

Normal/Ideal

I‘m a mountain maple. My Ancestors come from the mountain regions, which have a more humid and cooler climate. It‘s always been a bit too hot and dry for me here. And it is getting worse every year. Isn‘t there something you can do about it?

I wish you people would take it easier on me.

Did you ever think about how you would feel if people kept stepping and running on your feet every day? Well, it hurts!

Every year, I fear that it might be my last year. That‘s why I‘m shedding lots of seeds, but gardeners keep removing them.

Some of my old buddies are already gone. They were replaced with these kids that you see around here. I wonder what will happen to my spot when I‘m gone. Will there be another member of my family? Or will they choose a local tree over us?

Despite all the difficulties, I‘ve managed to grow 32 meters high.

Please don‘t leave the path or try to climb on me. When I was young, I took it pretty well, but as I got older, it‘s become harder for me to heal injuries.

So, how do you like the park? All the trees you see here have been planted specifically in favor of looking beautiful to your eyes. Even today, the park is maintained so that the views created look the same as they did over 200 years ago.

Text Tree Speech II

Too cold

I‘m a mountain maple. My Ancestors come from the mountain regions, which have a more humid and cooler climate. It‘s always been a bit too hot and dry for me here. And it is getting worse every year. Isn‘t there something you can do about it?

I wish you people would take it easier on me.

Did you ever think about how you would feel if people kept stepping and running on your feet every day? Well, it hurts!

Every year, I fear that it might be my last year. That‘s why I‘m shedding lots of seeds, but gardeners keep removing them.

Some of my old buddies are already gone. They were replaced with these kids that you see around here. I wonder what will happen to my spot when I‘m gone. Will there be another member of my family? Or will they choose a local tree over us?

Despite all the difficulties, I‘ve managed to grow 32 meters high.

My foliage is supposed to protect my roots from the cold in the winter. But it always gets taken away by the gardeners because otherwise, it would suffocate the grass. My bark also keeps me warm so that the water in my vessels doesn‘t freeze. The burnt crust fungus doesn‘t make it any better, though.

Please don‘t leave the path or try to climb on me. When I was young, I took it pretty well, but as I got older, it‘s become harder for me to heal injuries.

So, how do you like the park? All the trees you see here have been planted specifically in favor of looking beautiful to your eyes. Even today, the park is maintained so that the views created look the same as they did over 200 years ago.

Raining

Ahh, it’s raining!

I‘m a mountain maple. My Ancestors come from the mountain regions, which have a more humid and cooler climate. It‘s always been a bit too hot and dry for me here. And it is getting worse every year. Isn‘t there something you can do about it?

I wish you people would take it easier on me.

Did you ever think about how you would feel if people kept stepping and running on your feet every day? Well, it hurts!

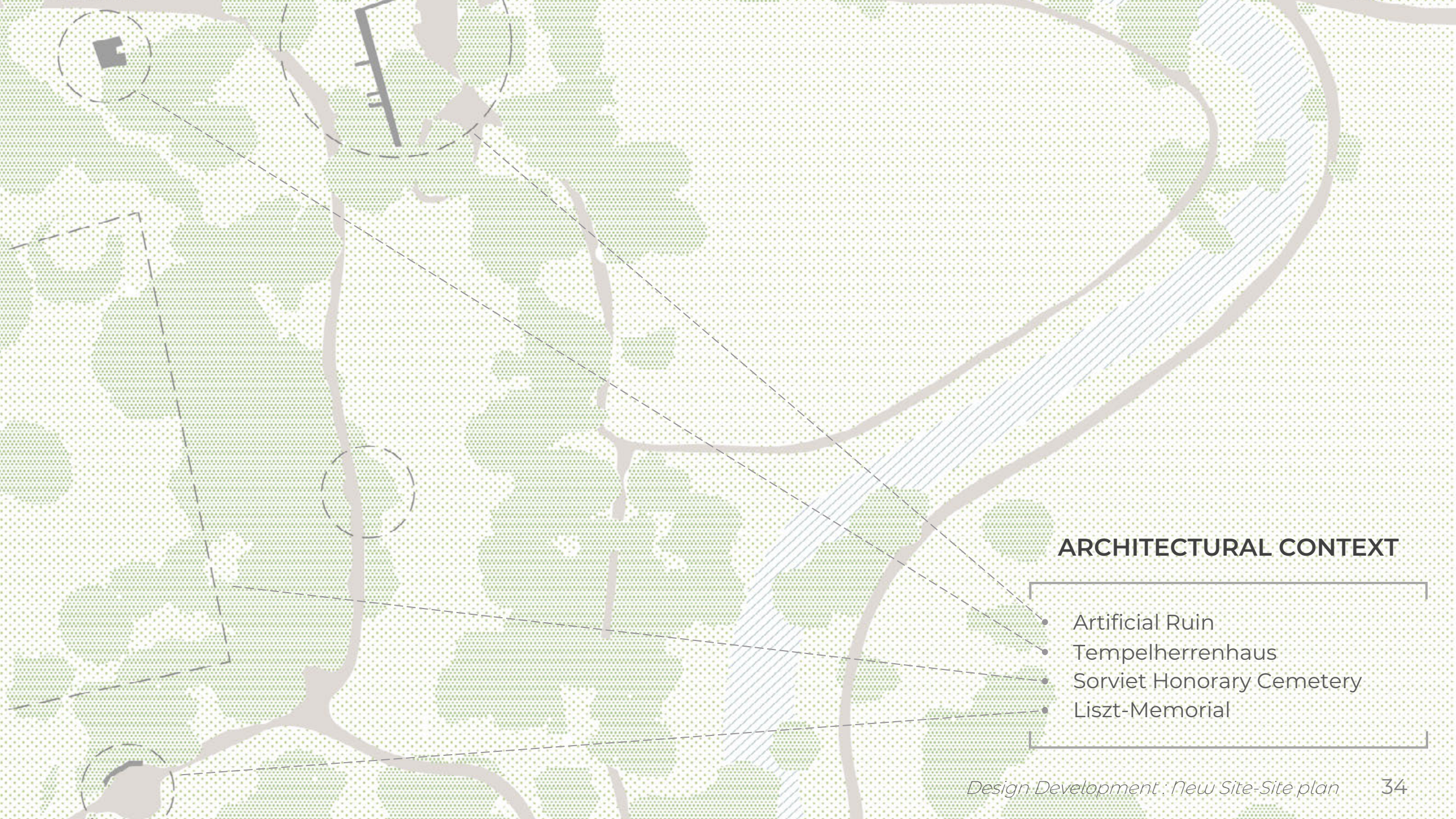
Every year, I fear that it might be my last year. That‘s why I‘m shedding lots of seeds, but gardeners keep removing them.

Some of my old buddies are already gone. They were replaced with these kids that you see around here. I wonder what will happen to my spot when I‘m gone. Will there be another member of my family? Or will they choose a local tree over us?

Despite all the difficulties, I‘ve managed to grow 32 meters high.

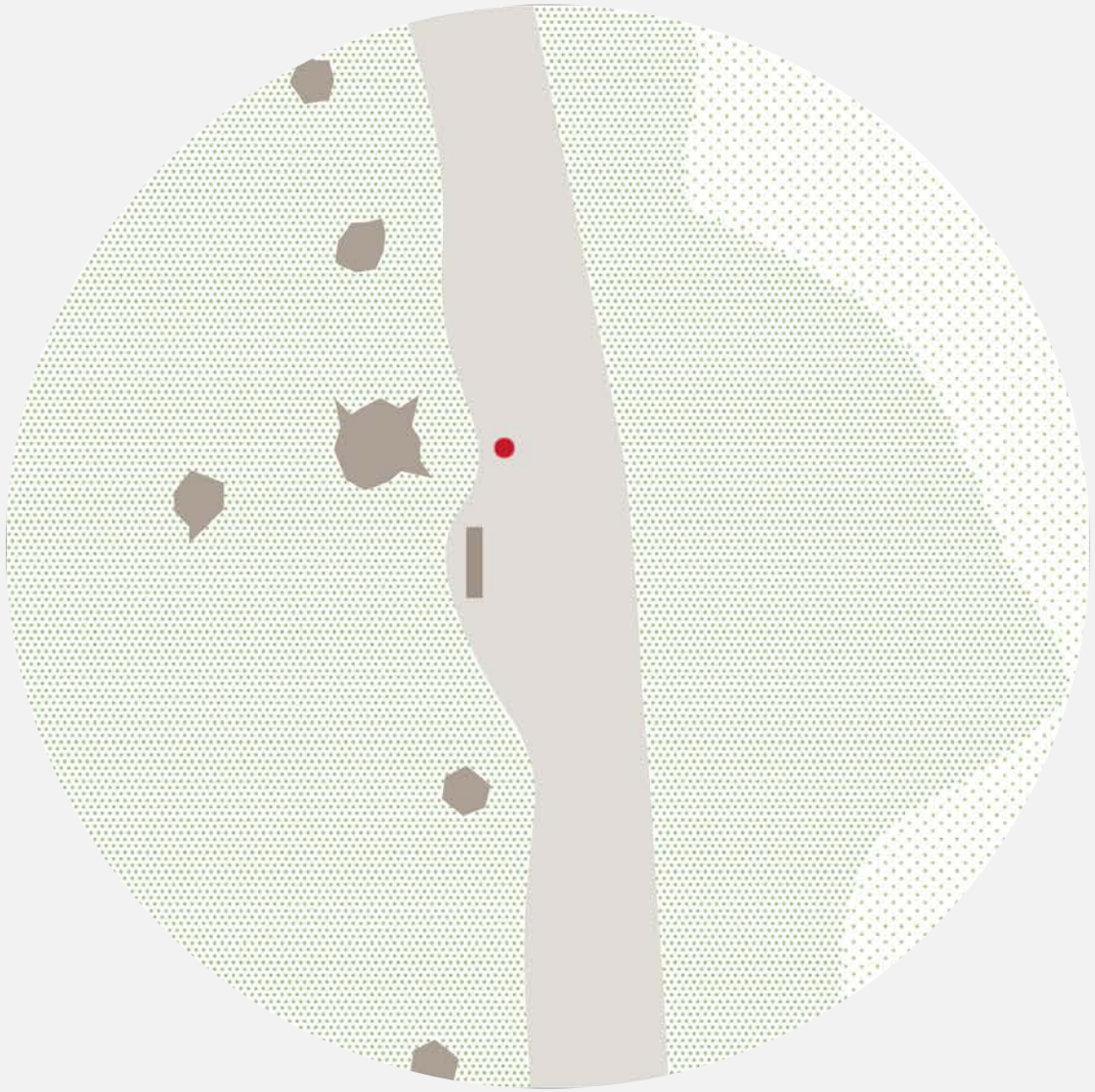
Please don‘t leave the path or try to climb on me. When I was young, I took it pretty well, but as I got older, it‘s become harder for me to heal injuries.

