Industrial Design

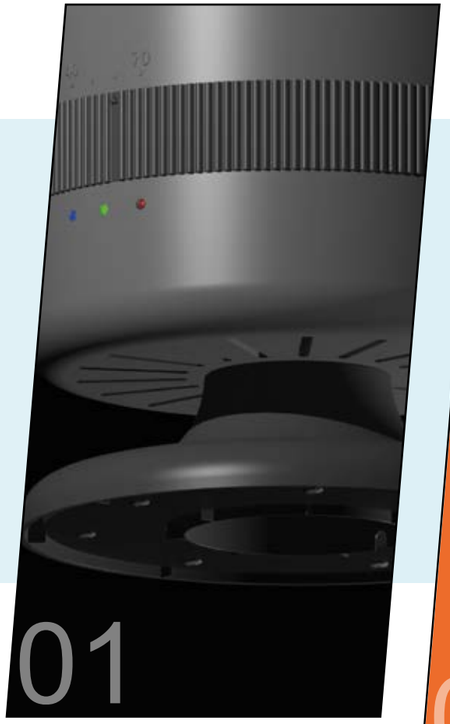
Portfolio

Bram Willems

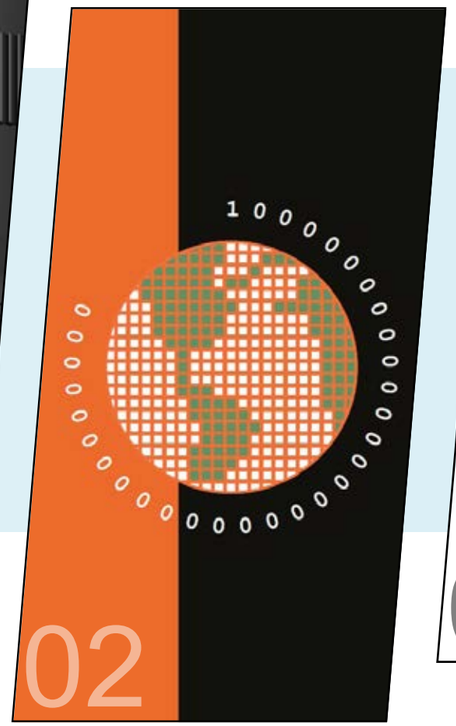
2025 // Selected Projects

PROJECTS

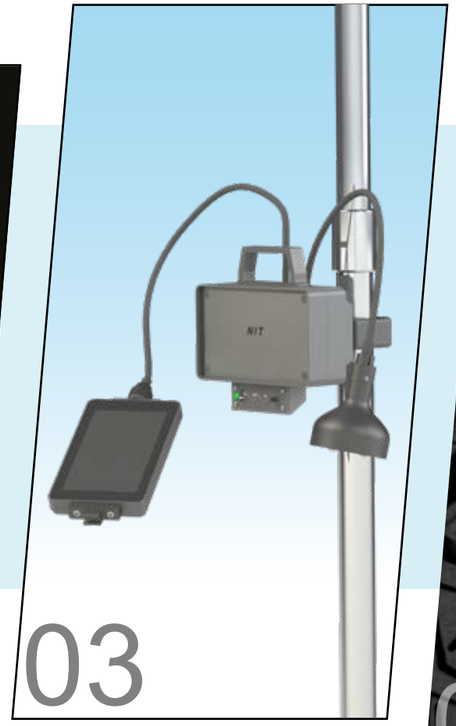
Humidifier



Quetta

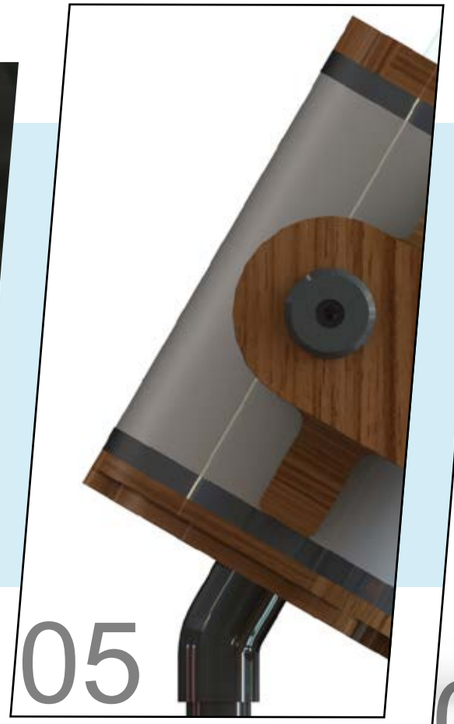


Vein Finder

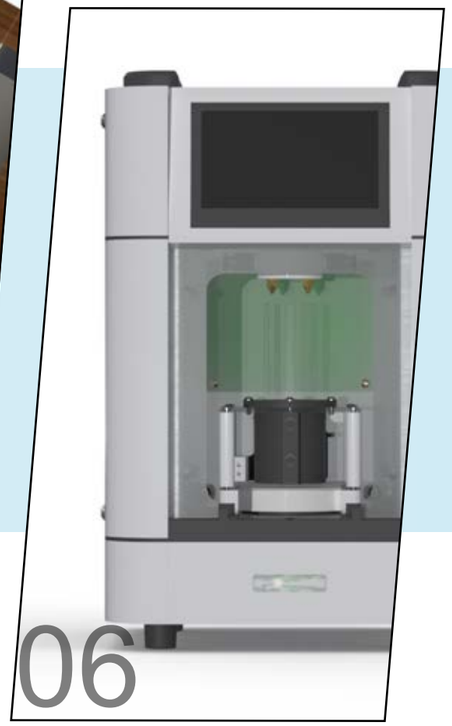


Paradox

Balanced Coffee



My-Odine



01 Humidifier

Type: Course Assignment (Bachelor)

Duration: 6 weeks

Groupsize: 3 people

Used Programs / Skills:

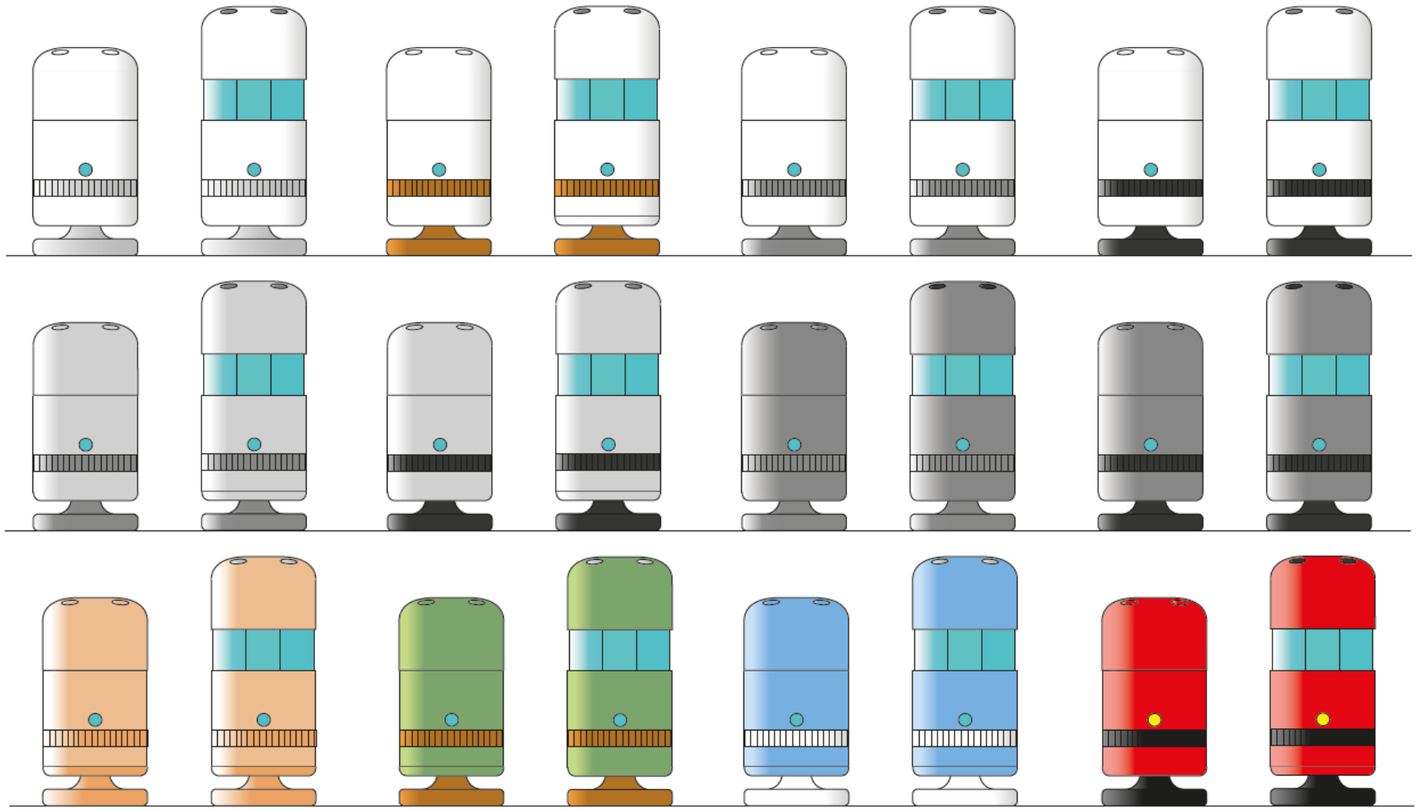
Project Brief

To design and create a concept for a technical consumer product which has mechanical moving parts.

Context

Our project team decided to develop a humidifier. Important tasks and requirements during this project were to design and make the product in 3D CAD (parts, assembly and technical drawings). To develop moving mechanical parts within the product. Program and make a working mockup with Arduino. And lastly, to compare and choose the best materials and production methods for all the product parts.

During this assignment, we divided the tasks. We all were responsible for the Computer-Aided Design of the humidifier. Next to that, we had our own responsibility for other tasks. I was mainly focussing on the mechatronics. One of my teammates was responsible for the device's construction while my other teammate was busy with the manufacturing process. In addition, We all helped each other with the different tasks, but we were in charge of our own divided tasks. We did the designing and 3D CAD together in consultation.

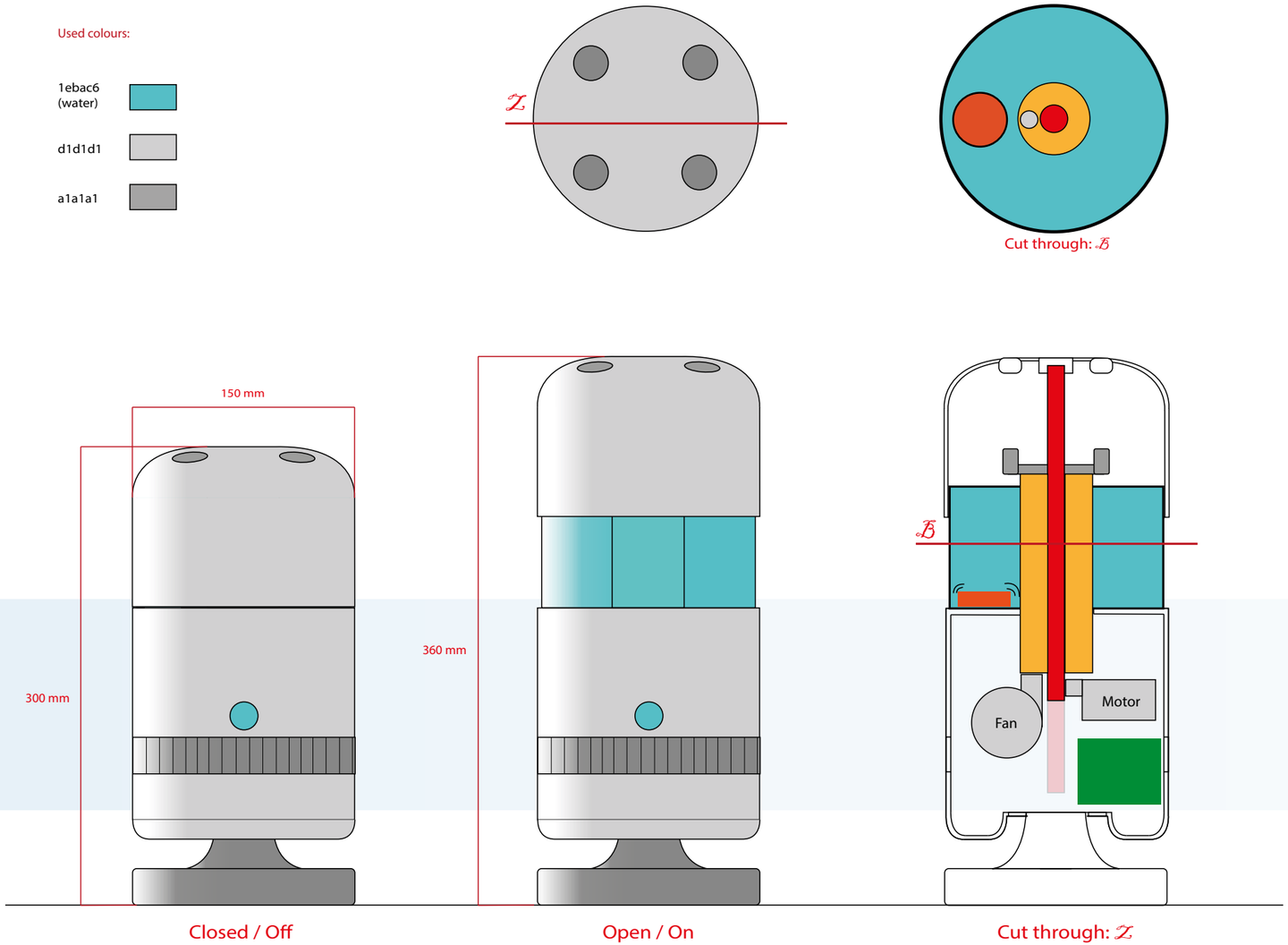


Ideation

During the ideation phase, we came up with this concept. When the device is not in use, it will be closed, which makes it compact and unobtrusive.

When the humidifier is on, the roof goes up. This makes the water basin visible and creates an open space for the haze to collect before being blown out by the fan.

The dark grey ring makes it possible to activate or deactivate the device and adjust the preferred humidity percentage. This makes the humidifier understandable and easy to use.

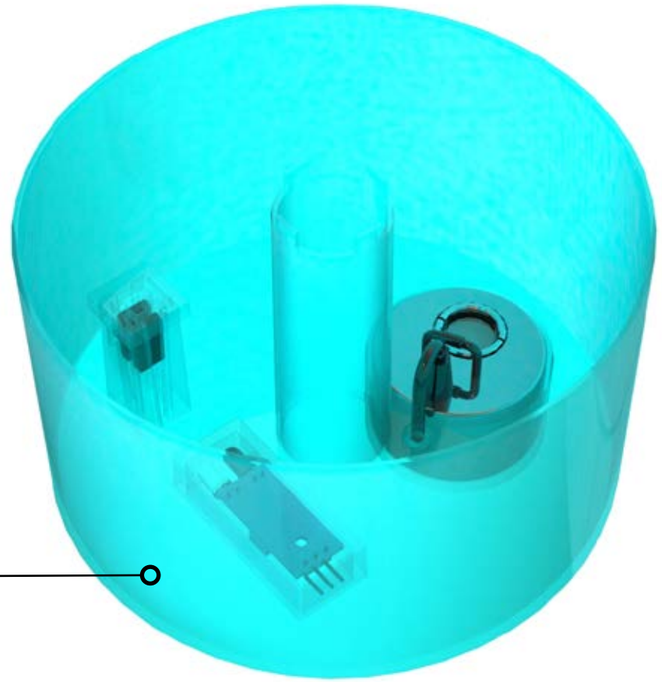


Design Concept

Developed Part

Water basin

One of the parts I developed was the water basin. The part is designed especially for injection moulding. There is a nebuliser component in the basin that creates the mist. There is also a measuring system inside that I designed to measure the water level in the basin. When the water level becomes too low, the system will let the user know that the basin needs to be refilled. This is because there is a level cube that goes down with the water as it sinks. This activates the sensor because the cube will block its view.