So, how do you like the park? All the trees you see here have been planted specifically in favor of looking beautiful to your eyes. Even today, the park is maintained so that the views created look the same as they did over 200 years ago.



ARCHITECTURAL CONTEXT

- Artificial Ruin
- Tempelherrenhaus
- Sorviet Honorary Cemetery
- Liszt-Memorial



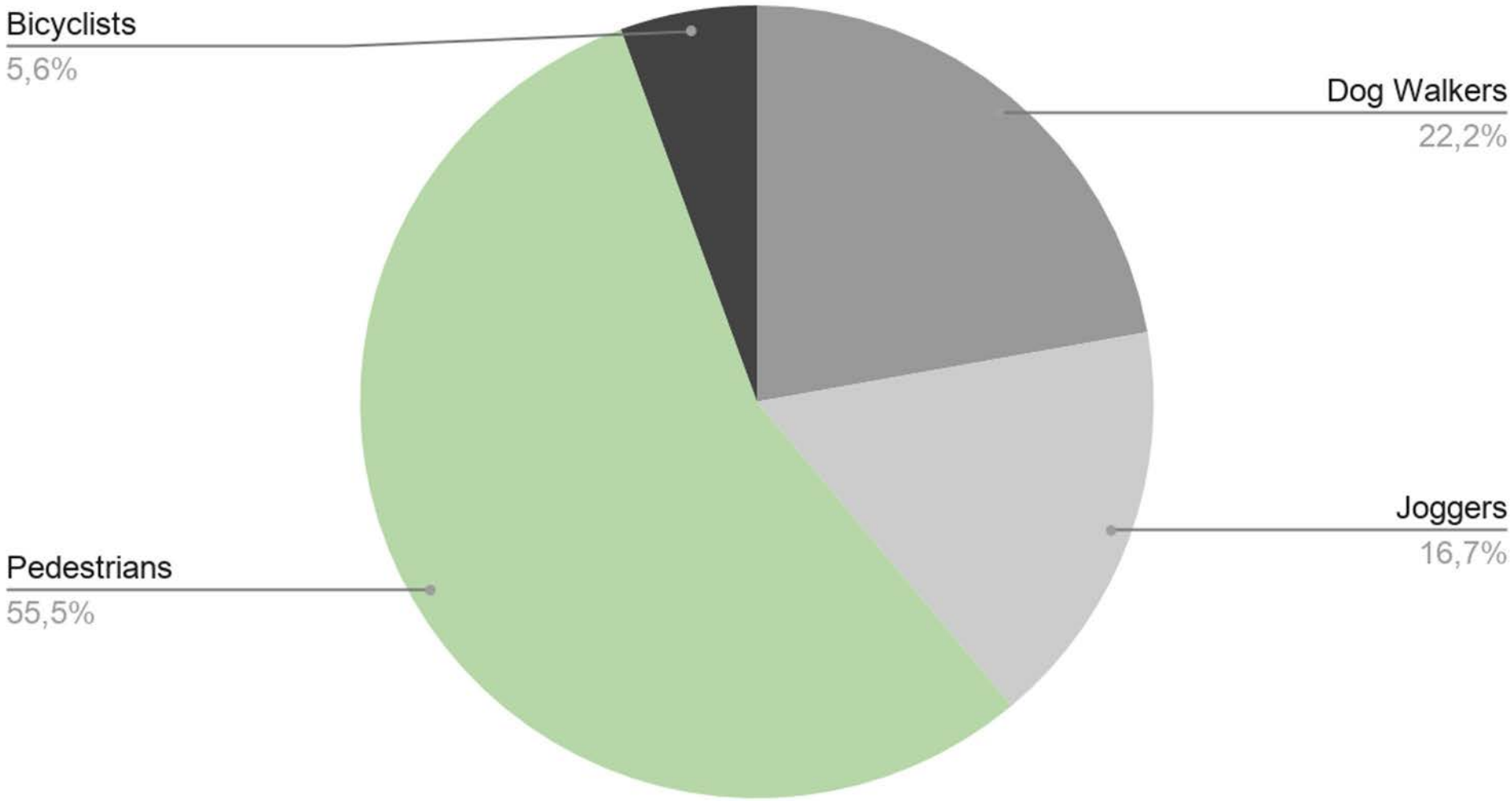
New Site

Our previous site was too inaccessible for our plans, also a raised platform would have been needed to access the trees.

When talking to one of the gardeners, he pointed out a specific tree that caught our attention as it is located along a highly frequented path between the Liszt-Memorial and Tempelherrenhaus and at the same time is one of the oldest trees in the Park. So, we decided to switch to this site.

Illustration

User Groups



Experimenting with size

One thing that we were debating on, was the size.

So, we took lampion-shades in different sizes and took them to our site in order to figure out at which height we wanted them to hang and what size they should be.

Ultimately, we decided on a height of 1,20m and a diameter of 18 cm – which later changed to 16 cm.

Mockup

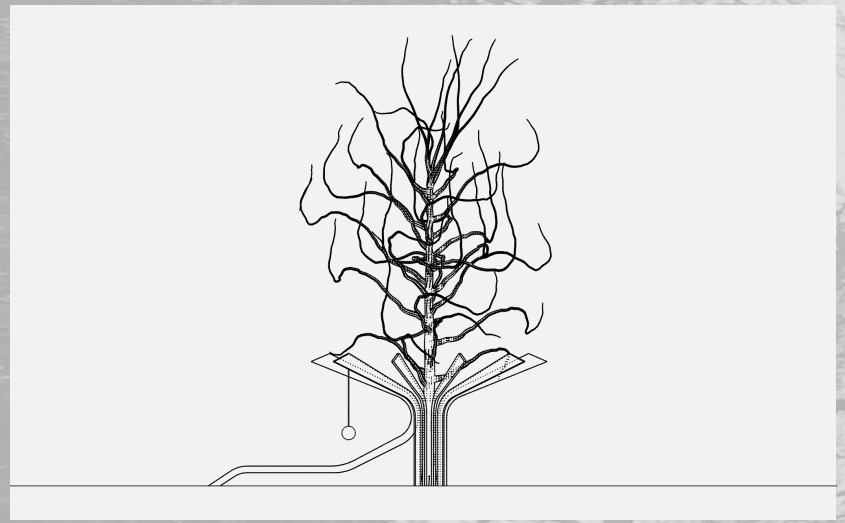
Story Board

How the orb functions as you interact with it

Phase 1
As you walk through the park the glowing orb will catch your attention

Phase 2
The orb starts pulsing as soon as you step in its 5 meters radius

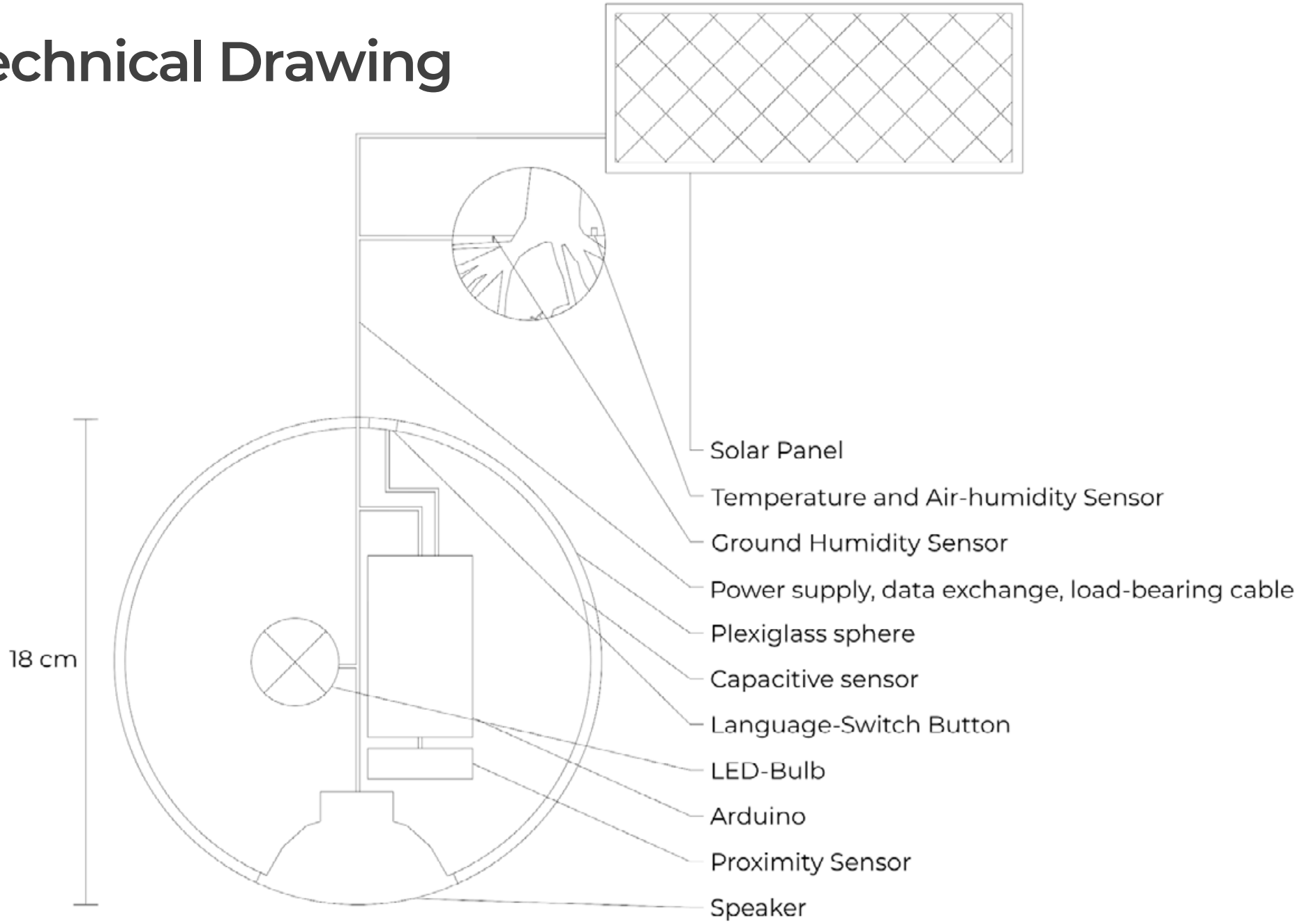
Phase 3
The tree starts talking while you touch the orb



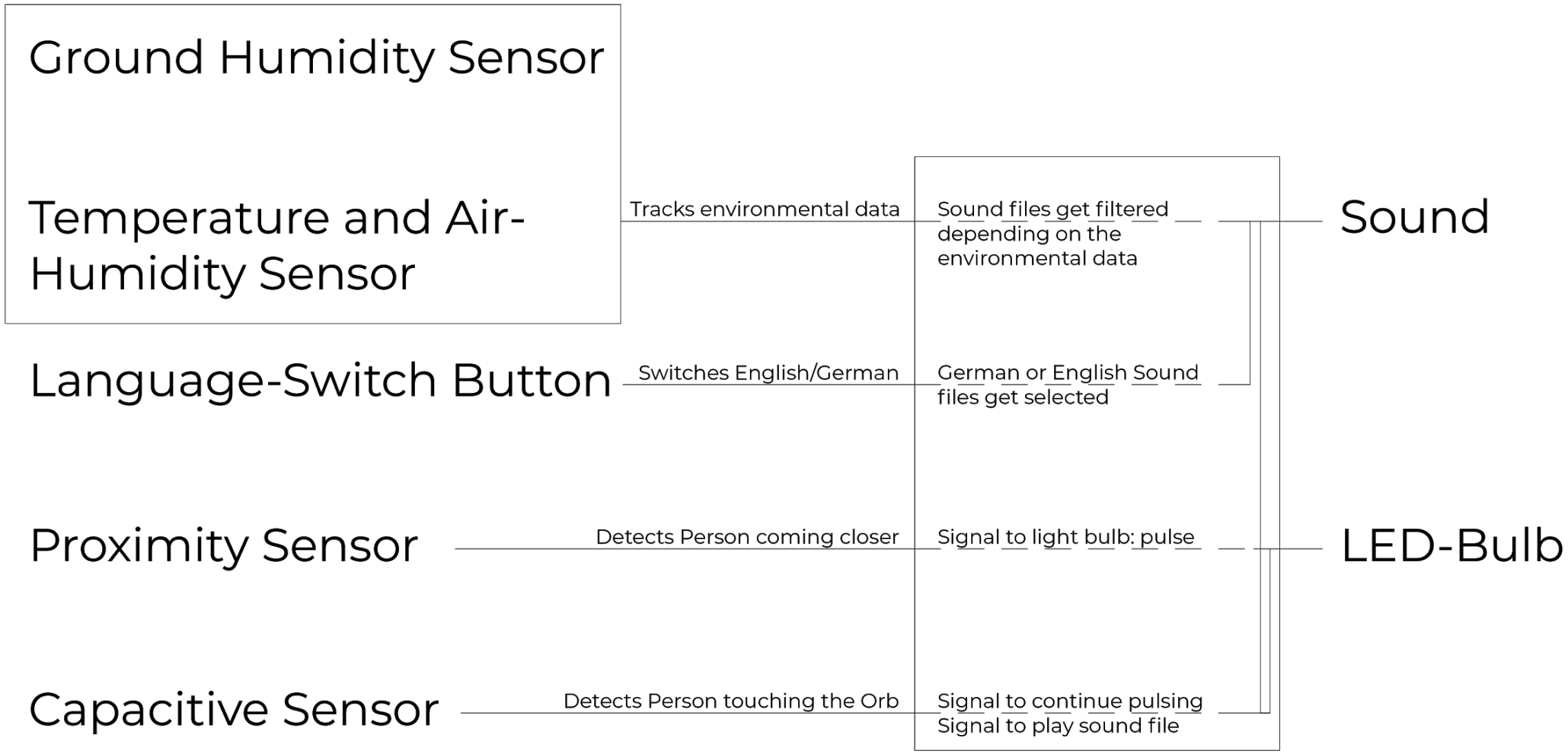
Support Structure

First proposed support structure for the tree and an accompanying bench

Updated Technical Drawing



Input » Output

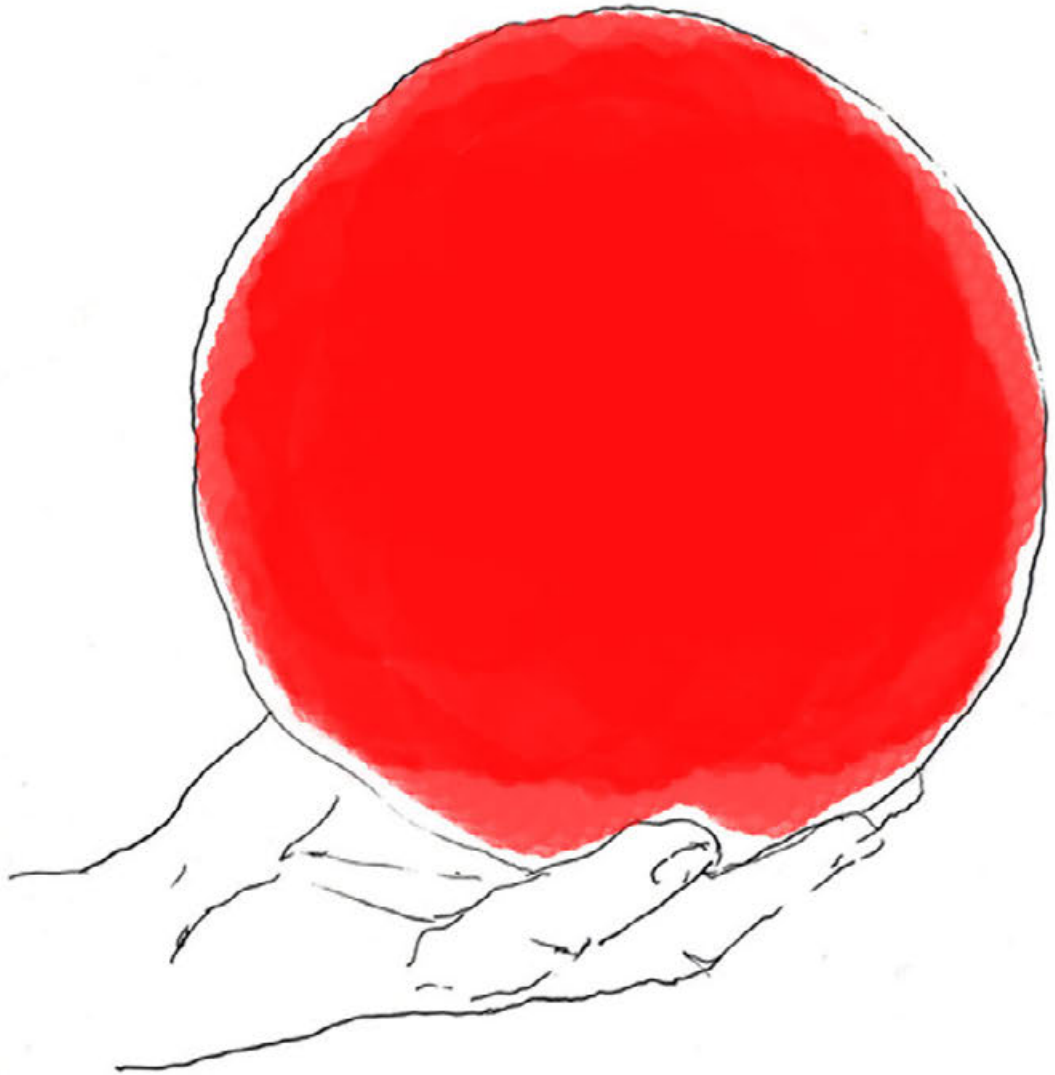


4. Plenum

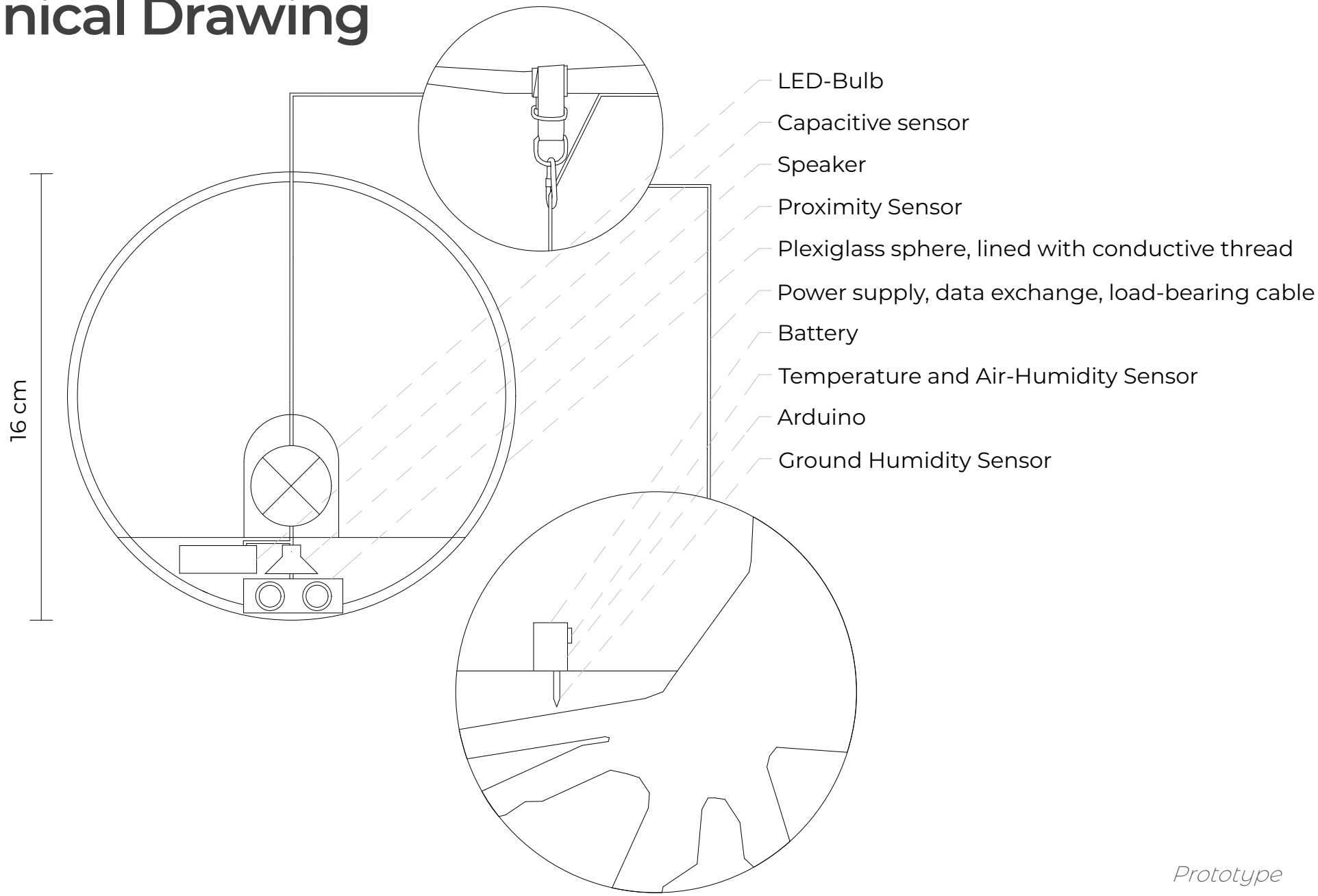
Prototype

Application of Digital Technology

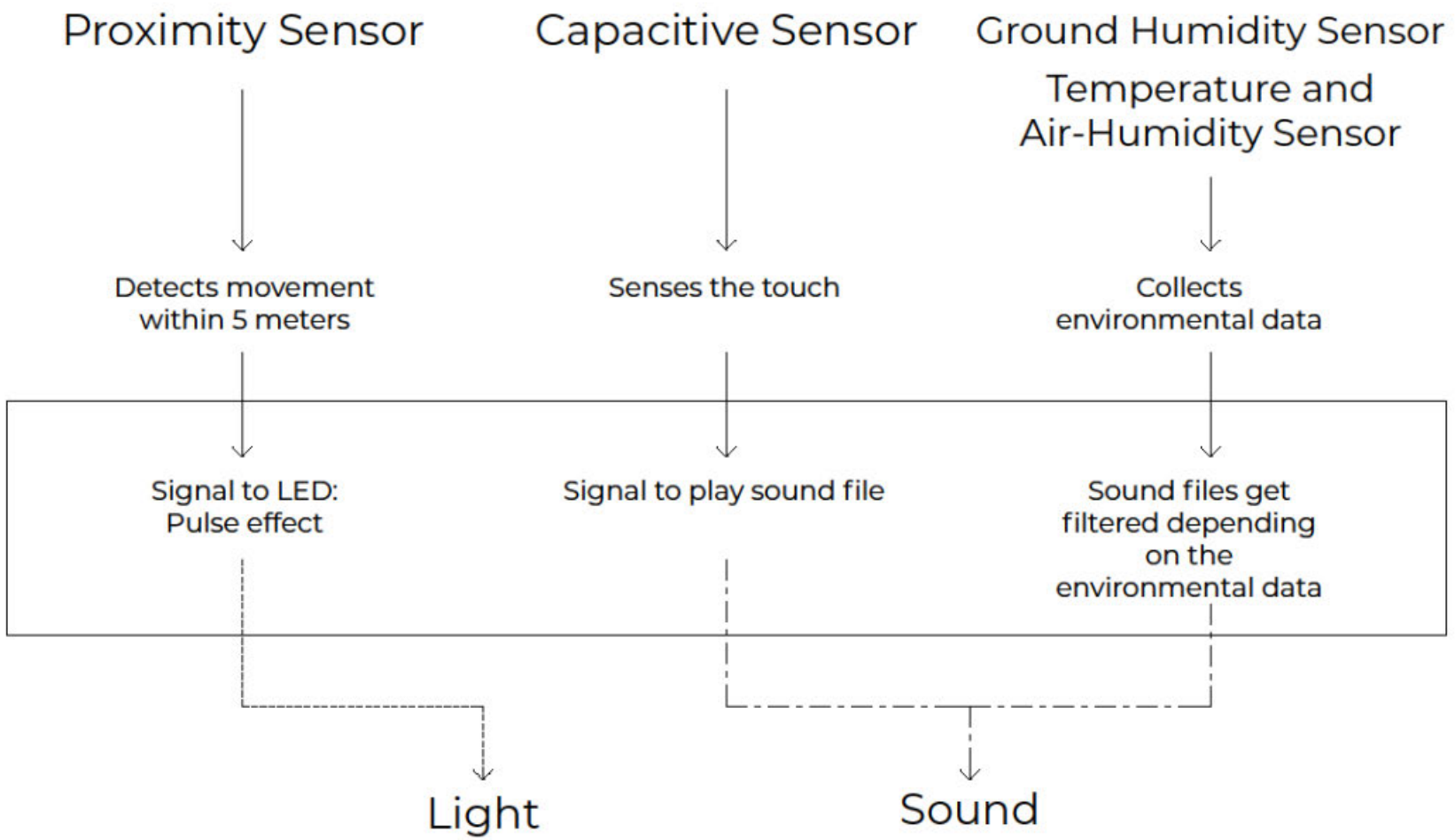
Arduino Code and Components



Final Technical Drawing



Input ≫ Output

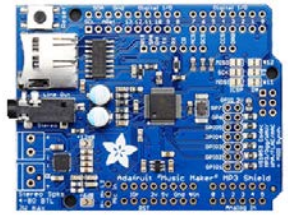


Components

Arduino Uno Starter Kit

microcontroller board in addition to one based on the ATmega328P

33€+16 €



Adafruit Music Maker Shield

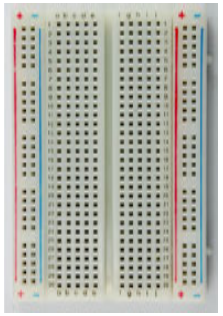
an encoding/decoding (codec) chip that can decode a wide variety of audio formats form a micro sd-card

42€ + 5€

2x HC-SR04 Ultrasonic Sensor

measures the distance of a target object by emitting ultrasonic sound waves

4€



mini-Breadboard

a way of constructing electronics without having to use a soldering iron

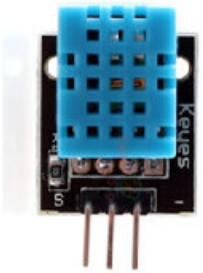
“Included in the starter kit”

Adafruit MPR121

detecting when a person (or animal) has touched one of the sensor electrodes

9€

Components



DHT11

commonly used Temperature and humidity sensor

“Included in the starter kit”