Assembly

Water basin

Parts

Basin

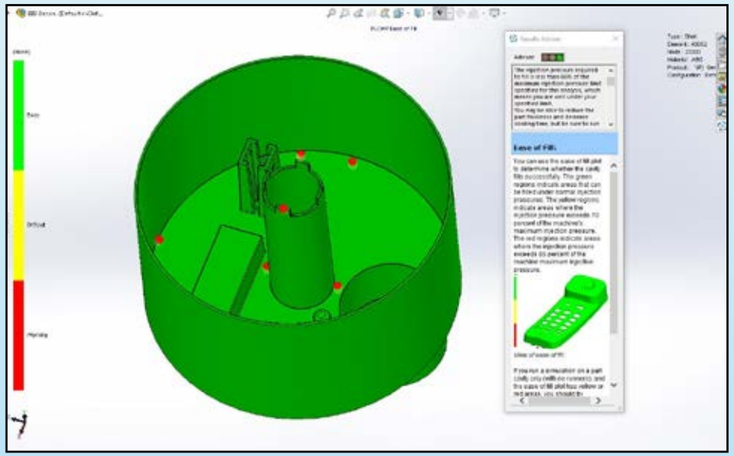
Nebuliser component

Object sensor

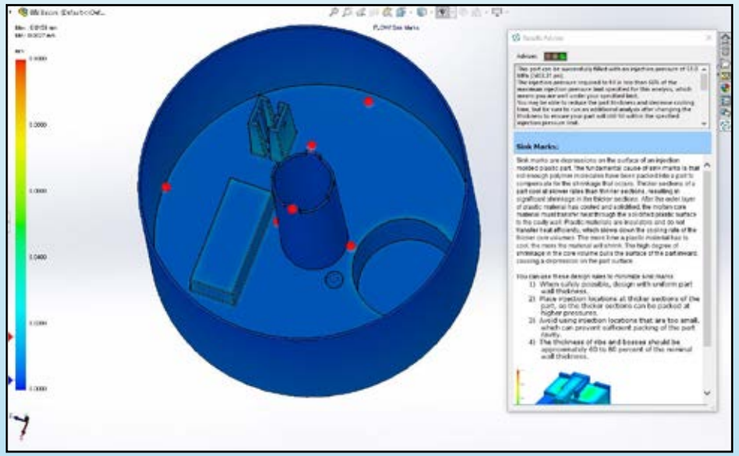
Level cube

Cube lid

Iterations on Water Basin

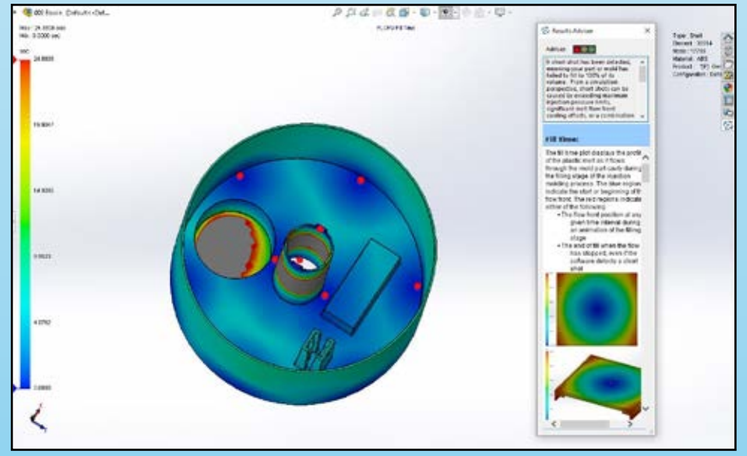


Check for Ease Of Fill

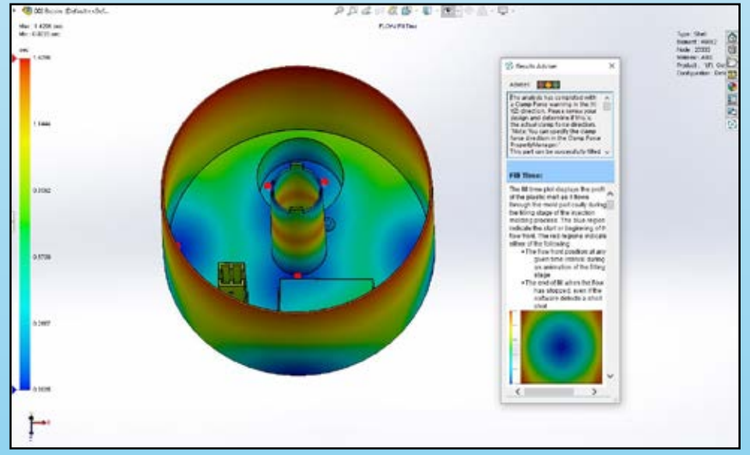


Check for Sinkmarks

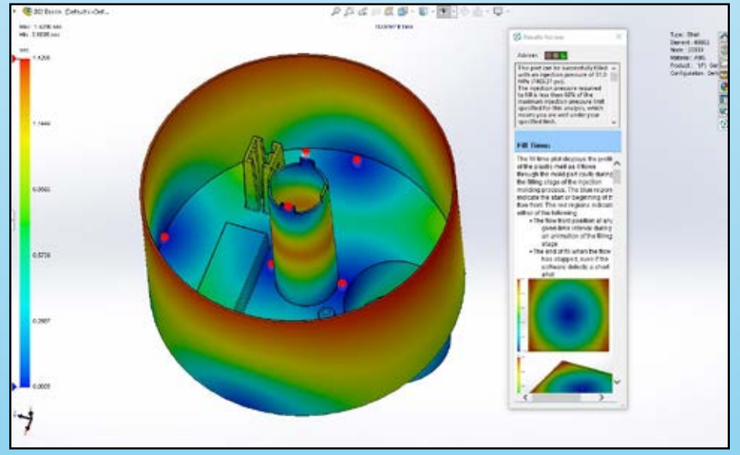
Draft Analysis



Bad Filling Time (position sprue not good enough)



Moderate Filling Time (coolingtime to long)



Good Filling Time (no problems at all)

Developed Part

Bracket

A bracket was designed to ensure that the assembly of the electric components will be as easy as possible before it gets placed into the product. This will make it easier to place, connect and test the components beforehand.

Assembly

Bracket

Parts

Bracket

Motor with spindle

Fan with tube

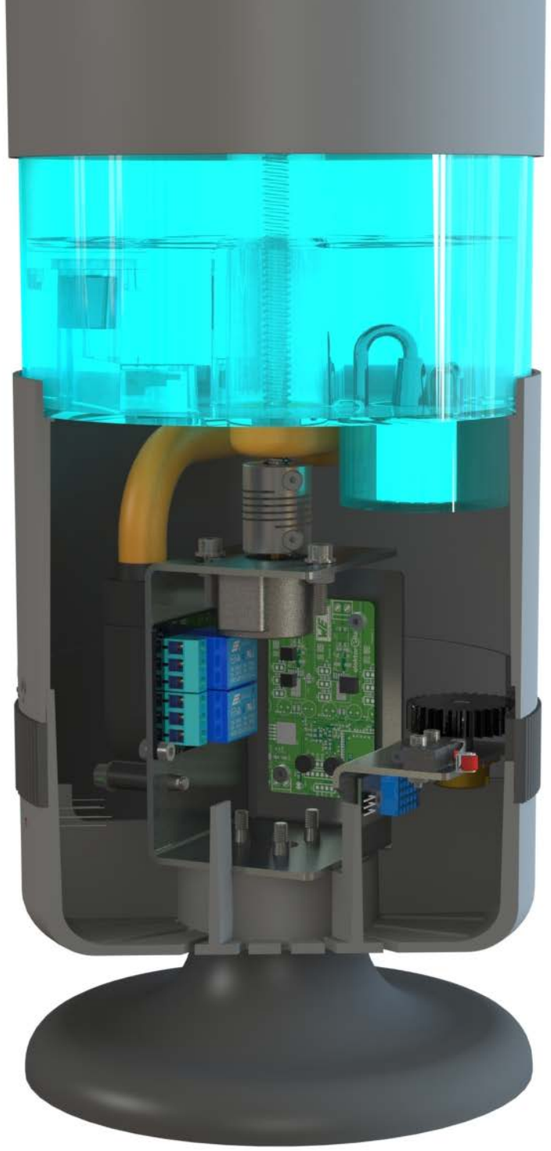
PCB

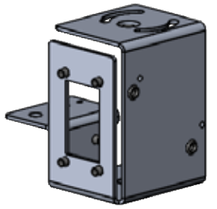
Relais

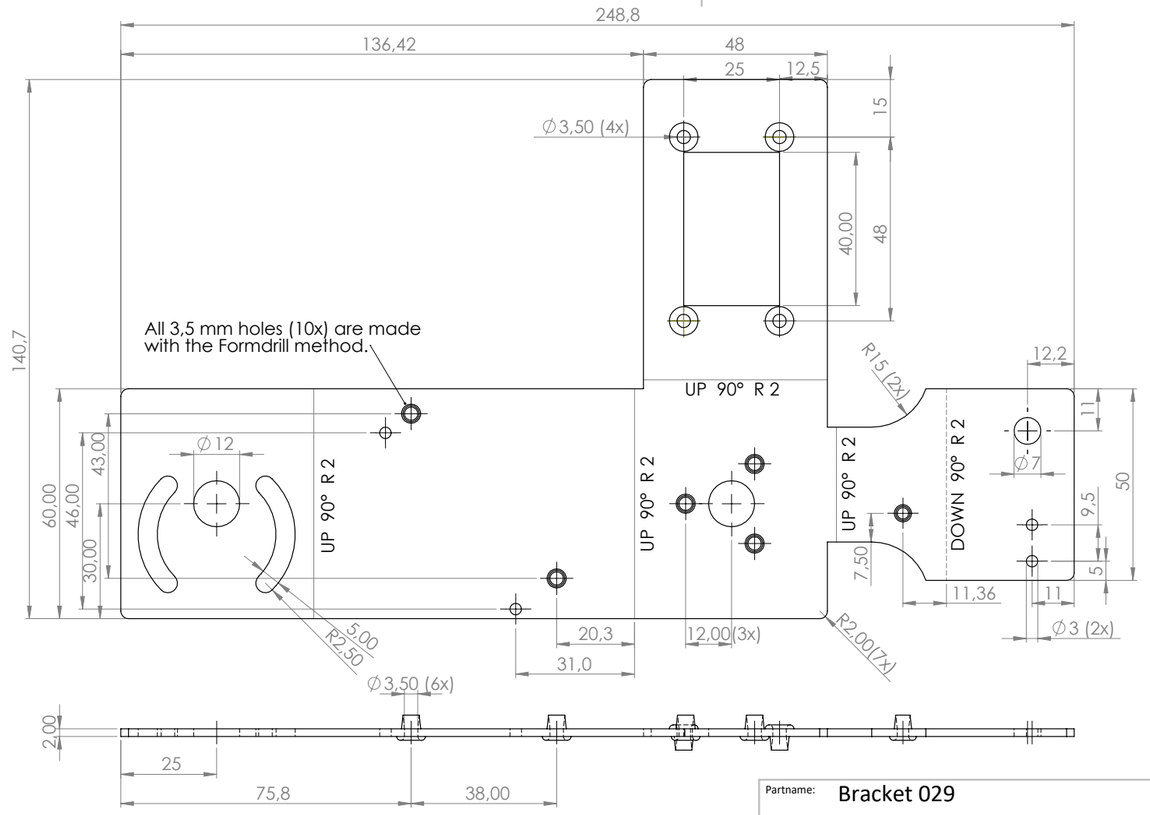
Potentiometer

Limit switch

DTH Sensor







Partname: Bracket 029			Drawingnumber: 029
Industrieel Product Ontwerpen Hogeschool Rotterdam Pieter de Hoochweg 129 3024 BG Rotterdam	Drawing by: B.c.j Willems	Checked by: S van Beek	Material: Aluminium (1060)
	Signature:	Signature:	
			Volume: 32498.99 cubic millimeters
Subject:	Date: 28-5-20	Dimensional tolerance: 0,1 milimeters	Surface area: 35703.37 squaremillimeters
	Revision: A	Geometrical tolerance: -	Weight: 87,75 gram
Not for production, reference only			Sheet: 1/1

3rd Angle Projection

Unit: mm

Scale: 1:1

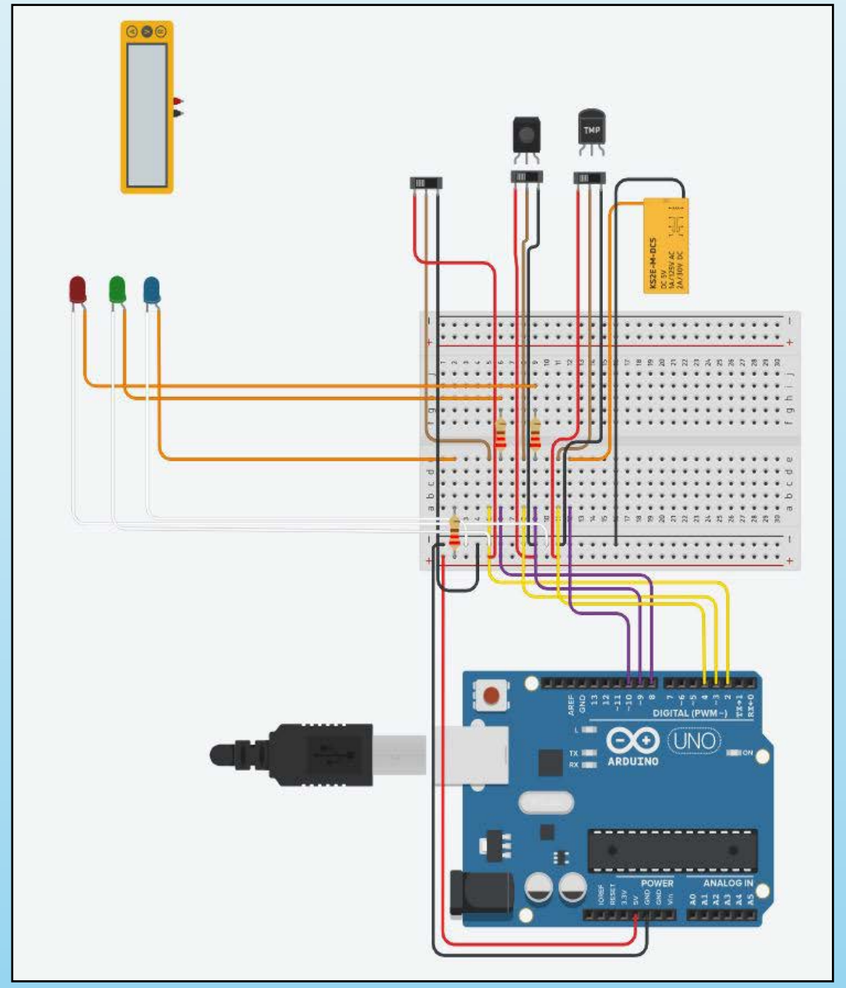
Paper size: A3

SOLIDWORKS Educational Product. For Instructional Use Only.

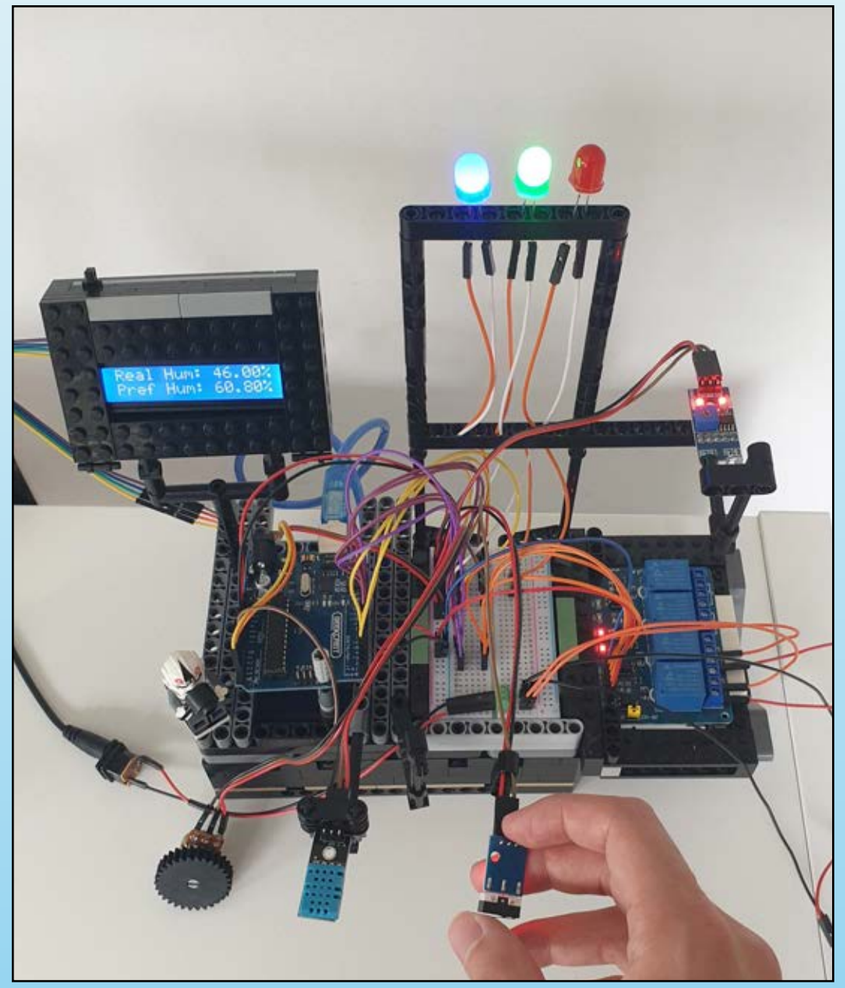
Software

Writing the Program

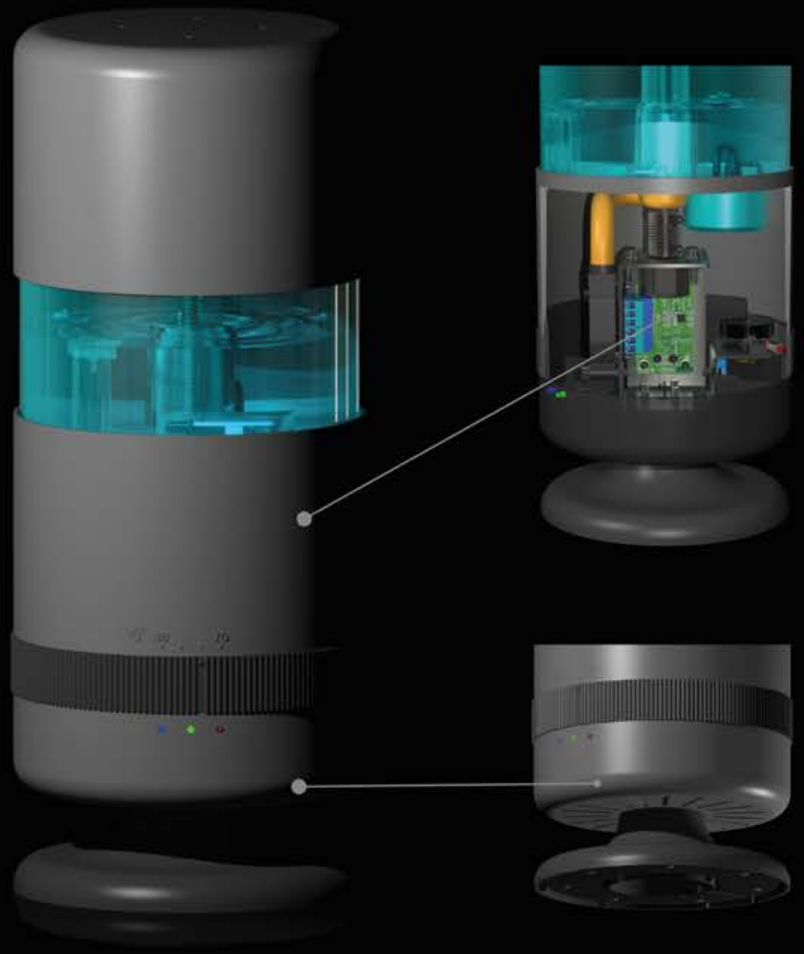
To be able to test the functioning of our concept, a code was written with Arduino IDE software. First, a digital setup was made to simulate the program in Tinker Cad. After verifying the virtual program, the right components were ordered to be able to make and test the final real setup.