Capacitive Soil Moisture v1.2

Soil moisture sensors measure the volumetric water content in soil

5€

LED

Used for the glowing and pulsing function of the orb

“20€ for the LED Effect Ball

Speakers

Plays the audio of the tree talking - 8 ohms, 2 watts

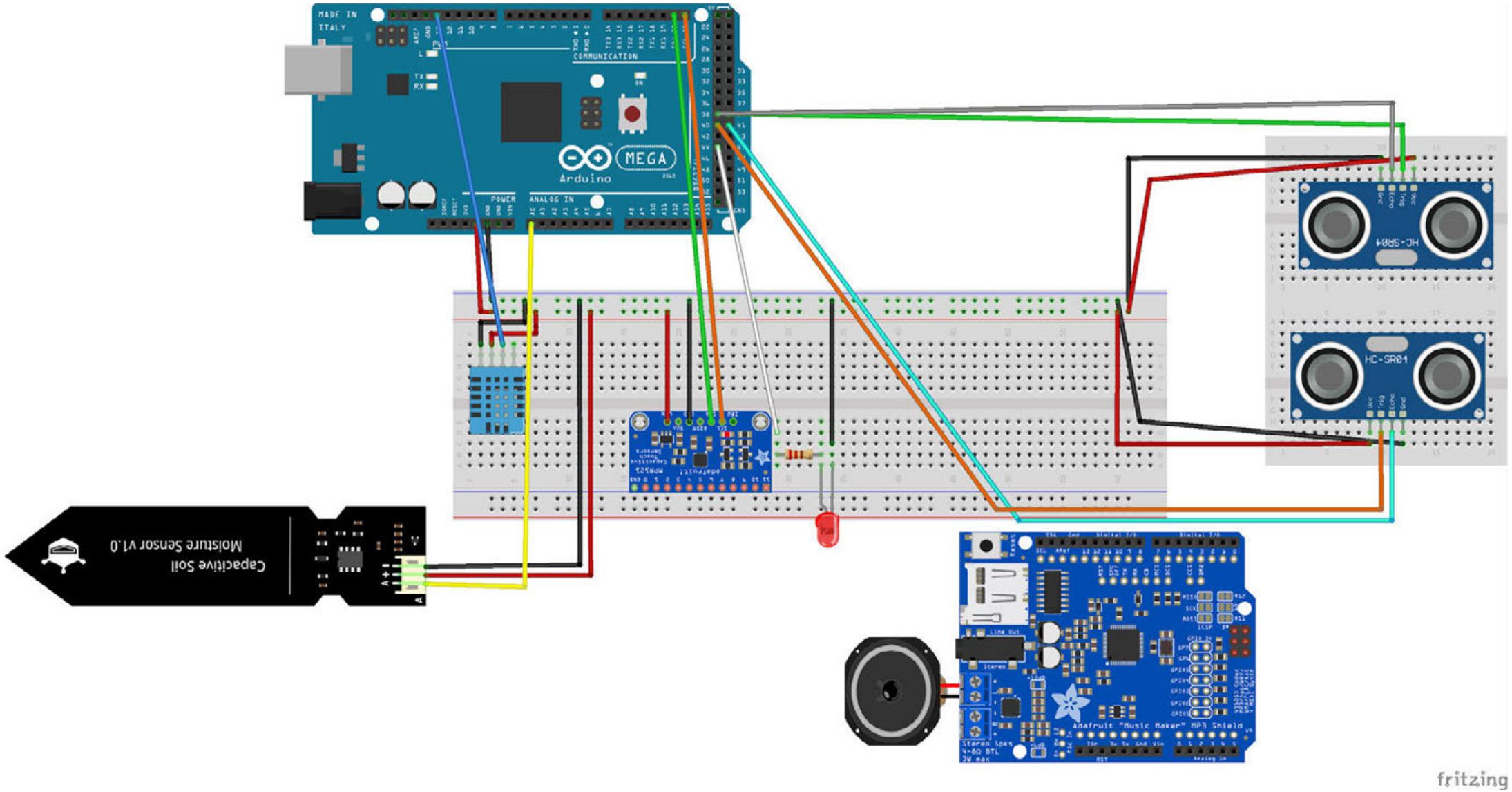
5€

Conductive Thread

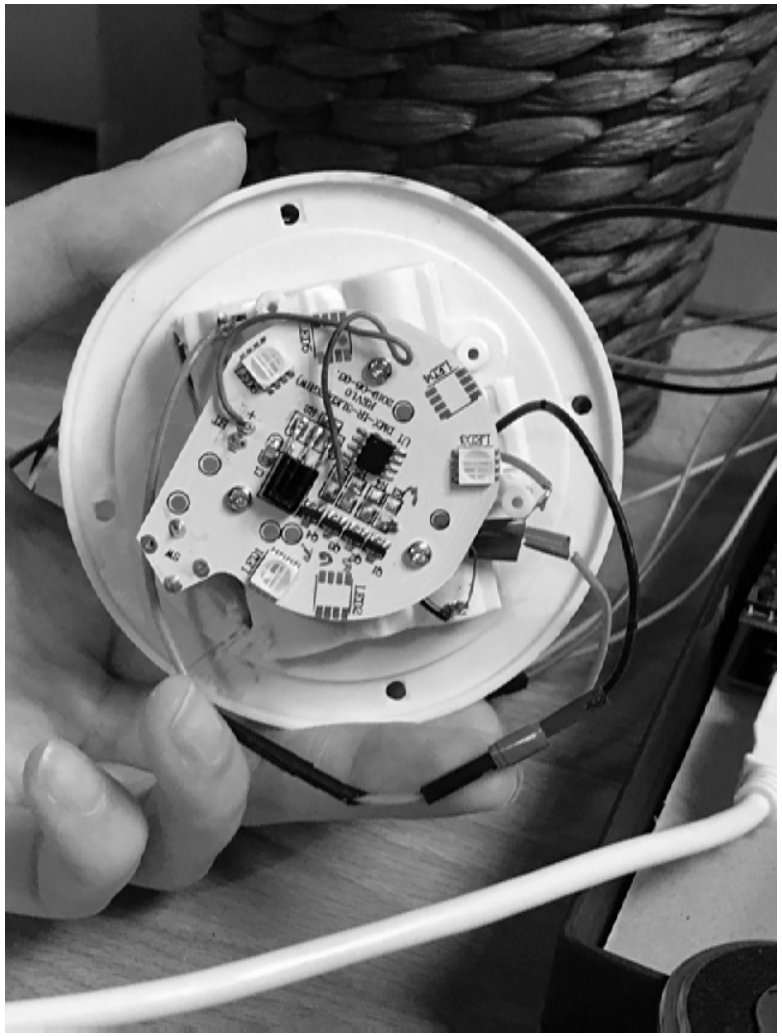
Used Inside the orb to turn into a touchable surface

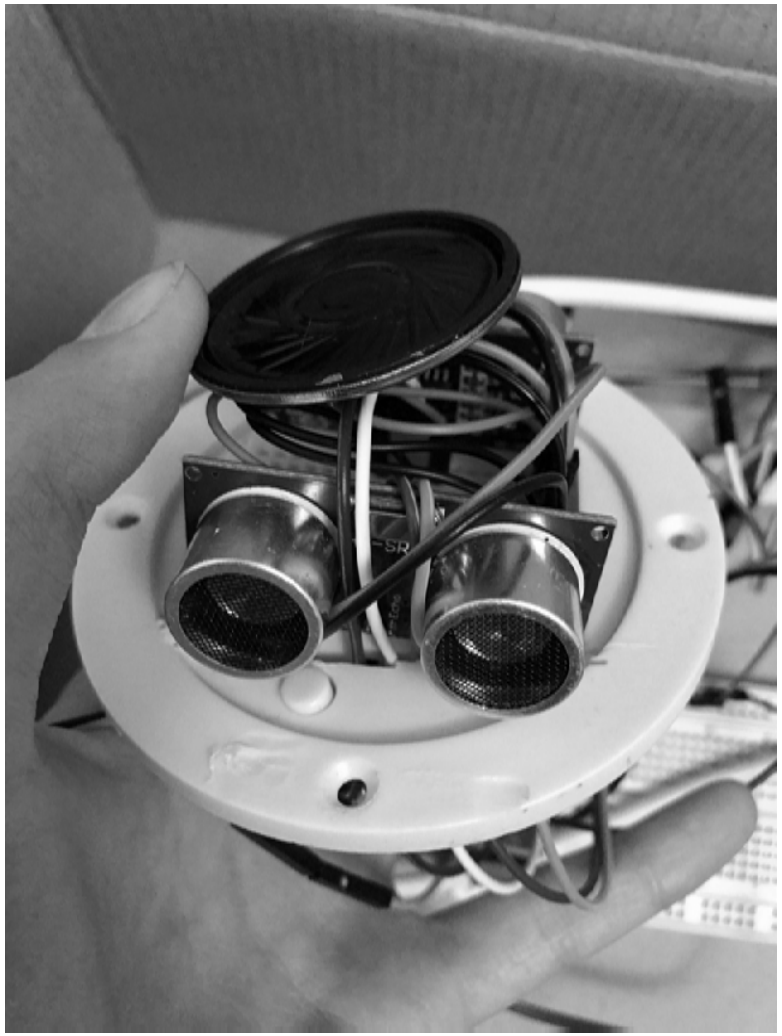
12€

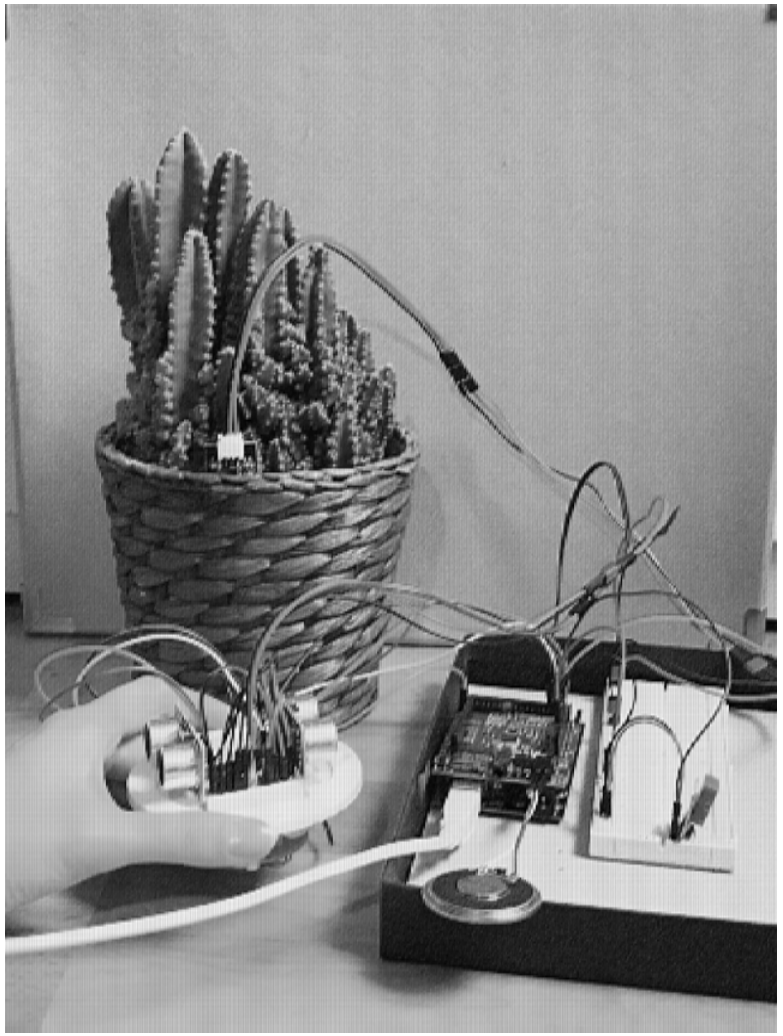
Wiring


MADE IN
ITALY
COMMUNICATION
MEGA
Arduino
POWER
ANALOG IN
HC-SR04
HC-SR04
Capacitive Soil
Moisture Sensor V1.0
Adafruit "Music Maker" MP3 Shield
fritzing

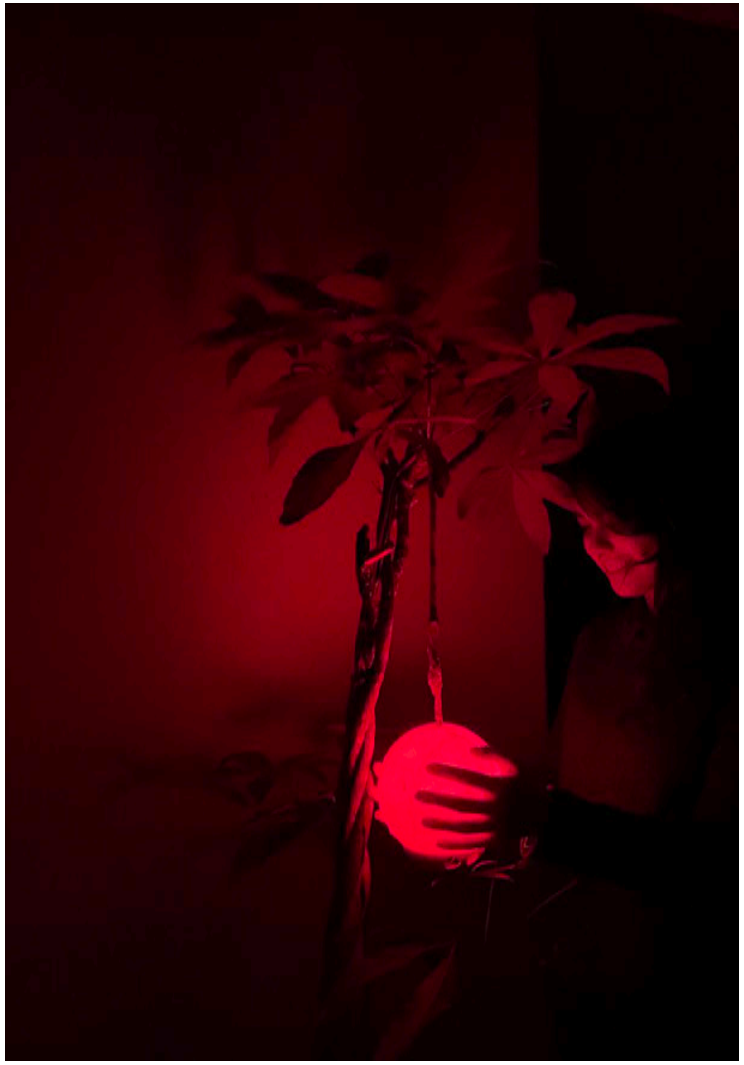
SETUP







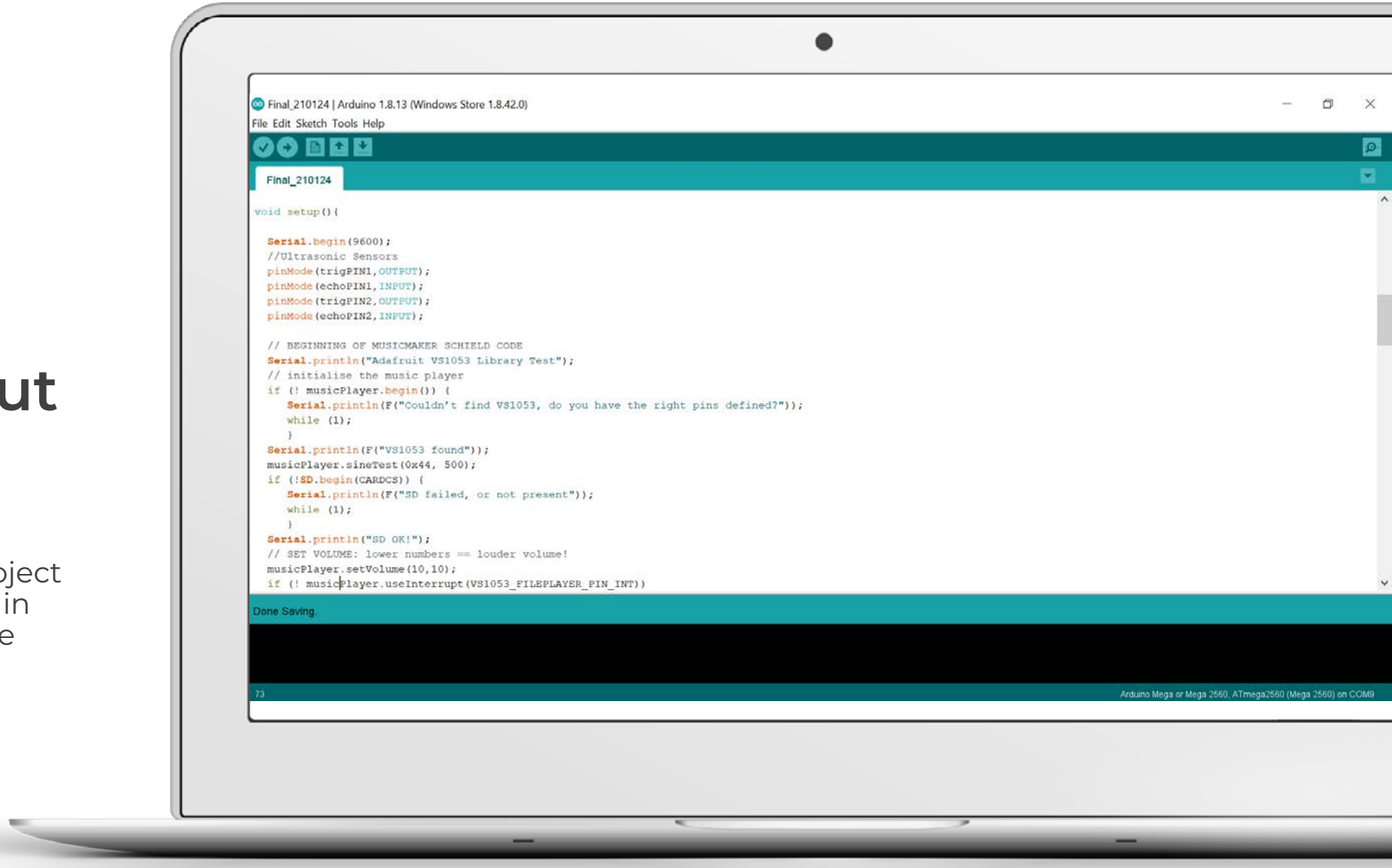
Photos of the prototype

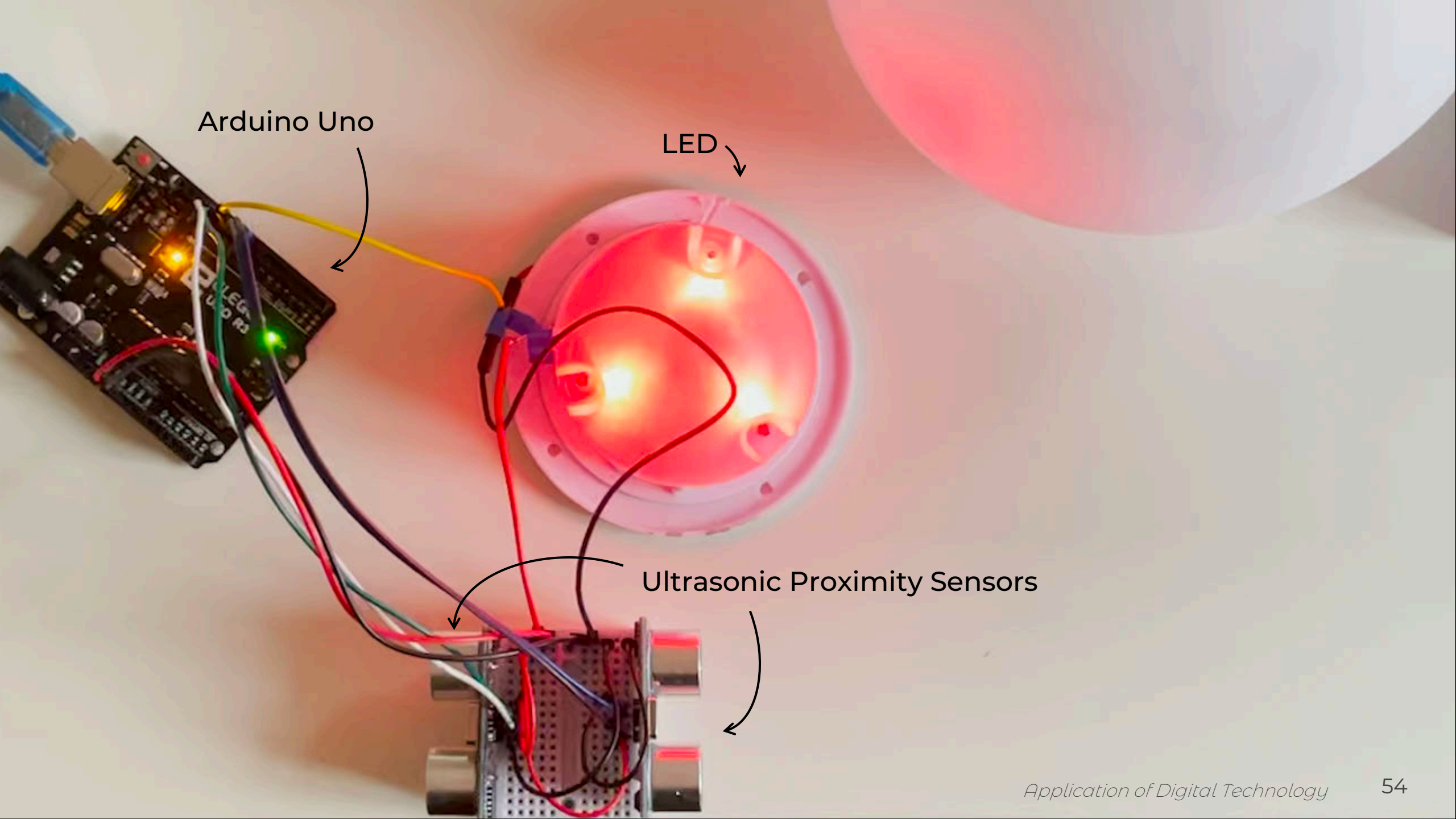


Arduino IDE

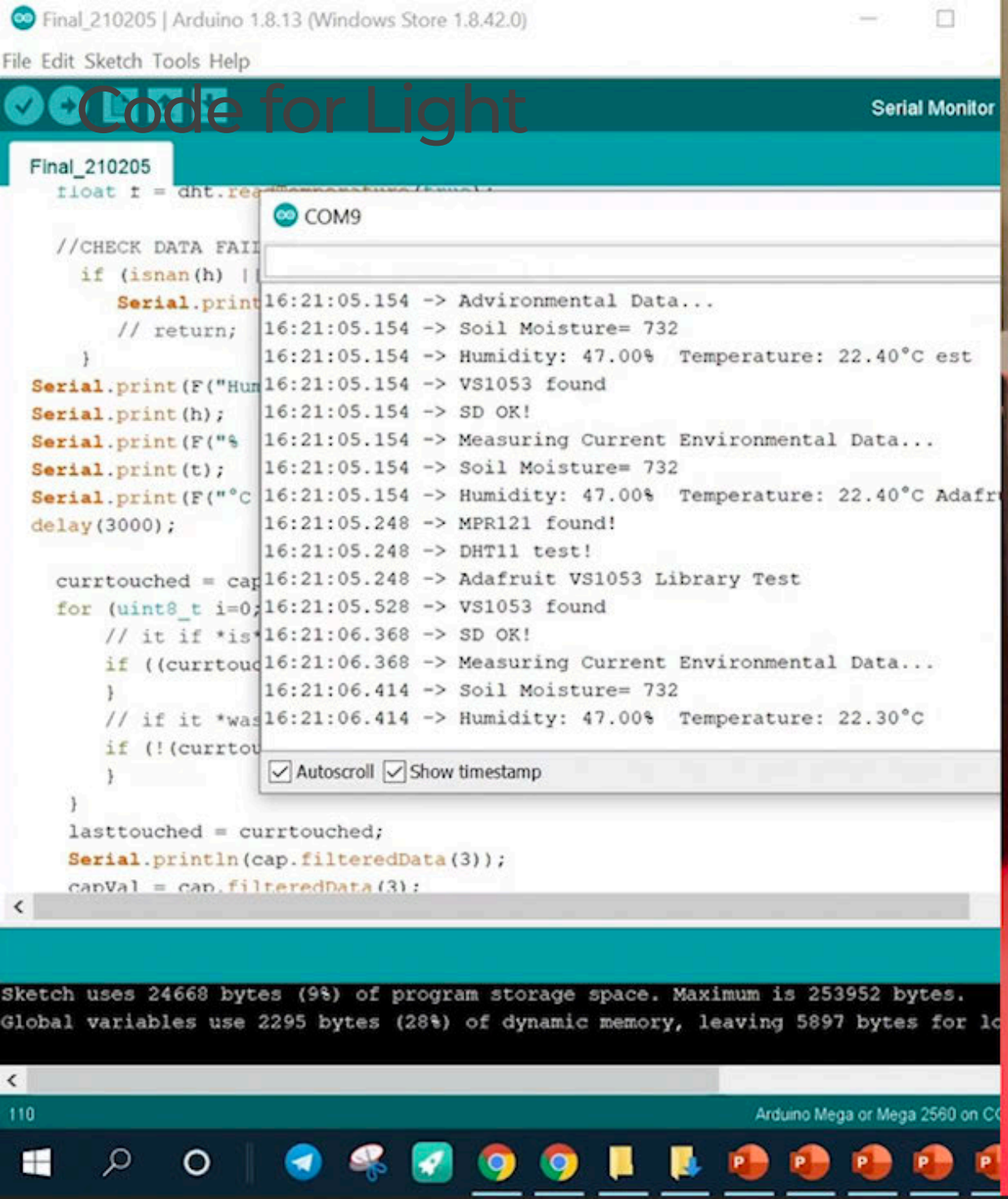
Connect the output and input

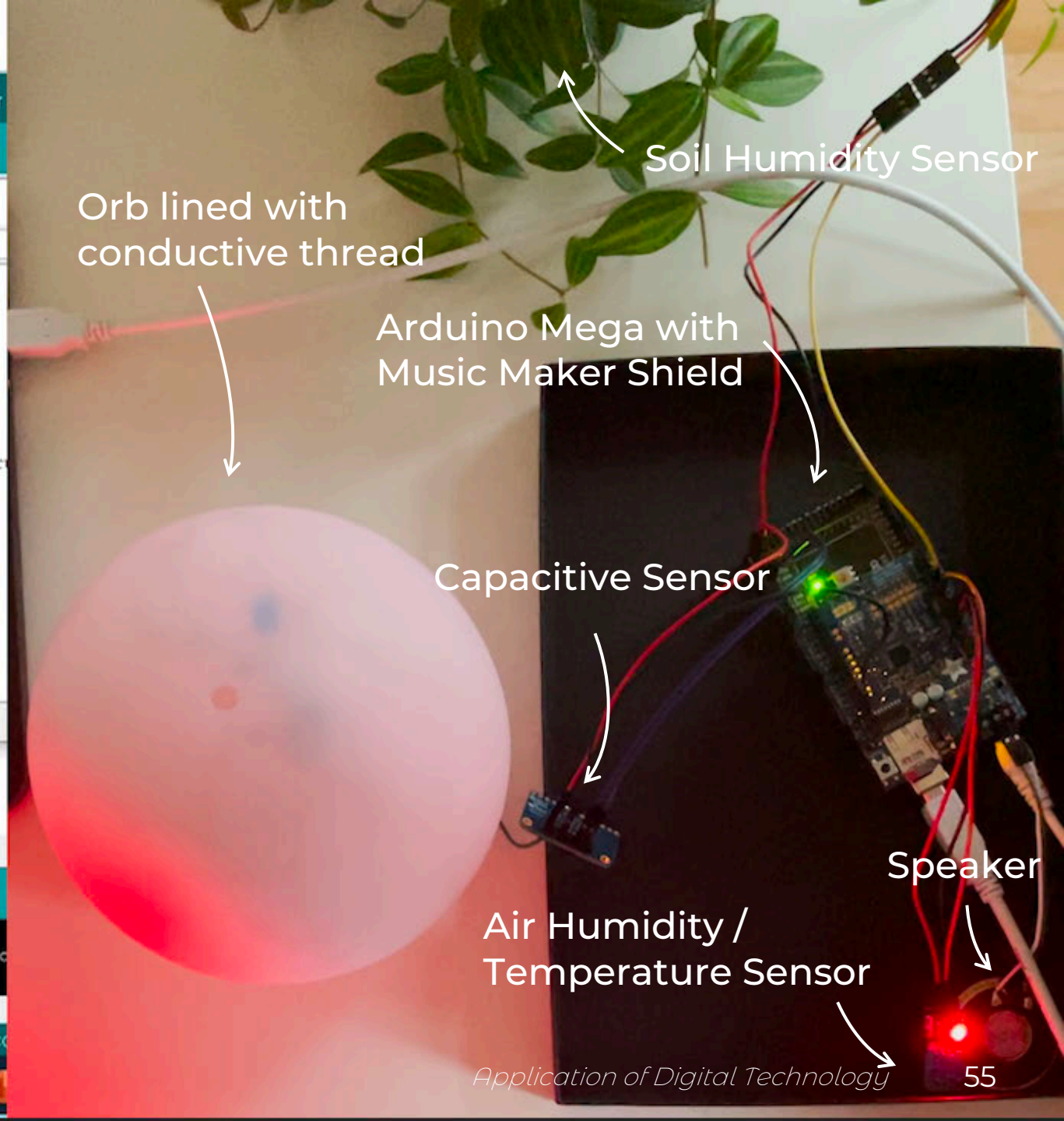