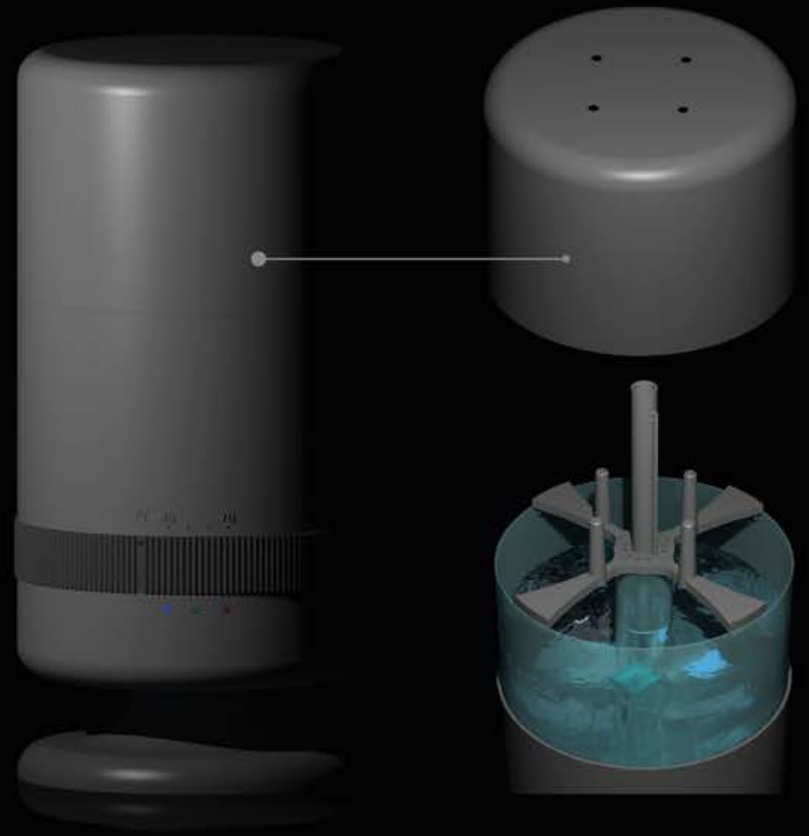
Simulation of product functionality



Testing the software with a test setup



Humidifier in use



Humidifier stand-by

02 QUETTA

Type: Design Project (Master)

Duration: 18 weeks

Groupsize: 4 people

Used Programs / Skills:

Project Brief

How can we design for moderate internet usage in daily life and make people more aware of it?

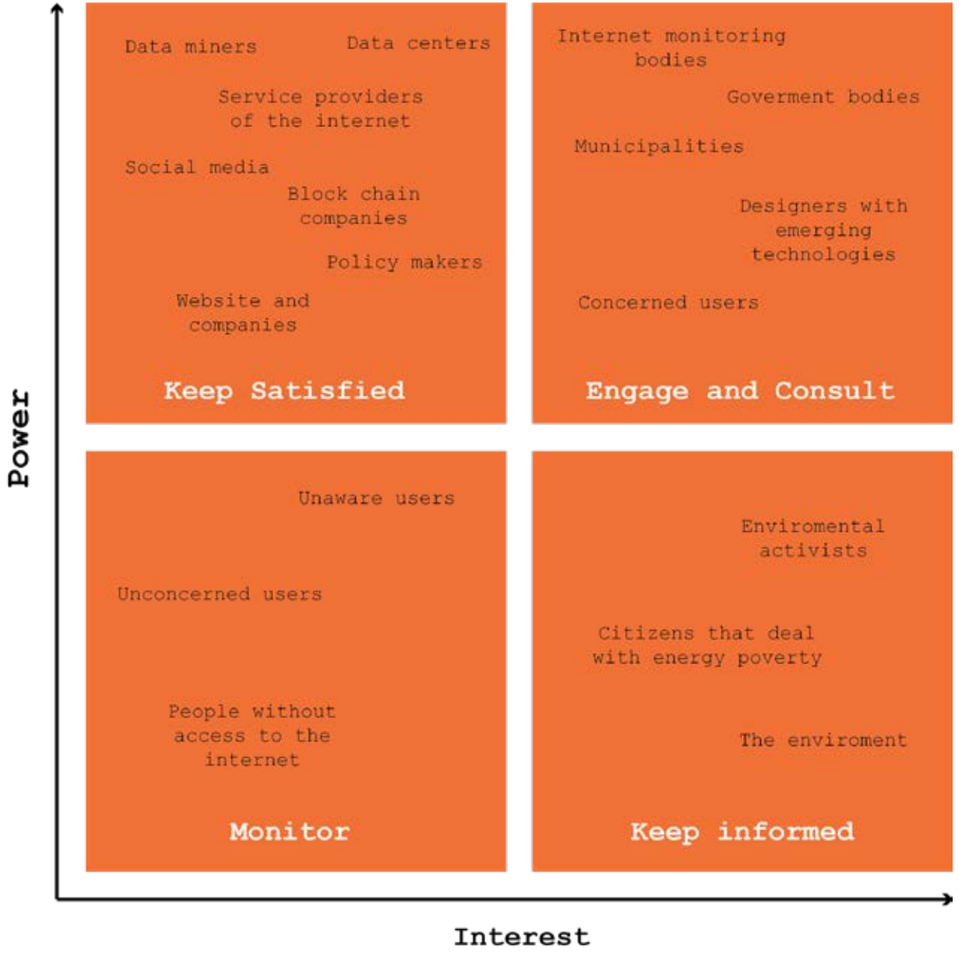
Context

The total amount of digital data is growing exponentially, and at some point in the near future, the worldwide amount of digital data will hit Quetta bytes. While updating the number system for a digital future is good, it emphasises how we see the internet as an unlimited resource. We just come up with a new number and go on with our everyday business.

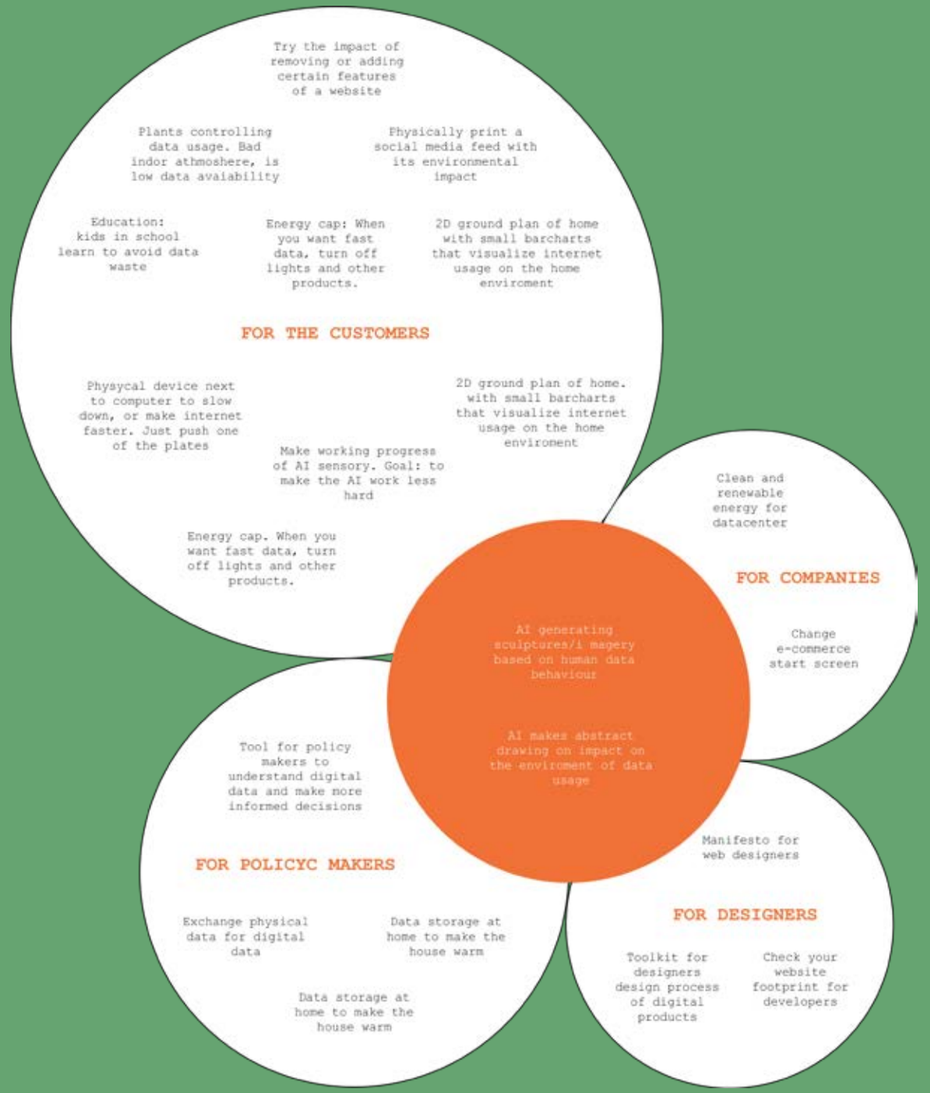
The Internet and digital devices are increasingly embedded in our everyday lives. From watching a Netflix movie, to interacting socially, controlling IoT homes, to the Cloud infrastructure that keeps our data safe and computes in the background as we drive our cars. The hidden environmental impacts of this infrastructure are substantial and quietly growing at an increasing rate (Widdicks & Pargman, 2019).

Design Process Project

Who’s interested and where could we go?



Stakeholder Matrix

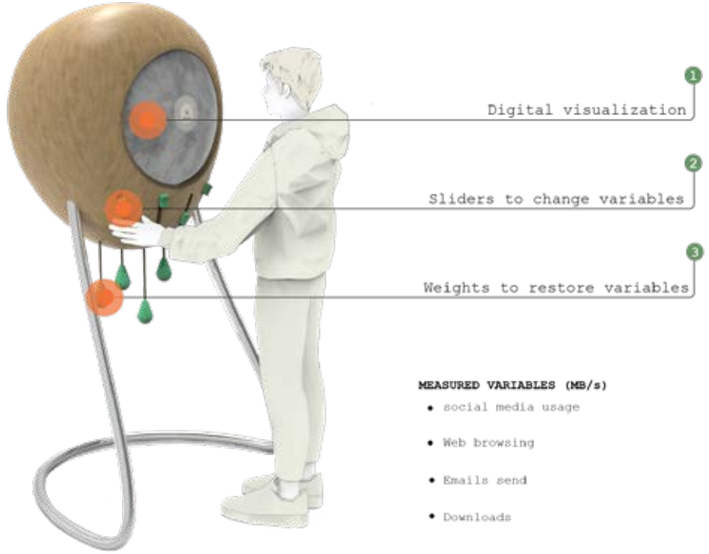


Exploring Design Directions

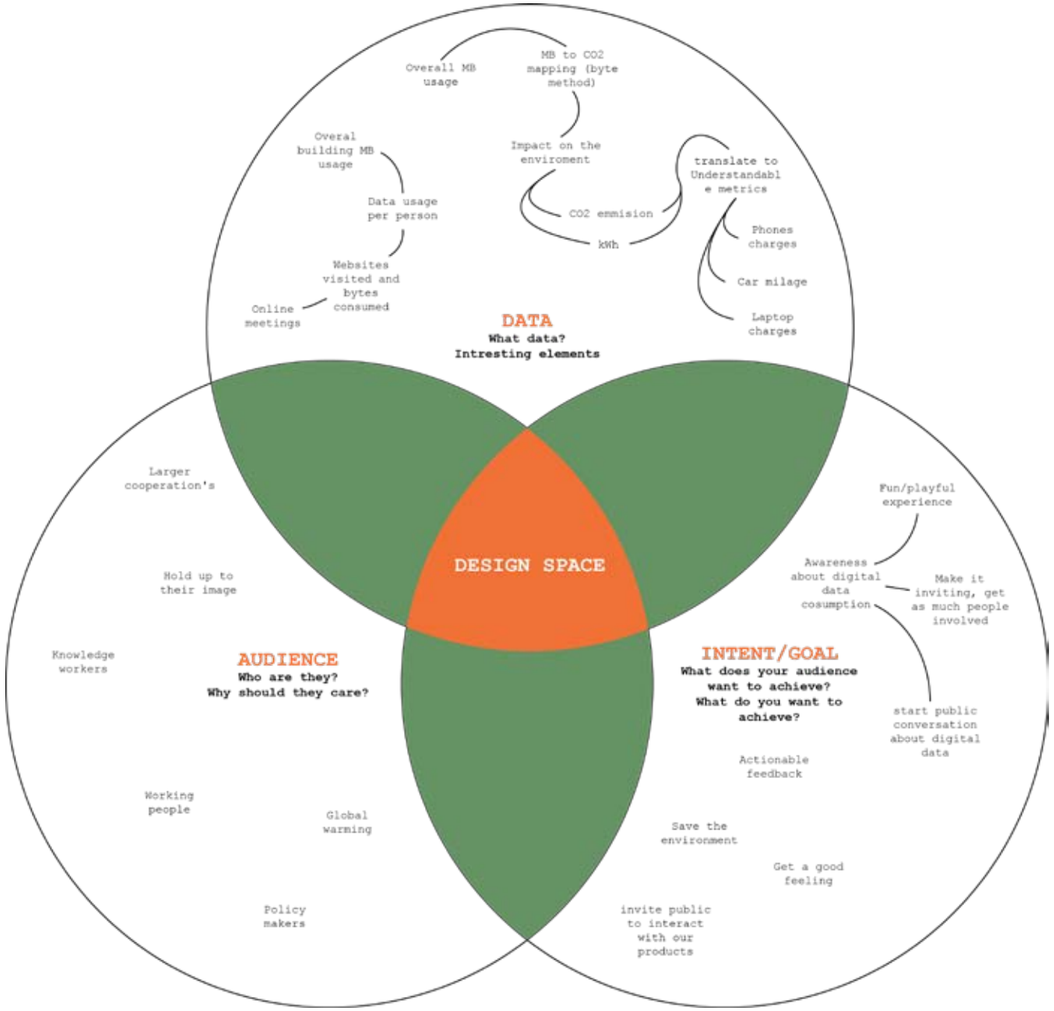
What direction did we go?

After exploring our design space, we first decided to create a public installation that allows users to explore the impact of the Internet on the environment, and stimulates users to change their internet behaviour.

But later on, **we decided to create an exhibition with more information and multiple artefacts** instead of only one installation. This allows us to explore more directions within our chosen context.



Our First Design

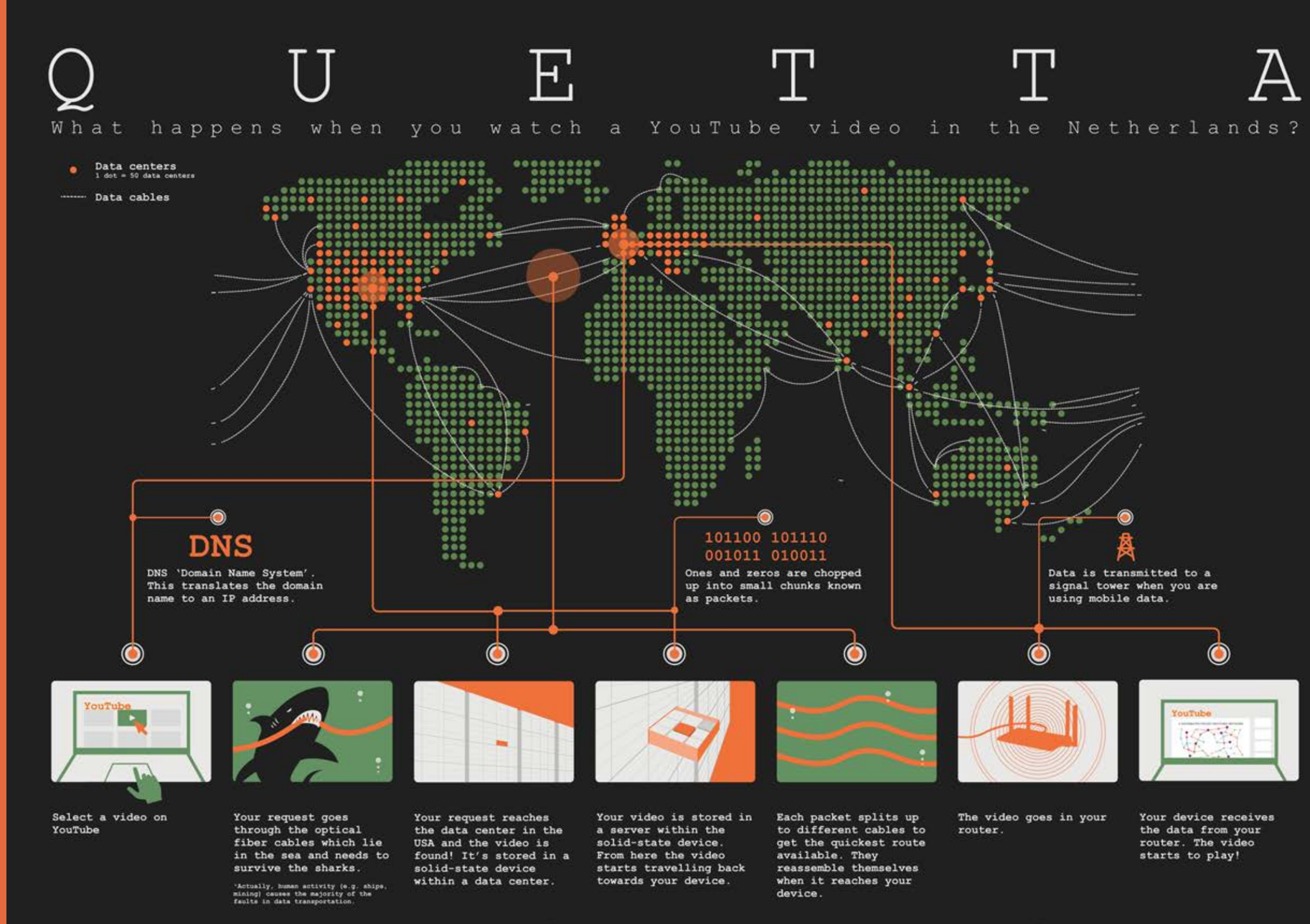


Our Design Space

Making the Poster

We decided to make an exhibition with a poster and two artefacts, we divided the tasks. I worked on the Poster and the Wi-Finder artefact.

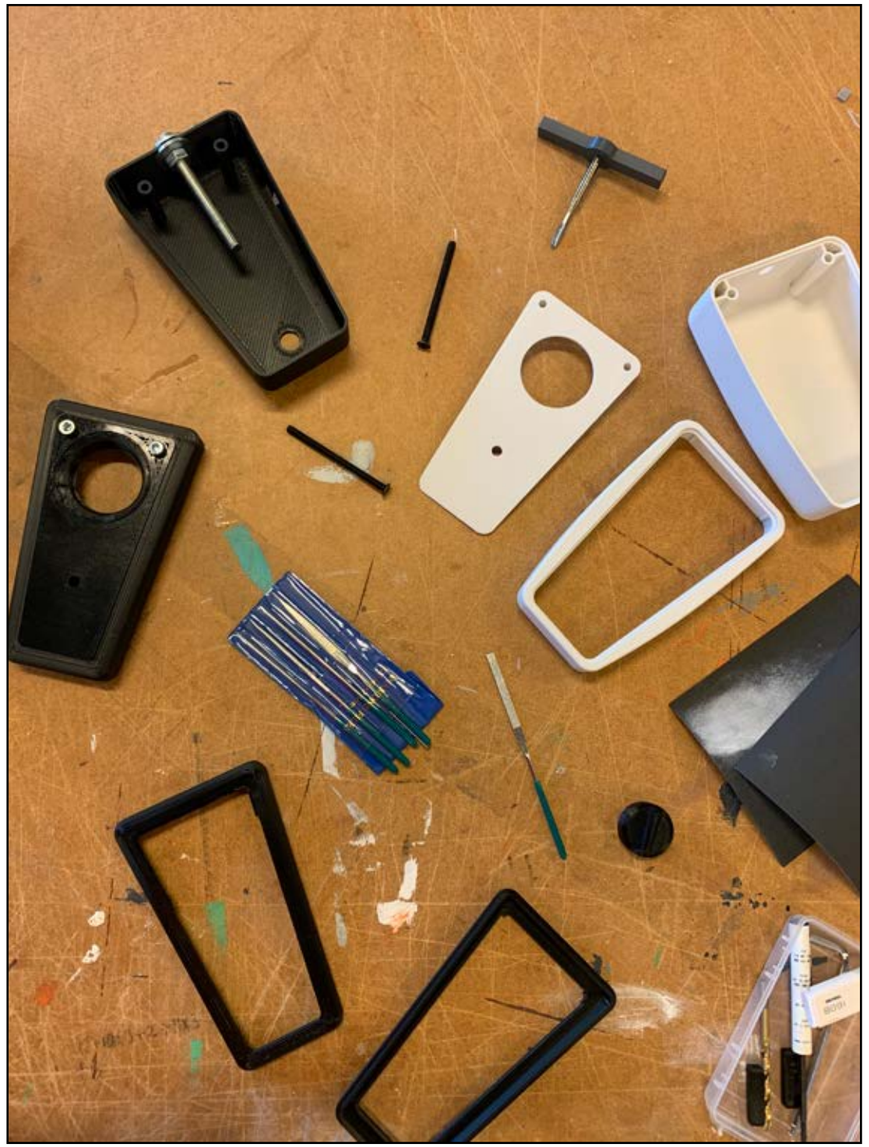
To give people a better view of the physical infrastructure of the data. I and one other group member designed a poster that showed how the data travels around the world. With the poster, I first did research on how data centres exactly operate and where they are placed and distributed around the world. Next, I created a visual representation of the data centre distribution and connections. One of my teammates created a storyboard of how the data travels from the data centres worldwide to our homes.



Developing the WiFinder

To gain more awareness among people of how much data is actually around them. A WiFinder device was created. It was my task to design, develop, and assemble the casing and the other parts of the final version of the WiFinder.

First, I made a design in Fusion 360. After discussing the form and look with the others, I ensured that all electronics would fit into the casing. After that, I optimized the parts of the WiFinder to be sure that they could be made with 3D printing. Lastly, to make the WiFinder fit in with the rest of the aesthetics of the exhibition, I painted the WiFinder in the right colours after sanding it. One of my teammates made the circuit and electronics for the WiFinder.



The WiFinder

As people are able to detect radiation with a radiation-detector. We wanted to create a similar experience with this device. The WiFinder allows people to explore the local Wi-Fi strength. We decided to make a handheld variant so that the interaction threshold would not be too high and intense for people to interact with it.

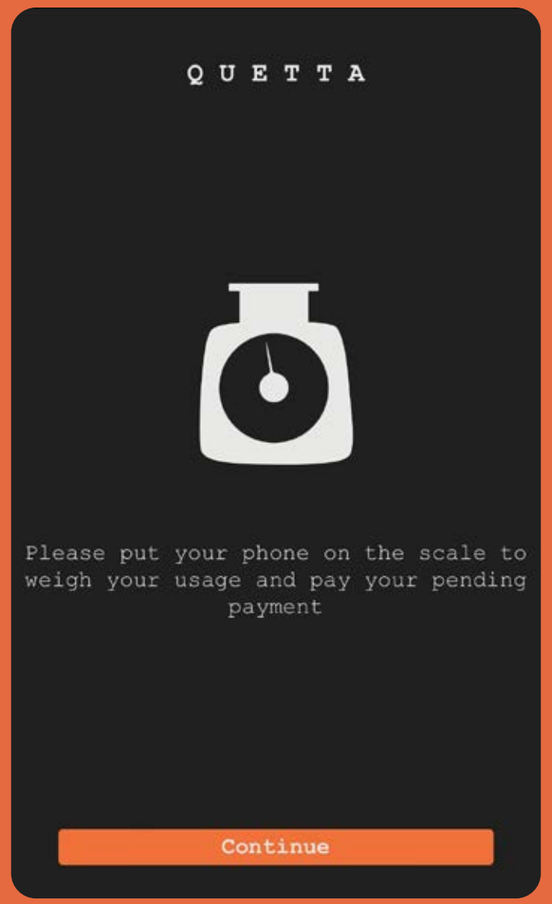
We also thought it was important that our visitors could explore the area with the device, so that they got the feeling that they were looking for something. By letting people move around, we wanted to create engagement and interaction between other people to increase awareness about the local presence of data.

Artefact: ‘Shop your Data’

In the meantime, the other teammates in my group were mainly working on another artefact for our exhibition, “Shop your Data.”

This artefact was developed to give our visitors a more personalized experience with their own data. A scale, a thermal printer and a website were combined in this third design. The website is an ‘online data shop’ where people can buy their internet behaviour. Visitors could first scan the QR code to go to the ‘online data shop’, where they could purchase their data for the next day. After their purchase, they could place their phone on the scale to receive the receipt for their “bought” data.

The Second Artefact



Welcome Message

Data Shop

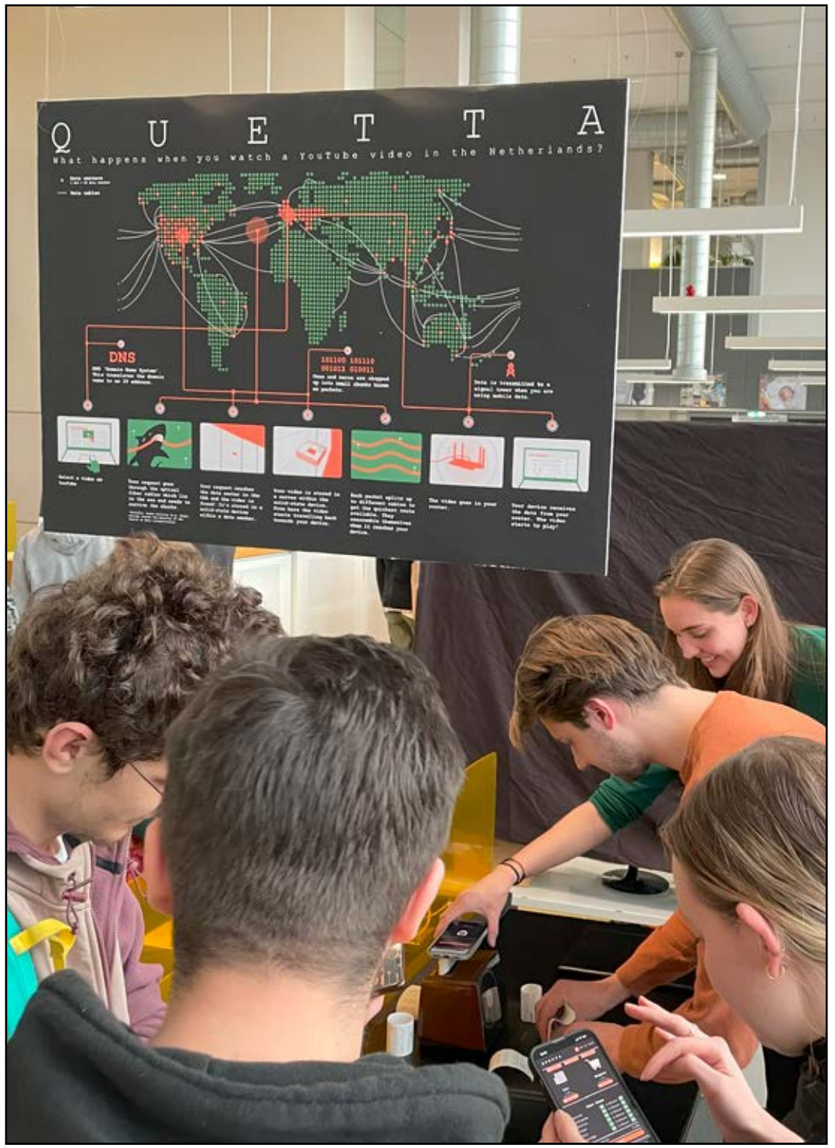
The Exhibition

Over 100 people in total visited and experienced the exhibition. The audience that visited Quetta were mostly design students, design professionals or relatives of the design students. This resulted in a rich collection of different interactions and discussions. After the exhibition, the project was displayed again in the Green Room of the TU/e, a hub for innovative projects focused on sustainability. After being displayed at the Go Green Office, the project also got a permanent place at the TU/e Industrial Design project hall.

Displayed at:

Green Office TU/e Eindhoven University of Technology

TU/e ID



03 Needle Injection Tool

Type: Graduation Project (Bachelor) & Research Project (Master)

Duration: 36 weeks (Development + Research)

Individual

Used Programs / Skills:

Project Brief

Develop a device that can assist healthcare professionals while inserting a needle into the patient's vein.

Context

A large amount of healthcare professionals have trouble injecting a needle in the vein of the patient. With around 80% of the patients, finding the veins and inserting the needle is not hard. But for the other 20%, it is a very unpleasant experience, because healthcare professionals can not find their veins or miss the vein with the needle.

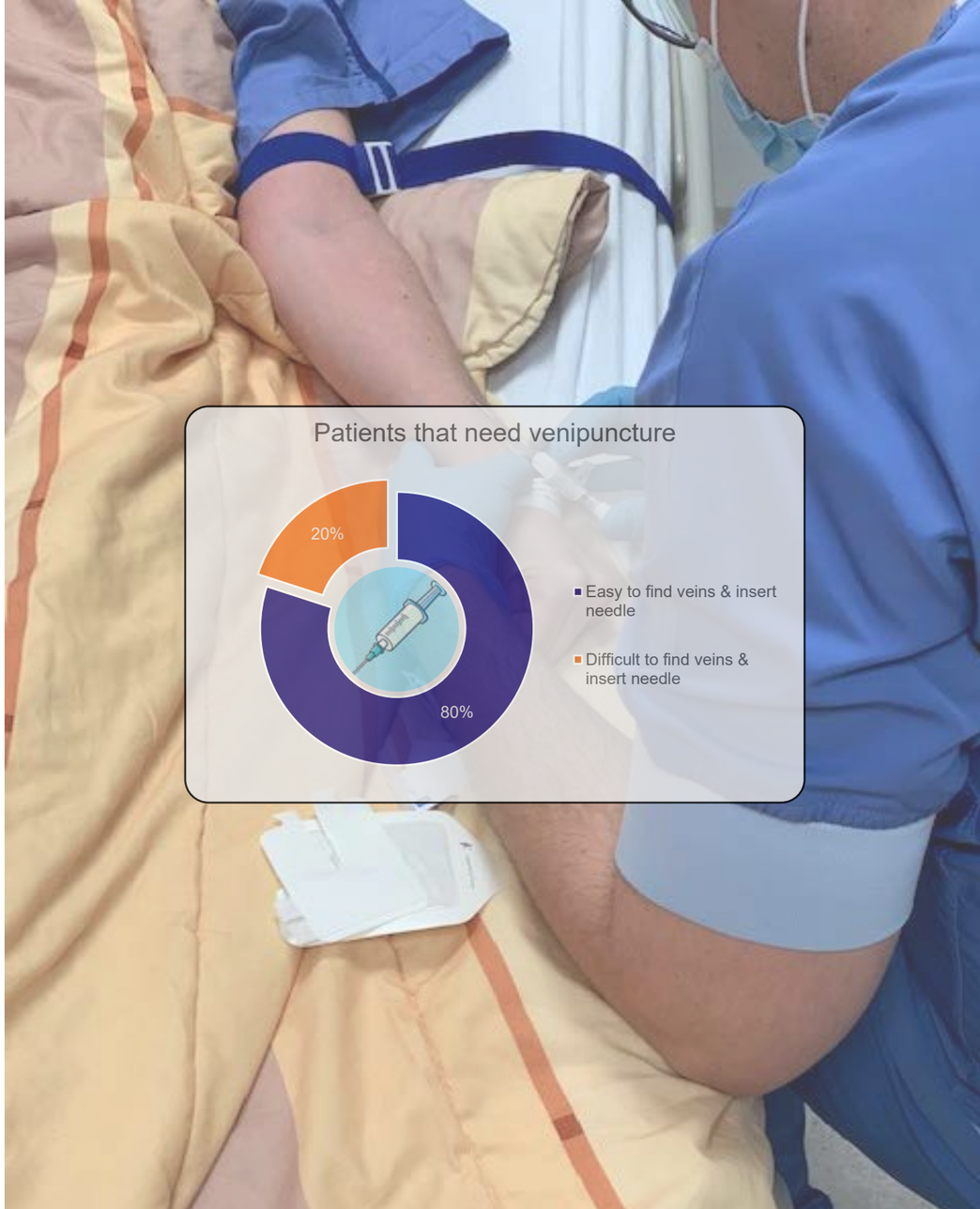
The project goal was to develop a functional model that can make the veins more visual for healthcare professionals and can be verified and tested together with the stakeholders on other desired functions.

In addition, research was conducted later on, on whether the device could increase the user experience for healthcare professionals.

In collaboration with:

ENDOSS MEDICAL

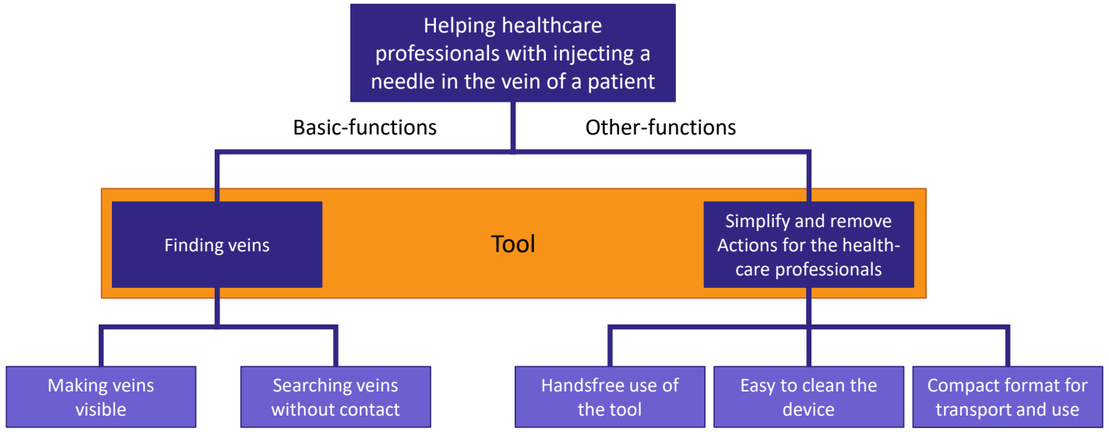
AmphiA



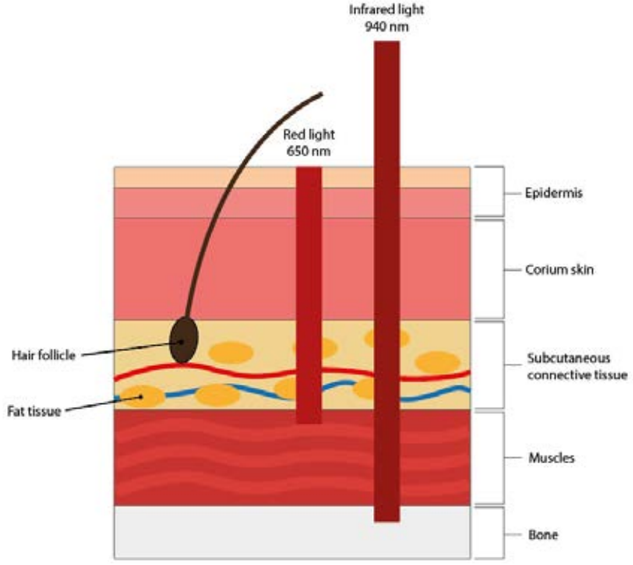
Research

Both desk and field research were conducted. Interviews and observations were conducted at the hospital. During these events, it became clear that the main problem is that the veins are not visible enough by some patients. Some reasons could be being overweight, or side effects of treatments which have an impact on the visibility of the veins.

The desk and field research resulted in design criteria and a design direction to continue with namely, infrared light.



Design Criteria



Design Direction

Ideation

Chosen idea main feature

The main idea consists of the following working principle:

The infrared light-emitting diodes create a contrast between the veins and the skin through the absorption of light by the veins and the reflection of light by the skin.

The near-infrared pass filter filters the visual light spectrum to display the contrast between the veins and the skin. The infrared camera records the contrast of the infrared light-emitting diodes and the minicomputer processes the images from the camera to display the location of the veins on the screen.