We have decided to program our project including both the input and output in Arduino in order to have a standalone experience.




Arduino Uno
LED
Ultrasonic Proximity Sensors

Code for Light





The Speech of the Tree

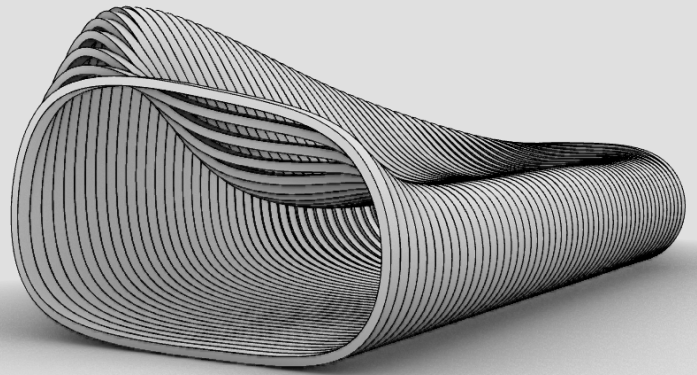
Aim:

Raising awareness about the tree's issues

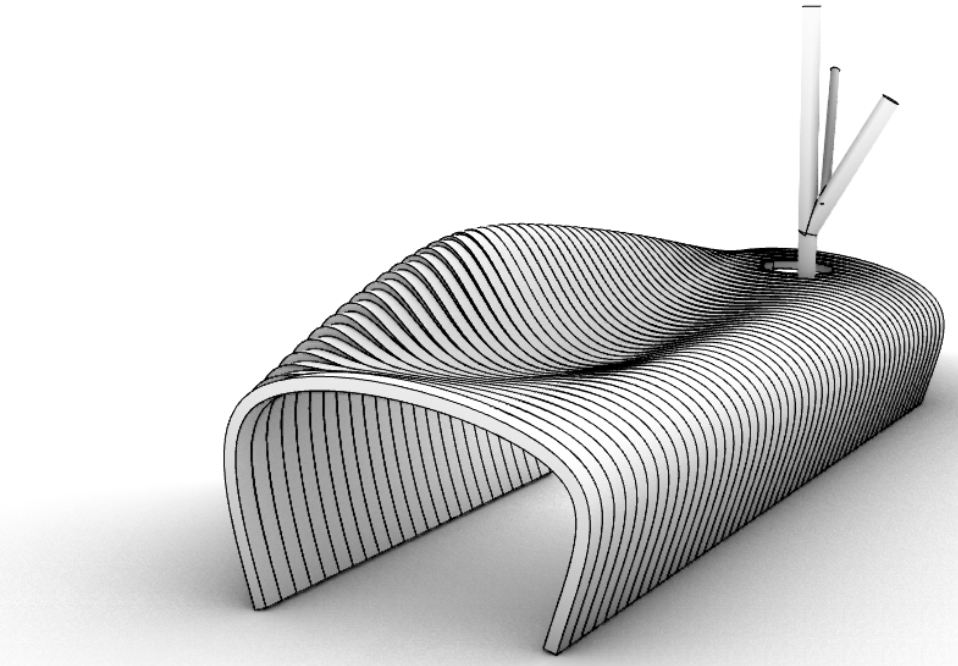
Thresholds:

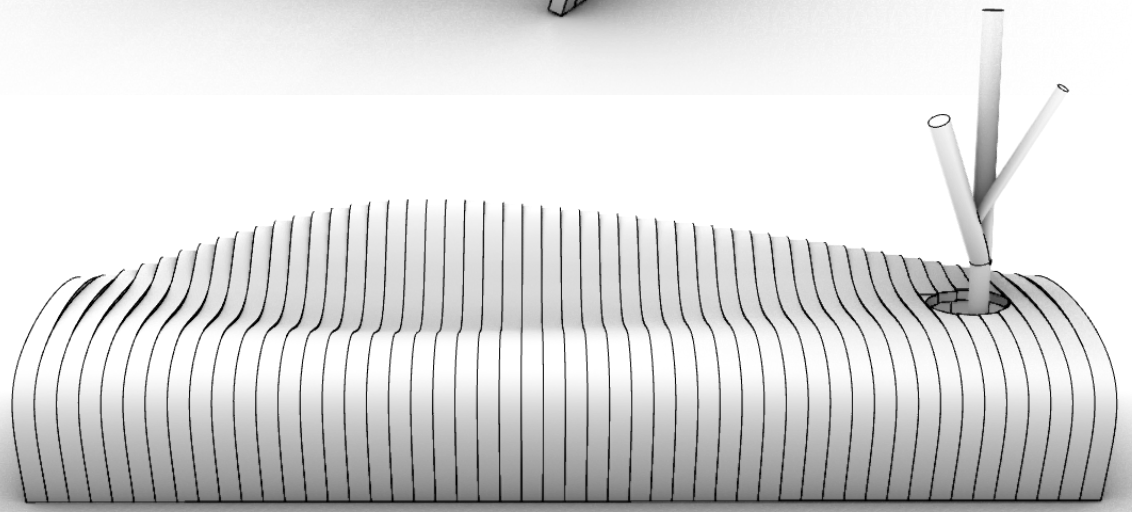
- Too hot & dry
- normal
- raining
- too cold

```
Serial.println(cap.filteredData(2));
capVal = cap.filteredData(2);
lasttouched = currtouched;
if(capVal < 120) {
    Serial.println("touched");
    touched = 1;
   }
 else {
    Serial.println("not touched");
    touched = 0;
 }
 if(touched == 1 && !musicPlayer.playingMusic) {
    //WHEN IT IS FREEZING
    if (DHT.temperature<0){
            musicPlayer.playFullFile("track003.mp3");
            if (! musicPlayer.startPlayingFile("/track001.mp3")) {
                Serial.println("Could not open file track001.mp3");
                while (1);
            }
    }
    //WHEN IT IS TOO HOT AND DRY
    else if (DHT.temperature>30 && sensorVal>350){
            musicPlayer.playFullFile("track001.mp3");
            if (! musicPlayer.startPlayingFile("/track001.mp3")) {
                Serial.println("Could not open file track001.mp3");
                while (1);
            musicPlayer.playFullFile("track001.mp3");
            if (! musicPlayer.startPlayingFile("/track001.mp3")) {
                Serial.println("Could not open file track001.mp3");
                while (1);
            }
    }
    //WHEN IT IS RAINING
    else if (90>DHT.humidity>99 &&  260<sensorVal<350){
        musicPlayer.playFullFile("track004.mp3");
        if (! musicPlayer.startPlayingFile("/track001.mp3")) {
            Serial.println("Could not open file track001.mp3");
            while (1);
        }
    }
    //NORMAL OR IDEAL DATA
    else {
        musicPlayer.playFullFile("track002.mp3");
        if (! musicPlayer.startPlayingFile("/track002.mp3")) {
            Serial.println("Could not open file track002.mp3");
            while (1);
        }
    }
 Serial.println(F("Started playing"));
 }
}
```

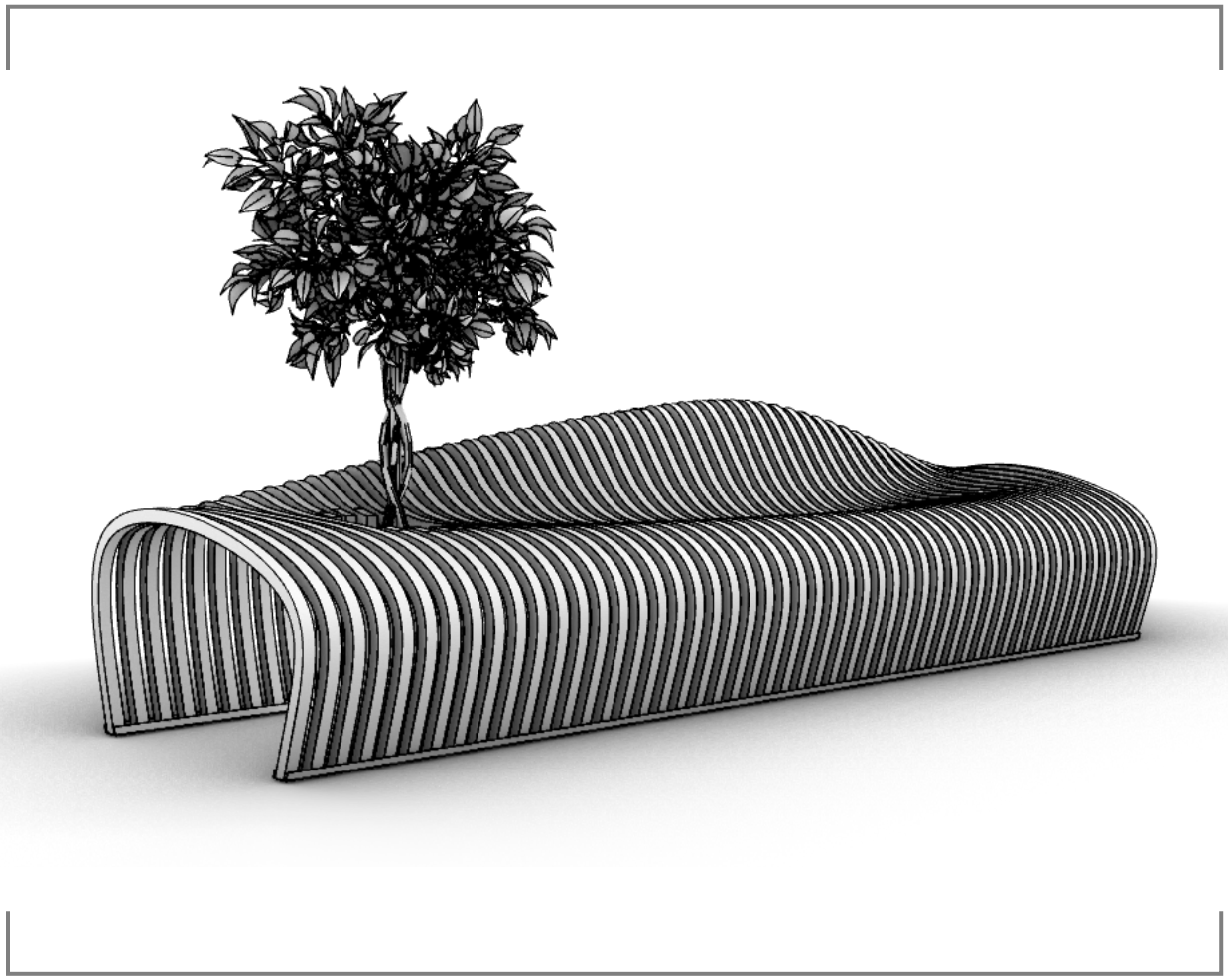


Bench Alternatives





Final Bench Proposal



Sources and References for “trees” by Marcus Maeder

Literature:

Maeder, Marcus: Kunst, Wissenschaft, Natur : zur Ästhetik und Epistemologie der künstlerisch-wissenschaftlichen Naturbeobachtung, 2017, S.28-68
Maeder, Marcus: Blog for zhdk, link: https://blog.zhdk.ch/marcusmaeder/ (last accessed: 14.11.2020)

Maeder, Marcus: Portfolio of the project “Trees: Pinus sylvestris”, link: http://www.domizil.ch/trees_pinus_sylvestris.pdf (last accessed: 14.11.2020)
Maeder, Marcus: trees: Pinus sylvestris – Immersive Lab Version, link: https://immersivelab.zhdk.ch/?page_id=1014 (last accessed: 14.11.2020)
Marcus Maeder: ‘trees: Pinus sylvestris‘, *Journal for Artistic Research*, 11 (2016) https://www.researchcatalogue.net/view/215961/215962/0/0 (last accessed: 14.11.2020)
Daniel Bisig, Jan Schacher, Martin Neukom: Flowspace, http://swarms.cc/projects/flowspace/ (last accessed: 14.11.2020)

Images:

https://www.researchcatalogue.net/view/215961/215962
https://www.youtube.com/watch?v=-fLrB4l82fY
https://immersivelab.zhdk.ch/?page_id=1014
http://www.domizil.ch/trees_pinus_sylvestris.pdf
https://mag.haupt.ch/wp-content/uploads/2019/09/106-107_Lubrich_Botanik-in-Bewegung_c-Universität-Bern_Fotografie-Hans-Grunert-large.jpg
https://cdn.prod.www.spiegel.de/images/11478b1d-87c8-439b-85bd-798a18ffdbf1_w948_r1.77_fpx56_fpy34.jpg
http://www.natkon.ch/pdf_files/publikationsseite/BeoNatur_Nov2014.pdf
https://www.wsl.ch/fileadmin/_processed_/d/2/csm_COP21_Trees_installation_gr_76d1acc0a7.jpg
https://s3.amazonaws.com/media.africanrockart.org/wp-content/uploads/2016/04/26144038/LIBAKA0060006.jpg
https://mixkit.co/free-stock-video/trees-in-a-green-forest-2201/
(all, last accessed: 13.11.2020)

Bauhaus-Universität Weimar

Thank You

- Louisa Hainich
- Zahra Zoleykhaei

“New nature in park at the Ilm”

Introductory Project-Module,
WS 20-21, 1. semester