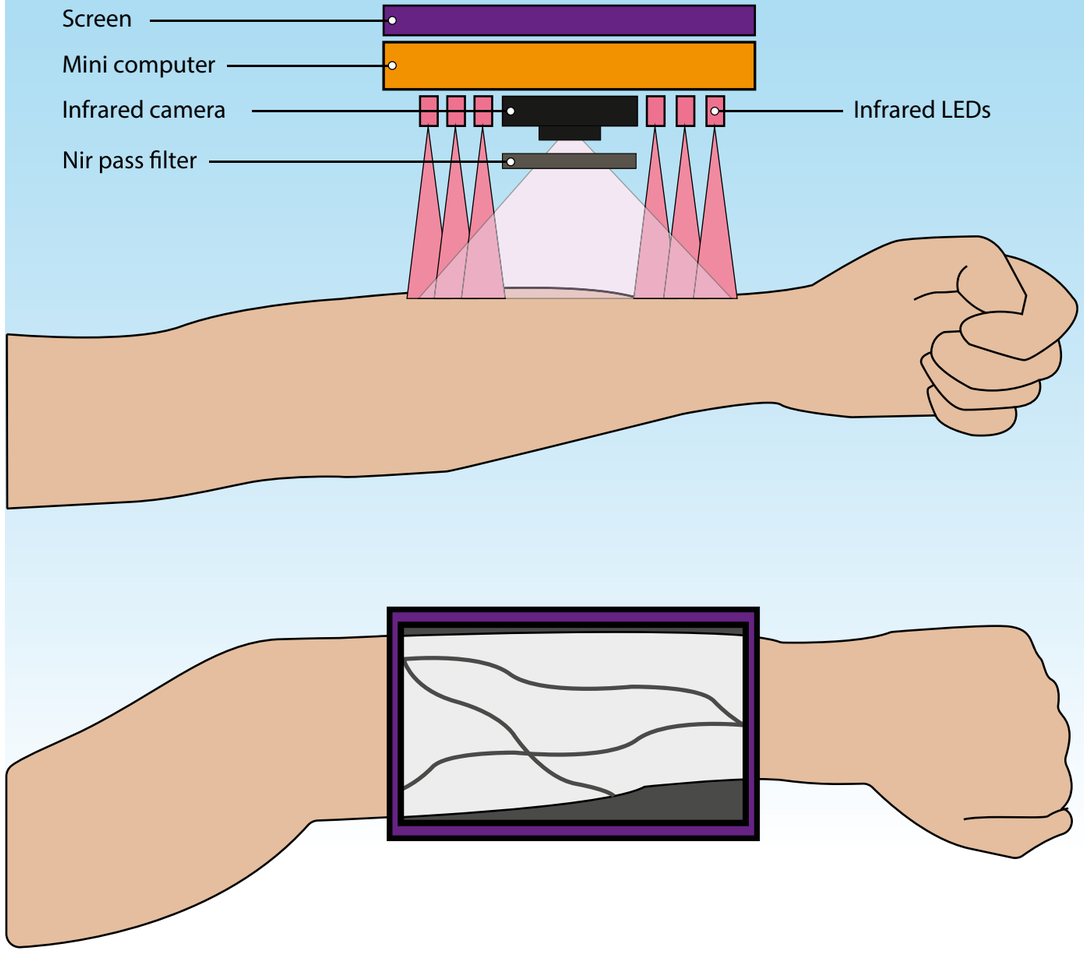
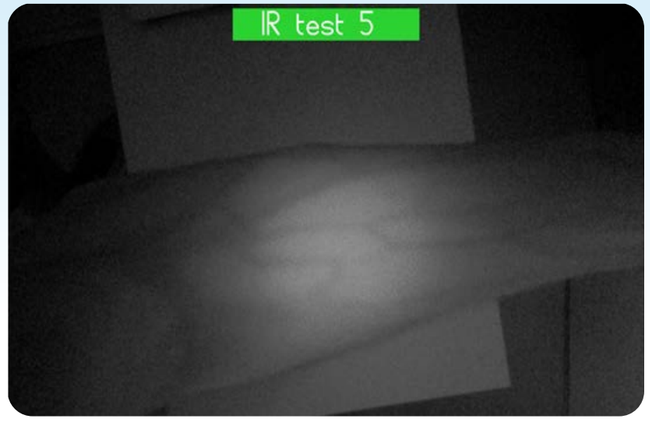


Illustration of working principle

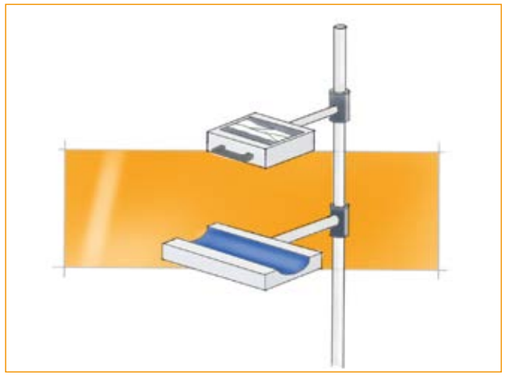


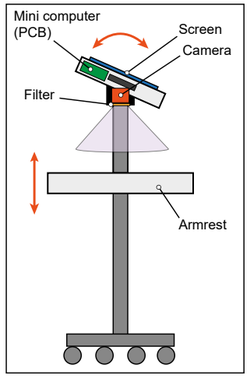
Testing the working principle

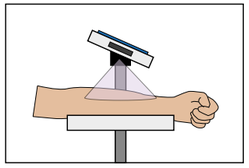
Concepts

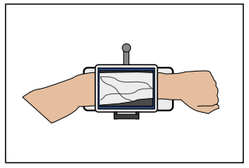
Generation & choice

Different concepts were generated with a focus on various features. The main function remained the same, but the side features of the concepts were all different. During the concept presentation, it was decided to choose each concept's best feature(s) and combine them for the final model.





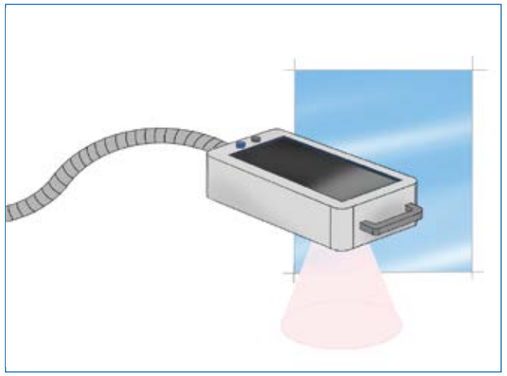


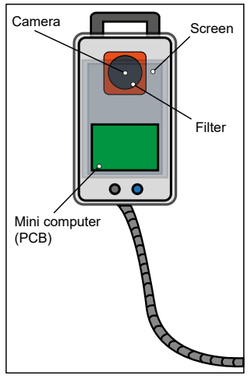


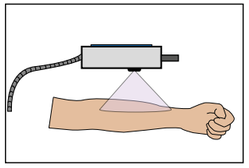
Most important features:

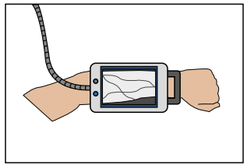
- Arm patient always well supported.
- Tool stands on its own.
- Easy to set up.

Concept 1





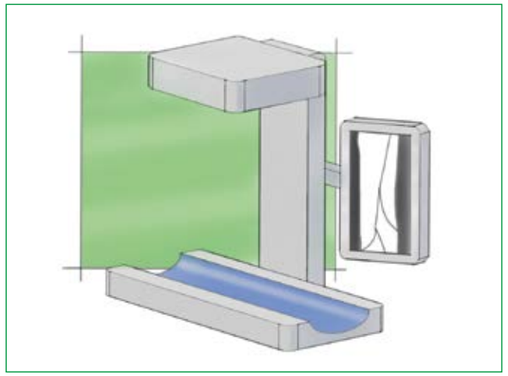


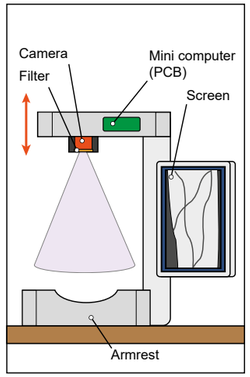


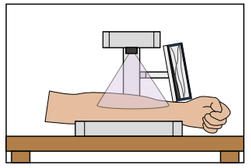
Most important features:

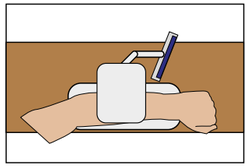
- 360 degree flexible arm.
- Rotatable camera.
- No contact with the patient.
- Tool is easy to carry.

Concept 2







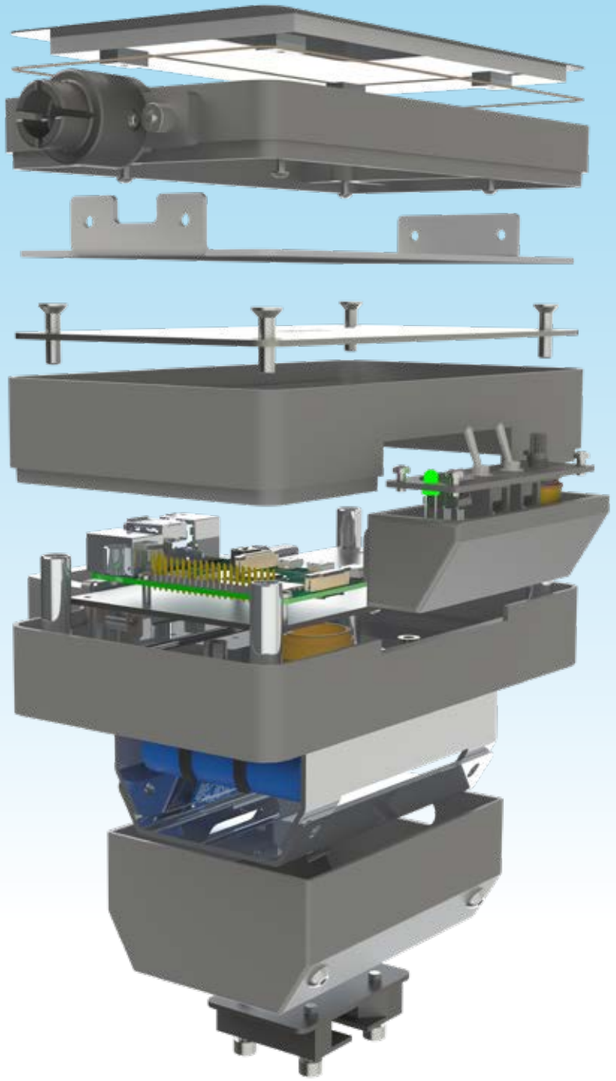


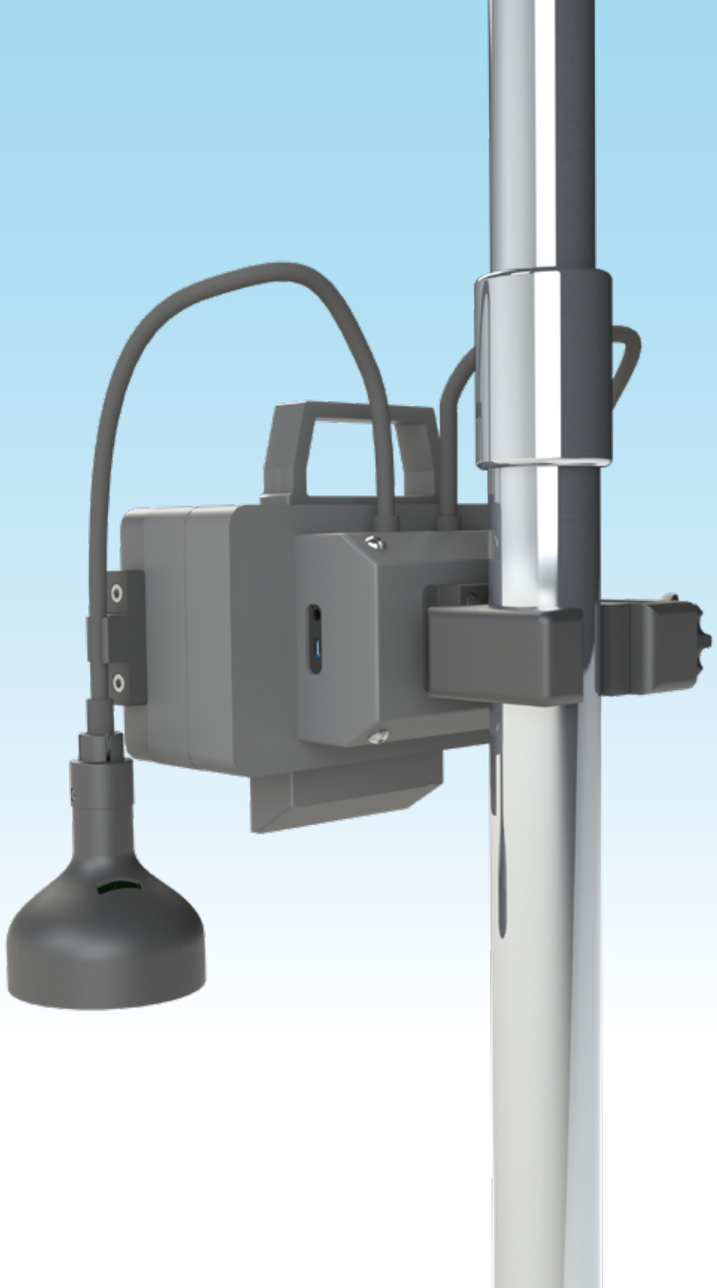
Most important features:

- Arm patient always well supported.
- Tool stays stable when in use.
- Screen and camera can be set separately.

Concept 3

3D CAD Model

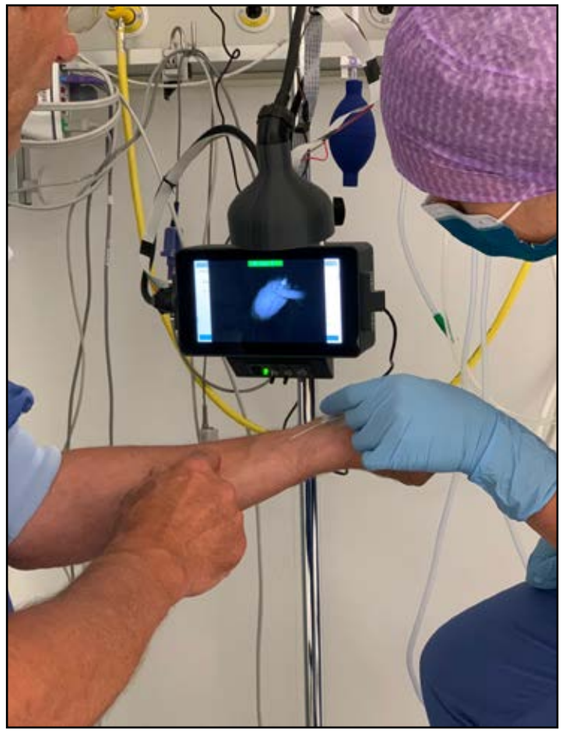




Functional Model

Testing main and side features

A functional model was made to verify the main and side features of the device. The device was tested by healthcare professionals at the hospital. The functional model met all the requirements and the stakeholders were blown away by the results.



User Experience Research

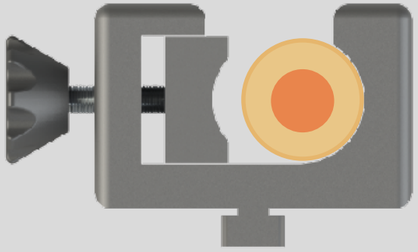
Research on User Experience

After a working functional model was developed, research was done among healthcare professionals regarding the user experience.

Phenomenological research was conducted with a group of healthcare professionals using a between-subject design approach. The healthcare professionals were randomly assigned into two different groups.

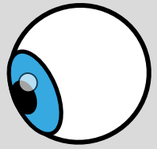
Observations were done to be able to write down comments that were made during the procedures. In addition, a Two-sided T-Test was conducted to record the time it took to find the appropriate vein. At the end of the observations, both groups filled in a user experience questionnaire and were interviewed individually.

Two flexible arms



Clamp for 15 to 40 mm

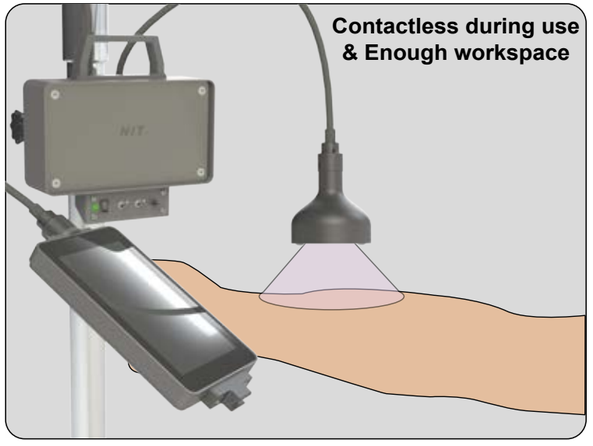
Battery for long use

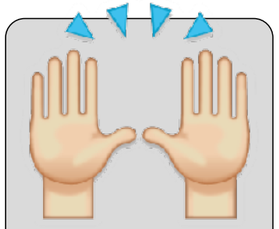


Always the right viewing direction

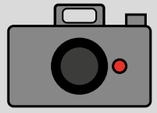
resistant

IP65 Resistance





Handsfree use



Make photos & video's

04 Paradox

Type: Course Assignment (Master)

Duration: 8 weeks

Groupsize: 3 people

Used Programs / Skills:

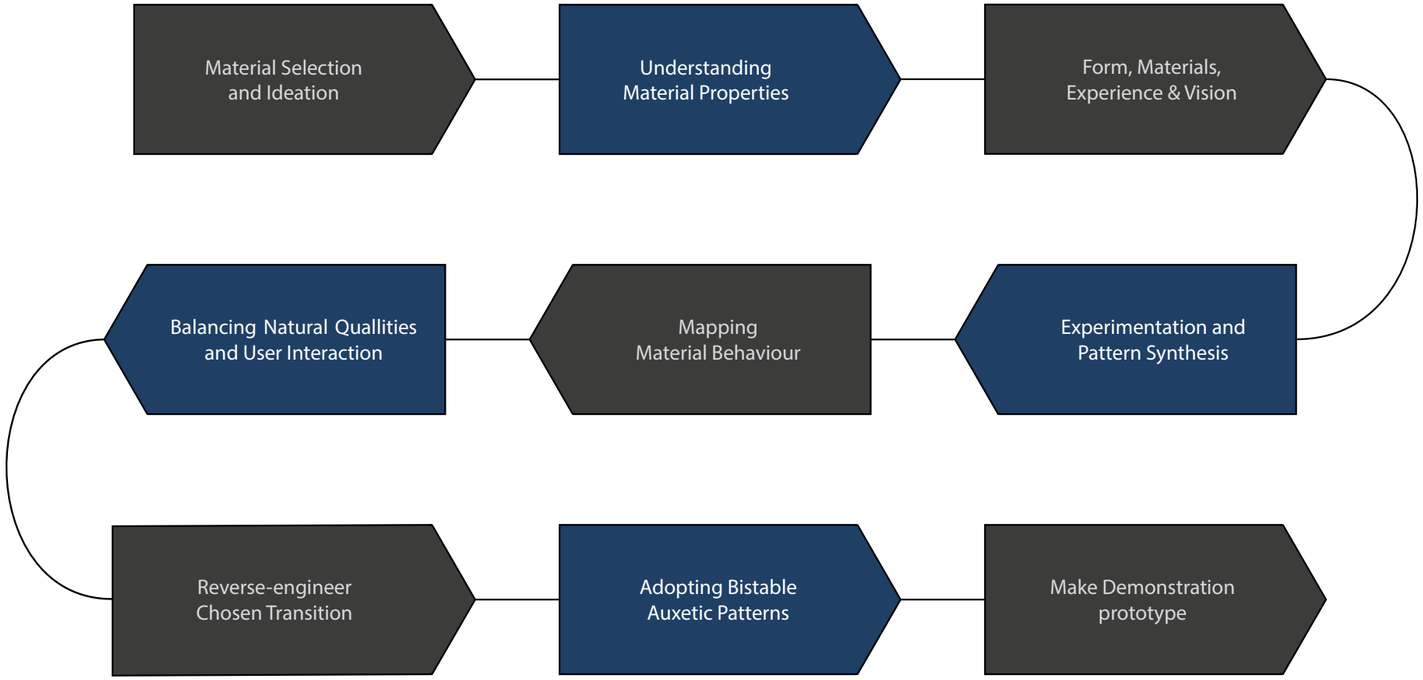
Research Topic

What interaction and experience is possible through the expansion and contraction of a (bistable auxetic) material which acts more vivid and unpredictable?

Context:

The goal of this explorative design process was to explore the possibilities of creating a new level of interaction between the user and the material. This was done by using a Bistable Auxetic material which is relatively new (Chen et al., 2021) and which has not been explored in much depth yet regarding interaction.

The aim was to create an object that uses the qualities of the Bistable Auxetic material (unpredictability & delay in contraction) in combination with electronic actuators and multiple vivid states to create an interactive experience and interplay between the object and the user.



Explorative Design Process

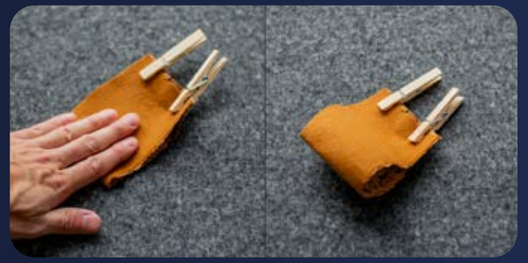
Material Exploration

During this course, various material explorations were conducted using a research-through-design process.

The first exploration revolved around the orientation of the aesthetic qualities of a wide variety of (a combination of) natural materials. The focus was on the perception, structure, and feeling of the materials. The idea of this exploration was to stay close to the source of the material characteristics.

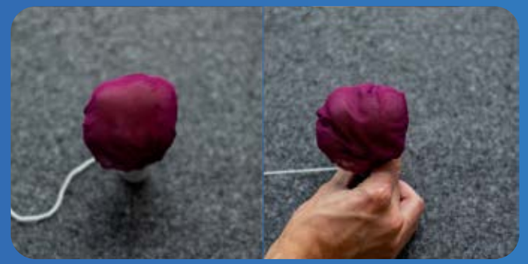
Material exploration round 1

Perception, Structure, Feeling

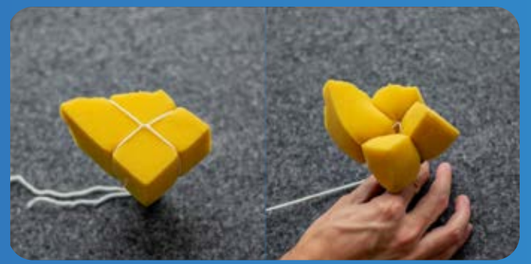


During this second exploration, the focus was mainly on the expansion and contraction properties of different materials.

The exploration resulted in a lot of insights about the certain qualities of the materials. The interesting qualities that we perceived were the expansion and contraction abilities of some of the materials (e.g. wool and sponge). Therefore, the next exploration will focus on the transition of the expanding and contracting qualities of different materials by looking at the density, structure, flexibility, and strength of the materials.



Material exploration round 2

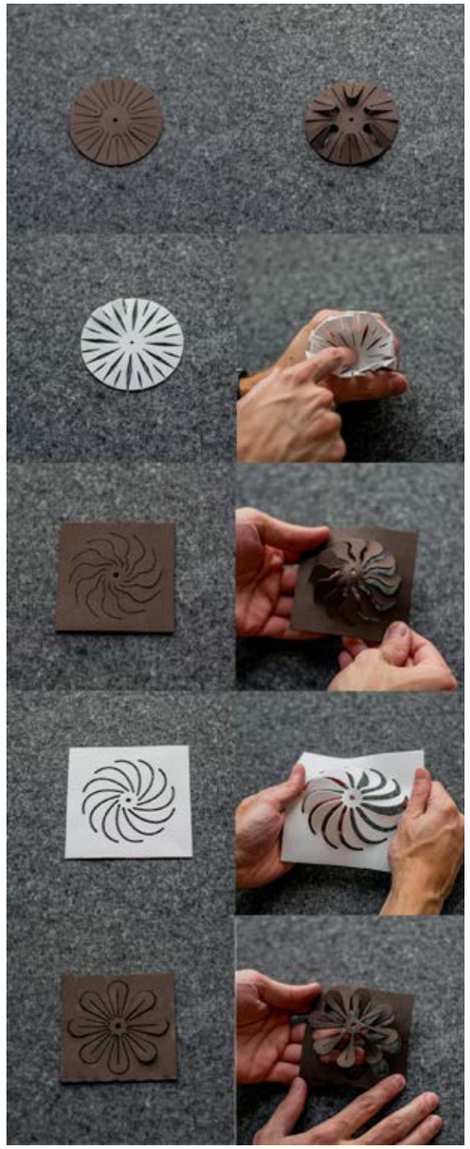


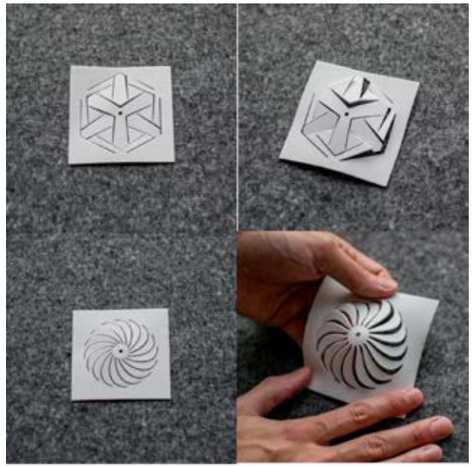
Expansion - Contraction

Material Exploration

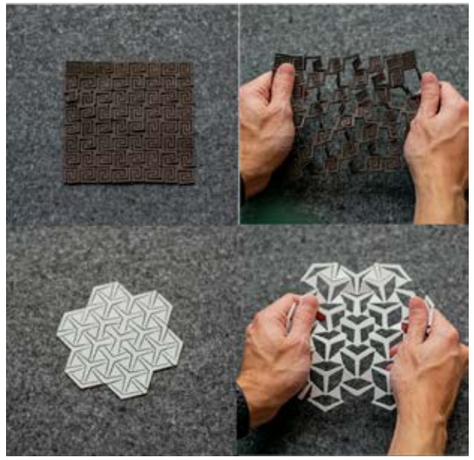
During the third exploration, a polyurethane foam was chosen as the main material to continue with as it has the possibility for a lot of modification and it has the expanding and contracting possibilities.

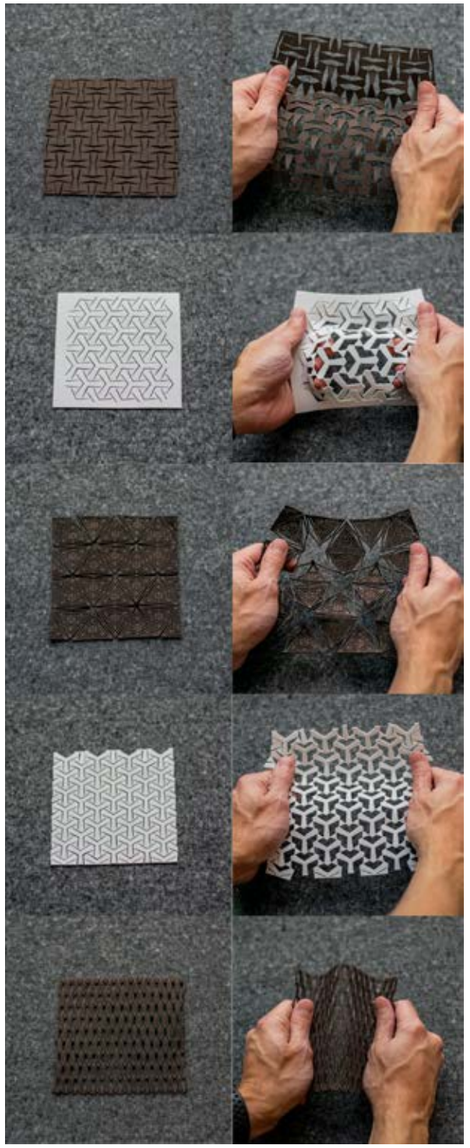
With this exploration, we concluded that the polyurethane foam has the strength and flexible characteristics we were looking for. We explored further by modifying the material's structure, pattern, and cutting lines to see how we could manipulate the material even further.





Various patterns were created and tested by laser-cutting polyurethane foam to investigate its expansion and contraction properties.





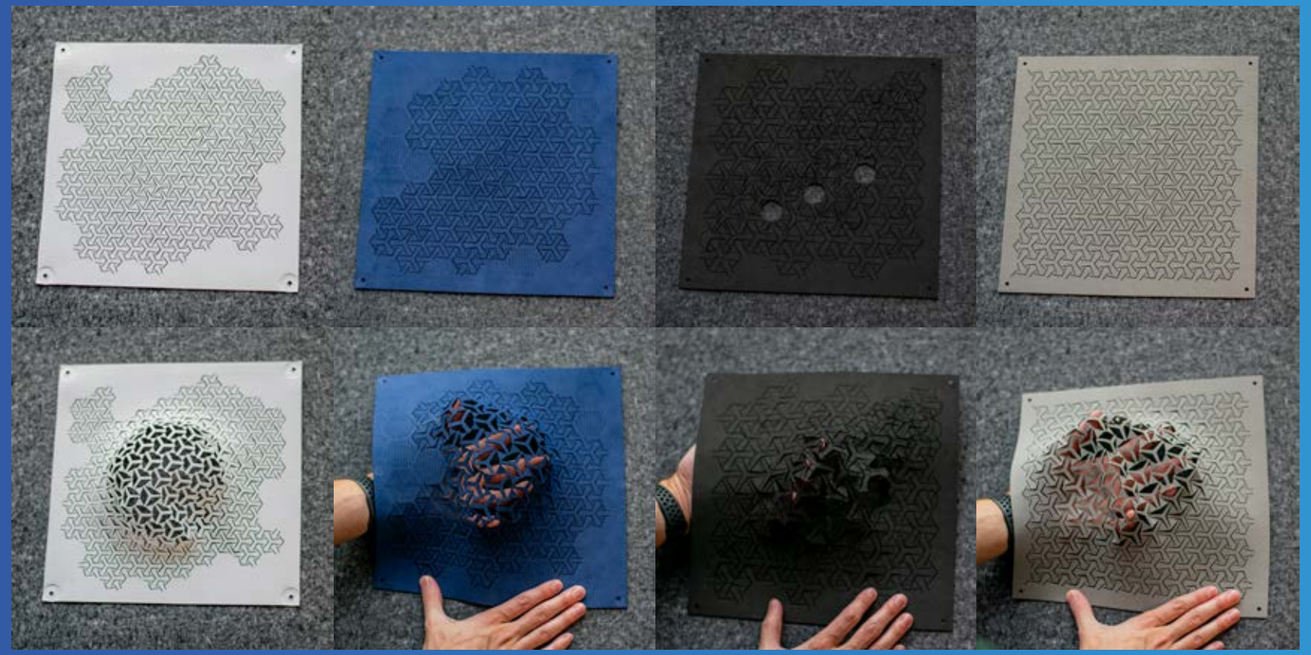
Material Experience Design

Material Analysis

With the chosen material, we focused on using its subtle qualities to achieve a new kind of novel interaction and experience concerning the expansion and contraction transition. The foam was chosen due to its tactile qualities like its softness to create a pleasant experience and its modification abilities to combine with the Bistable auxetic structure (Rafsanjani & Pasini, 2016). The material would delay the contracting phase during the transition, while the expanding abilities, on the other hand, were smooth and fast. This could be regulated by modifying the structure of the material. As can be seen, the thinnest structure with a randomized pattern would have a long delay which was desired.

Interaction and Behaviour

It was decided to use three different states for the behaviour of the material. They were called Passive, Active and Hide. Passive mode is activated when no one is around. The material will move up slowly and shaking to attract people's attention. When people get closer, the material switches to active mode and moves faster to create a 'material path' that remains expanded for a few seconds. This is to create an inviting surface to interact with. When people interact with the material, the material stops moving, which is the Hide mode. The material will not move until people move away from the material.



Modifications with final material

1 Passive mode
Nobody interacting

2 Active mode
People approaching

3 Hide mode
People interacting

4 Active mode
People leaving

5 Passive mode
Nobody nearby

Final Demonstration Models

Prototype
The final demonstrator can communicate by sensing the user’s appearance. The material is pushed upwards in a circular motion, giving the material a mysterious and lively character. The model has several modes in which it communicates with the user. Because the material has a delay in contraction, the user can feel and play with the material.

05 Balanced Coffee

Type: Design Project (Bachelor)

Duration: 16 weeks

Individual

Used Programs / Skills:

Project Brief

Design and develop a product that makes an impact on the user or the environment.

Context

Siphon-type coffee machines are rarely used these days, mainly due to their inconvenience and lack of customization during the brewing process.

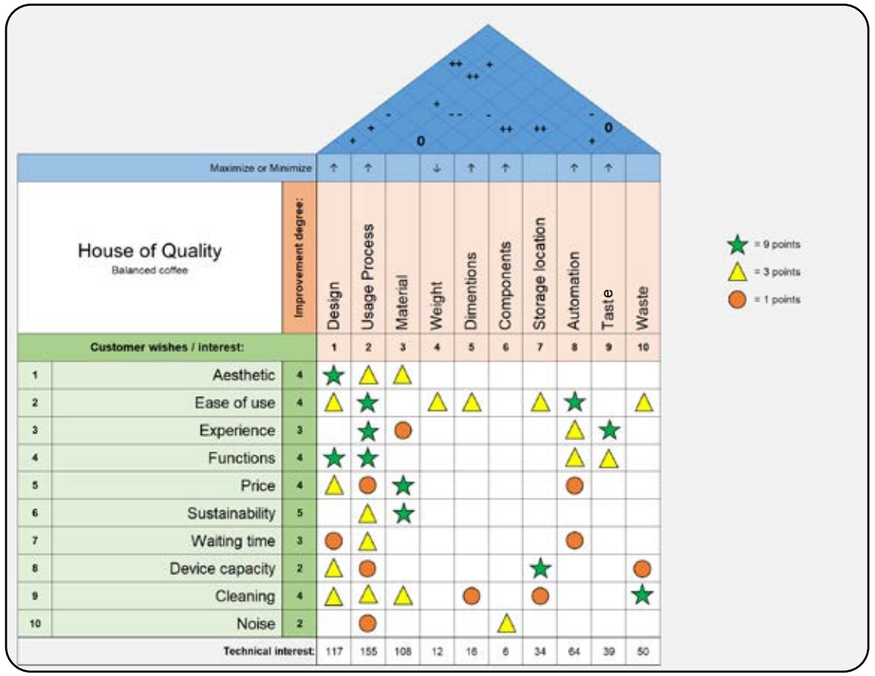
This project aimed to improve the coffee brewing experience and the design of the Siphon coffee machine. The purpose of the redesign was to modernize the machine's working principle and to make it a more efficient and pleasant experience to use. In addition, an important aspect of the project was to have a positive impact on the environment.

'Old fashioned' Syphon coffee brewer

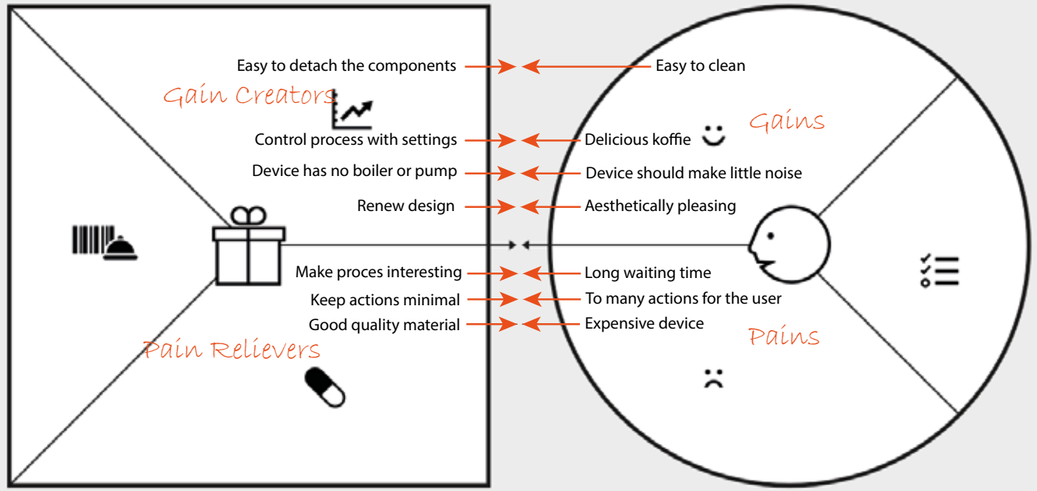
Research

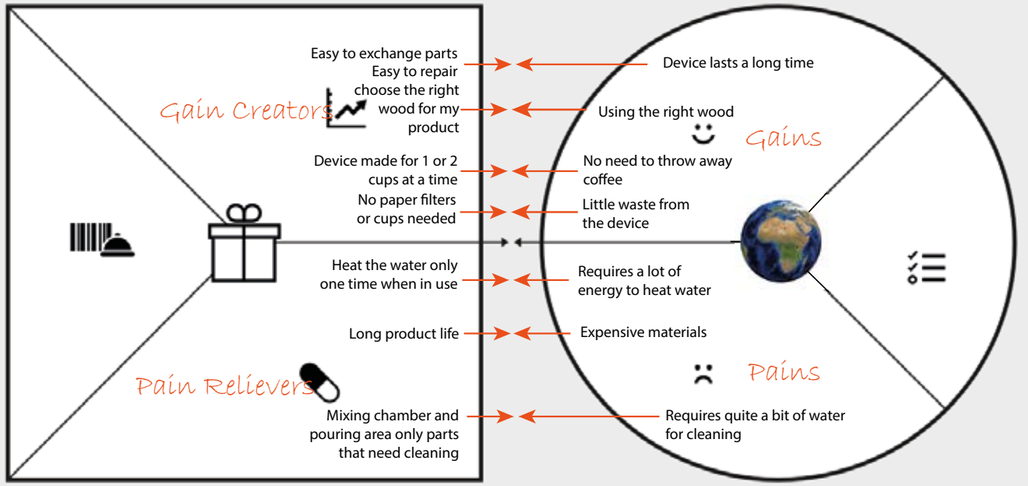
Most Important Criteria and Impact

Research was done by sending out surveys and visiting coffee shops. The results were processed in a matrix. By putting the data in a House of Quality matrix, customer wishes became clearer. This has led to the focus of this project being on the process and the result of coffee brewing, and the design / materials of the brewer.



Wishes customer in comparison with design criteria





Ideation

Once the main goals were defined during the research phase, an ideation session was started to explore the coffeemaker's possible appearance, form, and functions. After creating a mood board, product functionalities were thought out, written down and worked out. This led to a wide variety of options to choose from.

Concepts

Generating Concepts

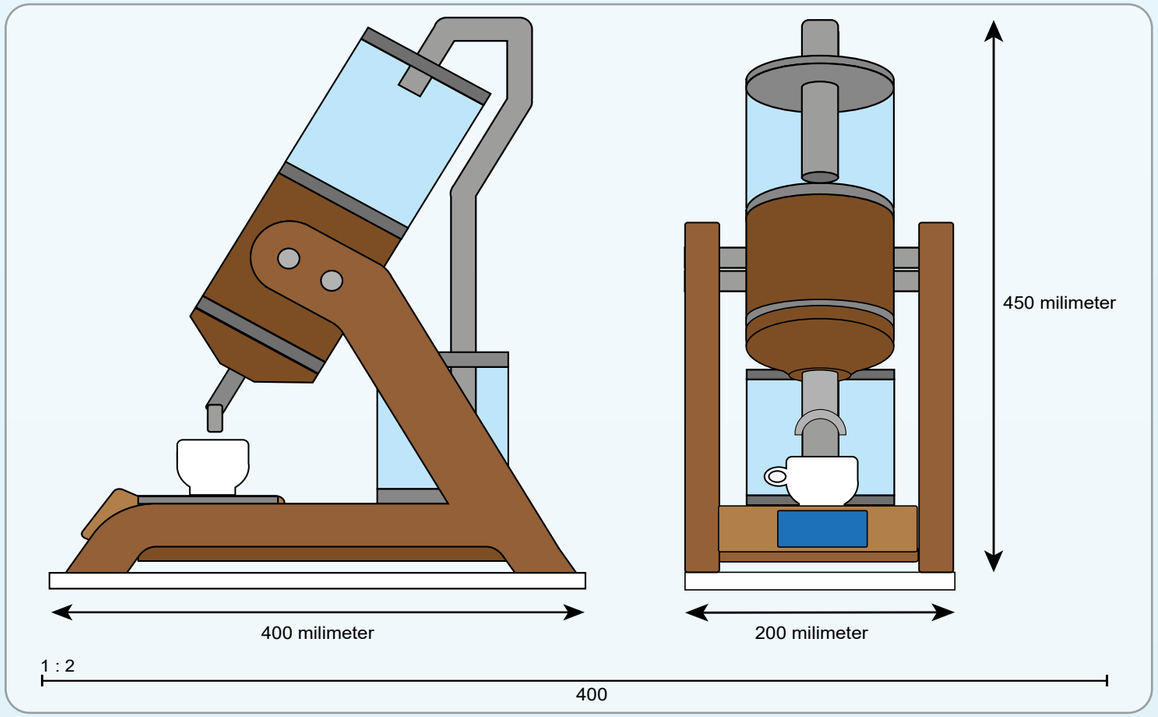
The concepts were generated by focusing on the different design criteria from the research phase. The concept exploration resulted in three different concepts. All concepts were compared on the success criteria and it could be concluded that Concept 3 was the best option according to its functions. Still, the aesthetics of Concept 1 were also added to the final design.

Concept 1

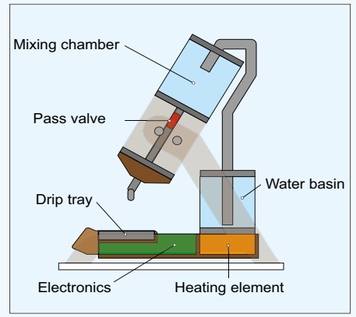
Concept 2

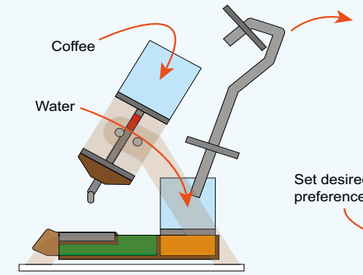
Concept 3

Final Design

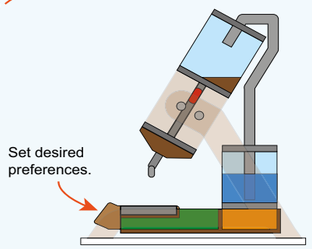


Final Design and Ratio

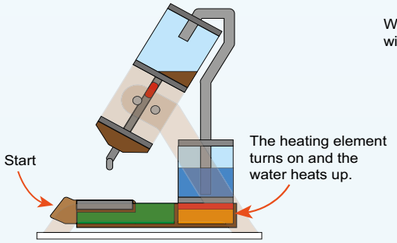




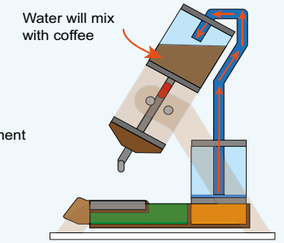
1. Remove the lid and put the water into the basin and the grinded coffee into the mixing chamber.



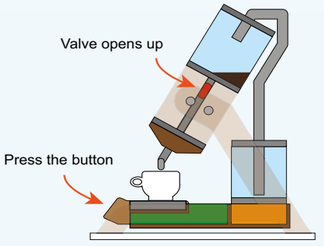
2. Set the desired immersion time.



3. Press start.



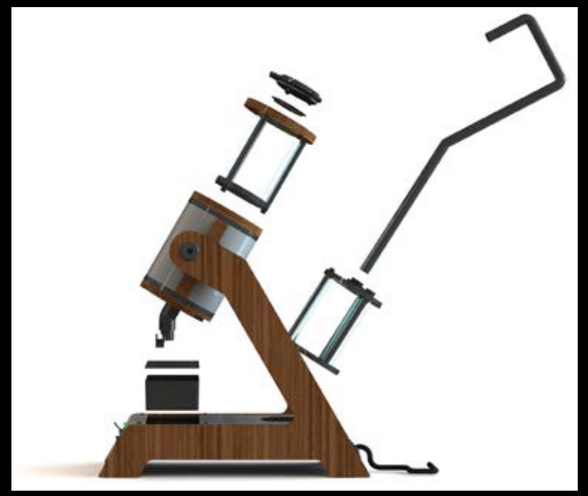
4. When the water is hot enough, the water moves from the basin into the mixing chamber.

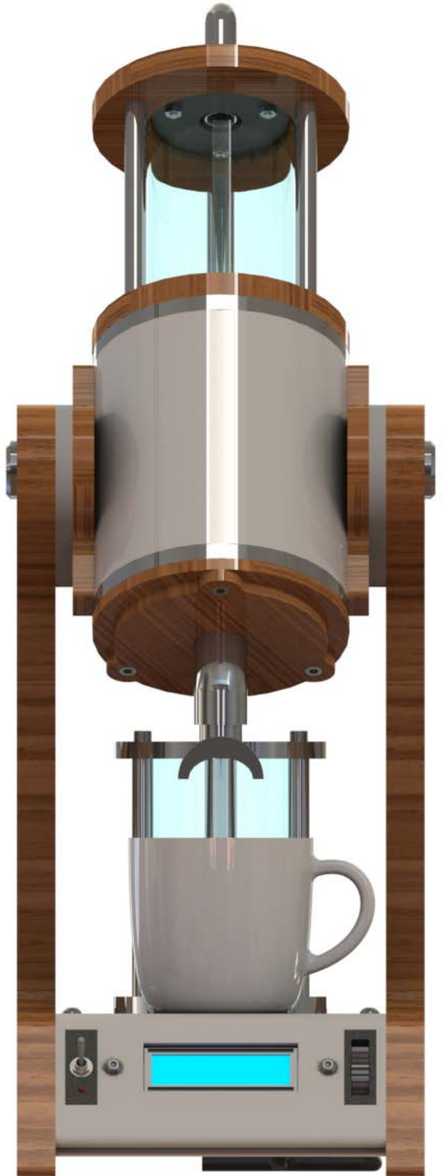


5. When the desired mixing time is reached. Press the button and the coffee pours out.

Working Principle of the Machine

3D CAD Model





Prototype

Several production methods were used to make a 1:1 demonstration model. All wooden parts were made using CNC milling. The more complex parts were made through 3D printing. All the plate parts were created by laser cutting sheets and bending them at the right angle.

06 My-Odine

Type: Graduation Project (Master)

Duration: 18 weeks

Individual

Used Programs / Skills:

Project Brief

How can people's iodine levels be tested more efficiently on location and how can additional data or external input help to increase awareness about the test results concerning iodine deficiency?

Context

Iodine is an essential element required for sufficient human growth and development (Kapil, 2007). Iodine deficiency occurs when the body does not receive enough iodine and is a global problem affecting an estimated 35- 45% of the population (Hatch-McChesney & Lieberman, 2022).

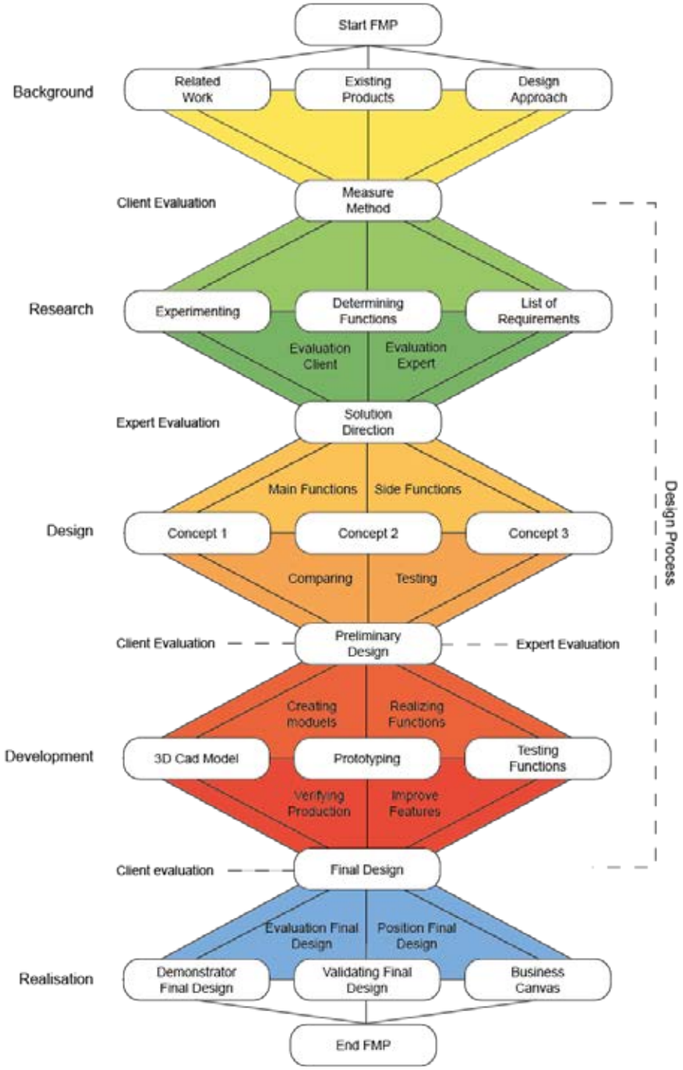
Iodine is important for the production of thyroid hormones. These hormones are necessary for the proper growth of the body and brain and the functionality of the nervous system. In addition, iodine regulates our overall metabolism (Healthdirect, 2023). We speak of (mild) iodine deficiency when an adult consumes less than 100 µgram iodine daily (Andersson et al., 2024). Iodine deficiency can lead to a slowerworking and swollen thyroid.

The main problem is measuring the iodine levels of people in the first place. It is currently challenging to measure or get an indication of people's iodine levels within a short period of time or at the place where they are treated.

In collaboration with:

máxima mc

Amsterdam UMC



Design Process Project

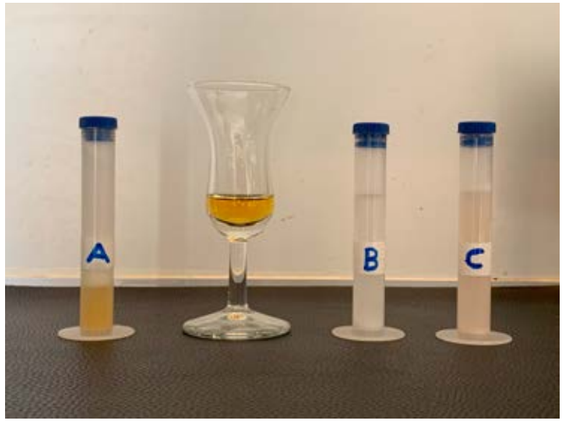
Research

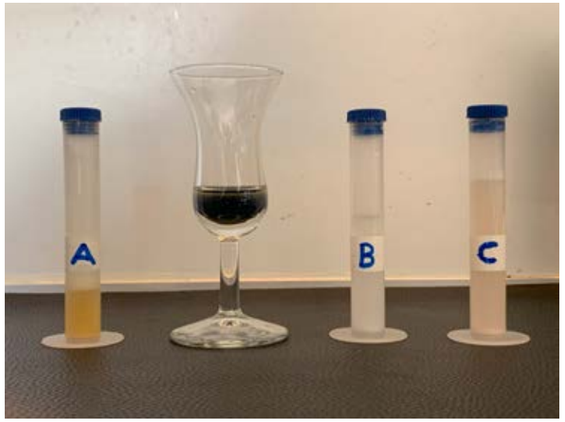
Research was conducted were existing iodine-measuring methods were investigated. In addition, two relevant existing iodine-measuring devices were selected to evaluate their working principle.

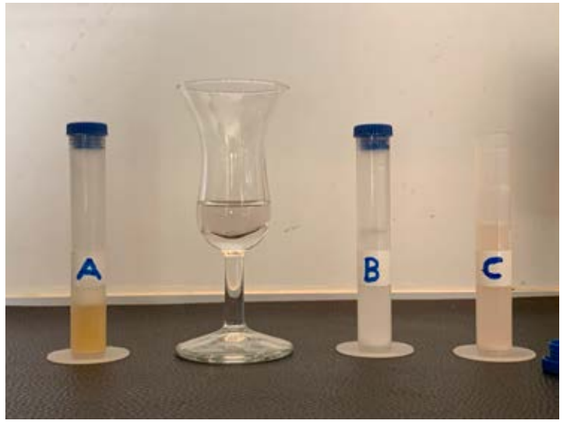
Through the analysis of the different measuring methods and existing devices, a better understanding of the existing solutions was achieved.

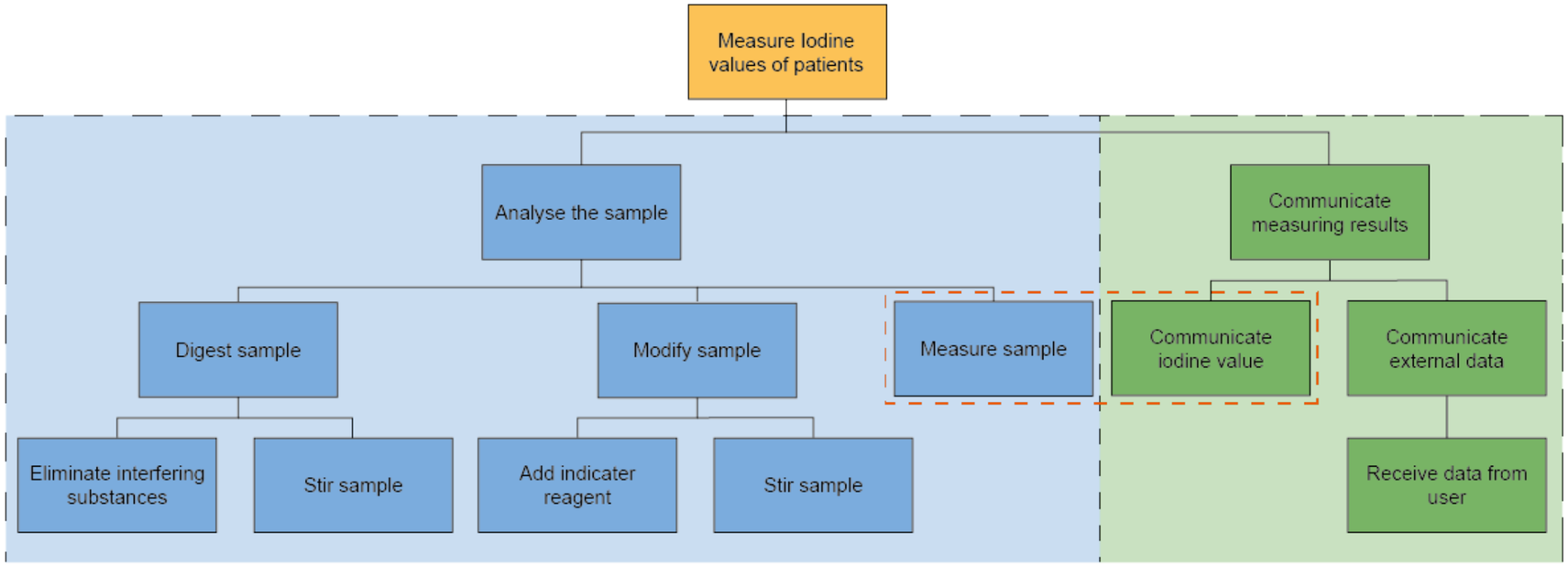
In addition, experiments were conducted to determine which method would be the most promising and feasible to pursue. By doing exploratory experimentations, volume-based Iodometric titration was analysed.

The experiments showed that a titration method does indeed work. After the exploratory experiments were conducted, the possible and desired functions were analysed. This resulted, for instance, in a function tree.









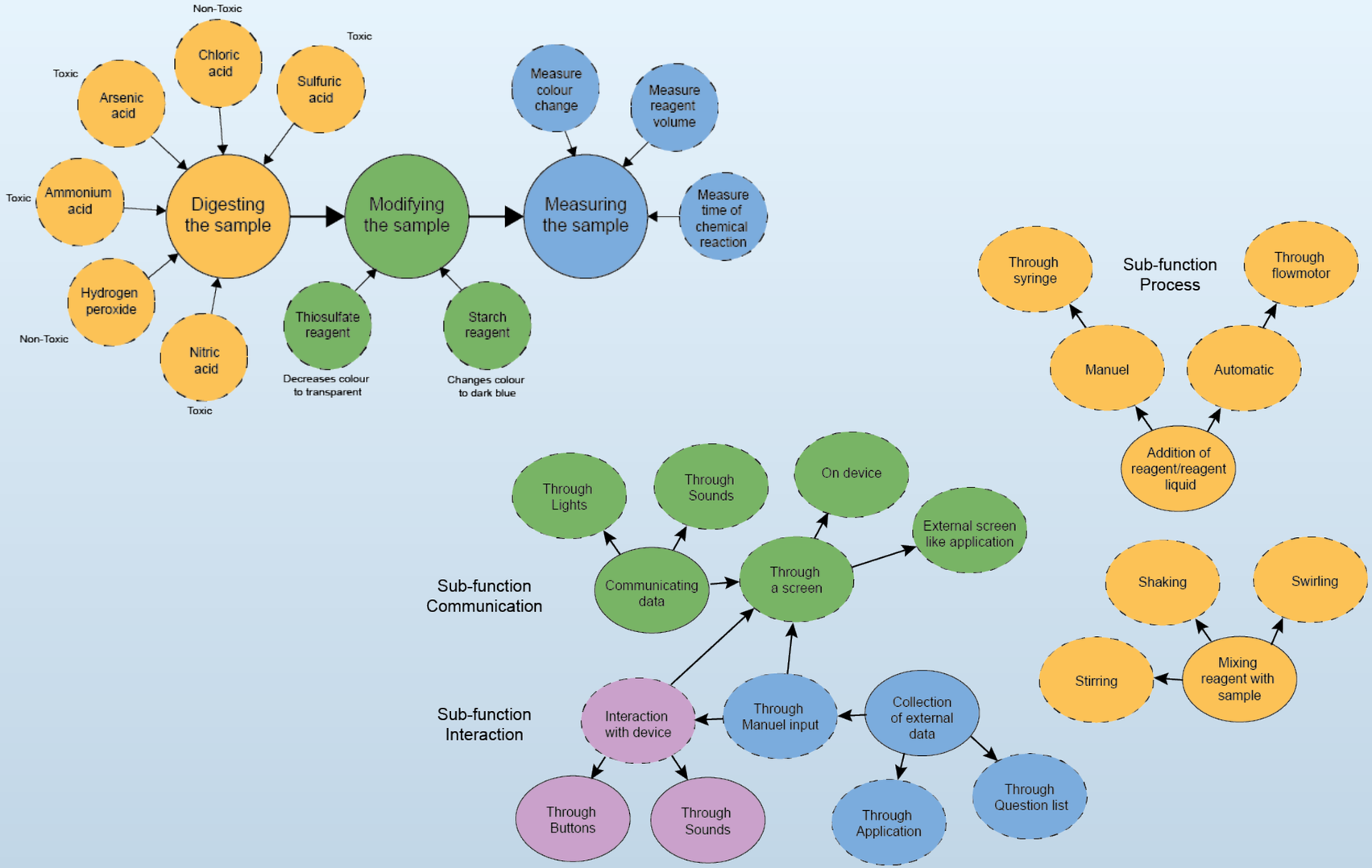
Choosing Functions

Chosen Main Function

Iodine has the characteristic of changing colour in certain chemical reactions and because it is already used a lot on existing methods and devices, it was decided that the colour change of the sample was the direction of modifiction to continue with.

Chosen Sub-functions

The sub-functions could be divided into 3 categories; process, communication, and interaction. For all these subfunctions, ideas were generated. Several subfunctions were combined and used in different concepts later during this design phase.

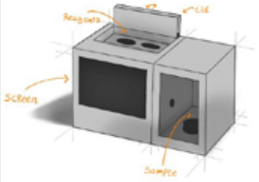


Concepts

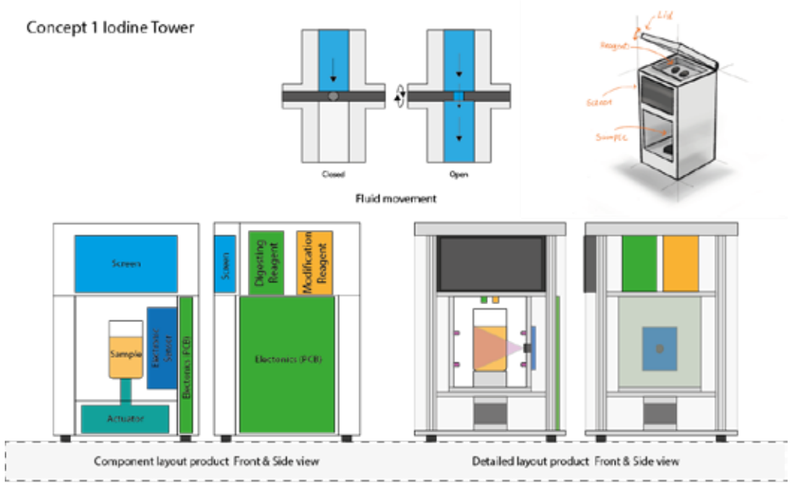
Generation & choice

3 concepts were created. For each concept, a 2D front and side view were illustrated to show the component layout. In addition, a 3D sketch was drawn to give an impression of the concept's design and interaction possibilities.

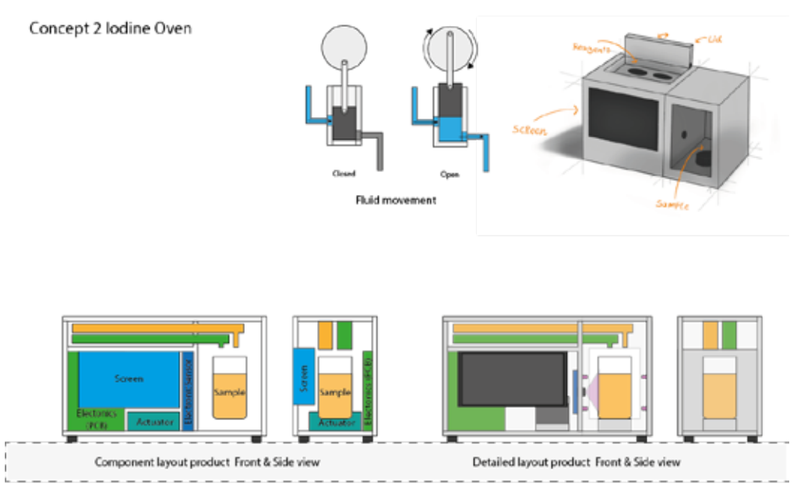
After comparing all concepts to the aspects of functionality, use, responsibility, and the design vision, it could be stated that (with minor differences between them) acombination of concepts 1 and 3 would be best to continue with

Concept:	1 Iodine Tower	2 Iodine Oven	3 Iodine Barrel
Sketch			
Functionality	++	++	++
Use	+	+	++
Responsibility	+	-	+
Design vision	++	+	++
Total Score	6	4	7

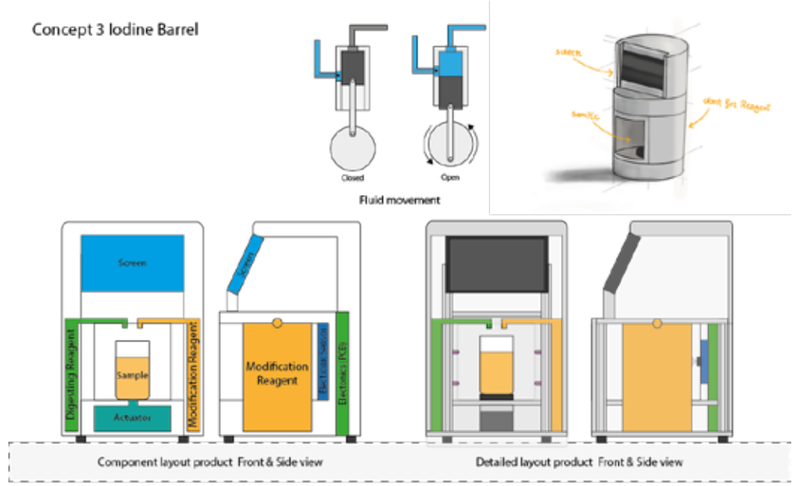
Concept 1 Iodine Tower



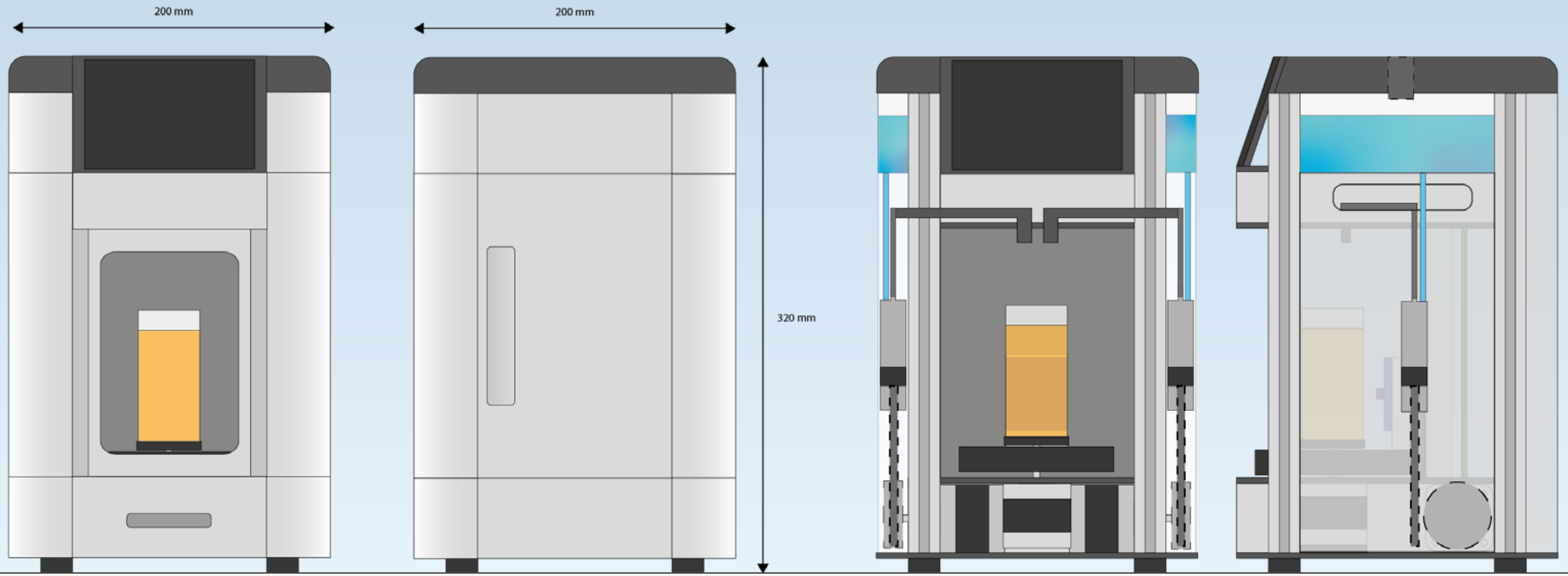
Concept 2 Iodine Oven



Concept 3 Iodine Barrel



Preliminary Design



3D CAD Model

Goal with 3D CAD Model

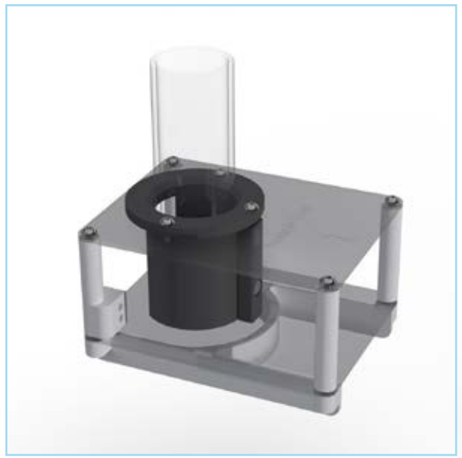
With a 3D CAD model of each module, a first version could be created of how the parts would look and fit together. Furthermore, it could also be determined how the parts would be connected together and how they could be prototyped Lastly, drawings and digital files could be extracted from the digitally created parts which would serve as the preparation for the prototyping.

Modules

The choice was made, based on the design vision, to split up the design into four main assemblies that could be worked out separately. Together they form the final design. This made it possible to build up the final design step by step, iterate or change a module when needed, and think through all design considerations.

Inner Section

Outer Section

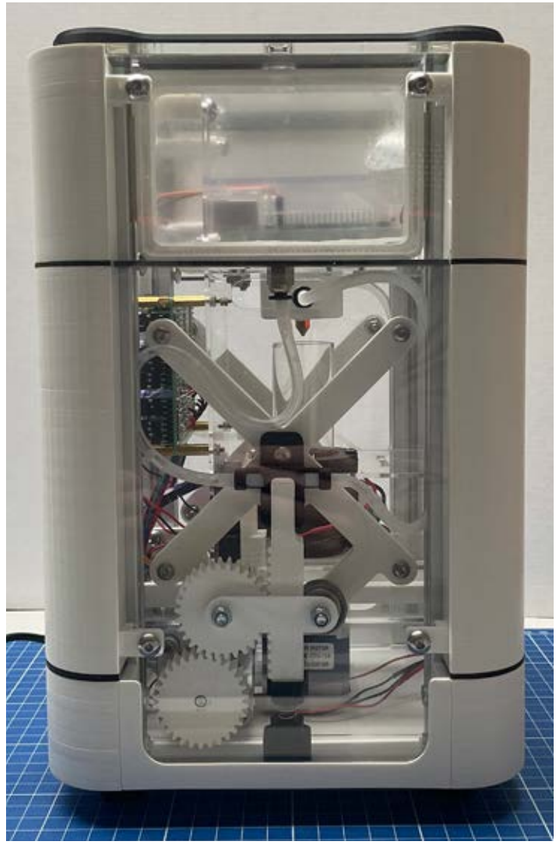


Sample Tray

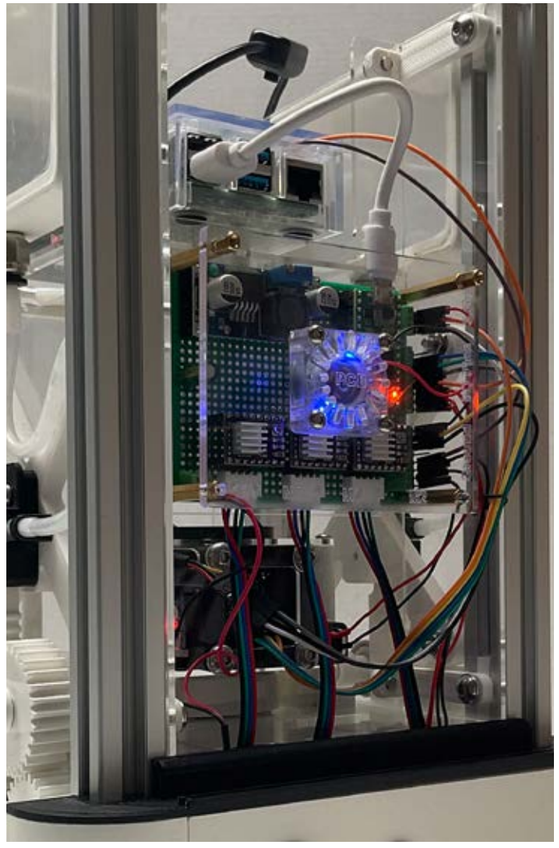
Bottom Section

Functional Model

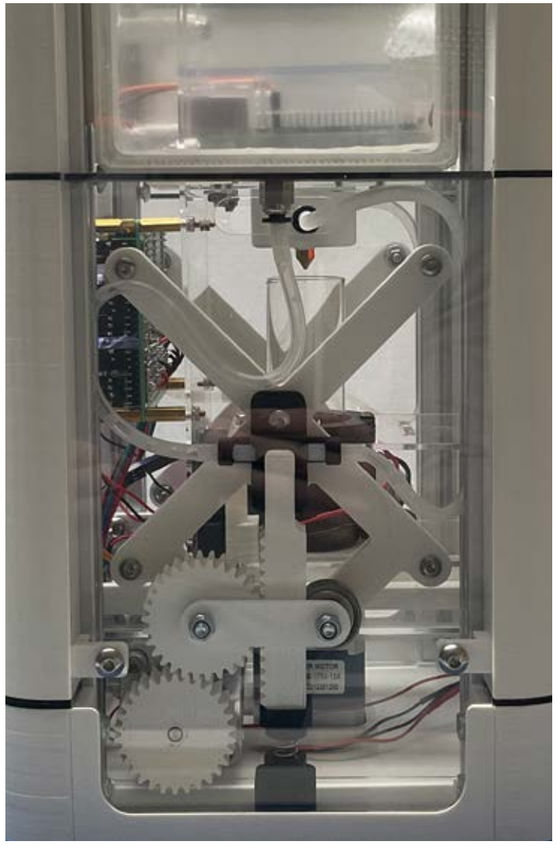
Demonstrator Front



Demonstrator Side



Demonstrator Detail 1



Demonstrator Detail 2

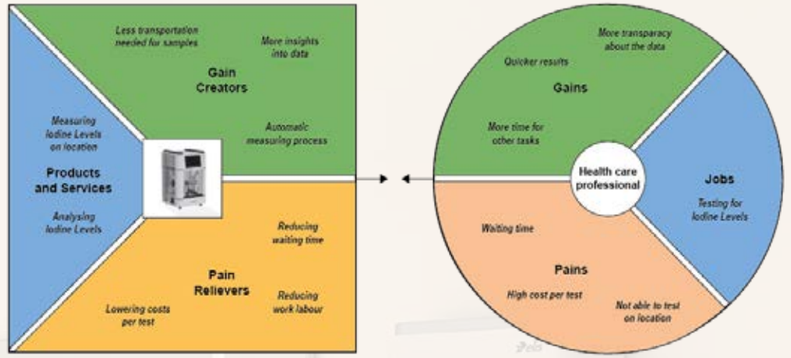
Position of the Final Design

Careful consideration was given to positioning this final design between the already existing options of handheld measuring instruments and the complete systems available in the laboratories.

The added value of the final design for the user is that it has more automation and connectivity options compared to other similar iodine measuring devices. This has the advantage that healthcare providers have more time to perform other work-related tasks in the meantime. The device takes the responsibility of making the measuring process easier and less labourintensive for the users who work with it.

Focusing on societal values, the final design brings a more advanced way of receiving an iodine indication to the treatment site due to its size and ease of use. This will significantly reduce the measurement time from weeks to minutes and will reduce the transportation and infrastructure of the measurement process. This way, it will be easier to run tests, which will lead to doing more tests. This could ultimately lead to more awareness about this problem.

The Value Proposition Canvas



Value Map

Customer Profile

The Business Model Canvas

Feasible

Desirable

Key Partnership	Key Activities	Value Propositions	Customer Relationships	Customer Segments
Realisation: *Investors, Promoters, Distributors* **Validation:** *Notified Body (Certification), Healthcare and Youth Inspection (IGJ),*	*Sell the Solution (product Value)* *Raise awareness about the problem* **Key Resources** *Patent, Investors, Industry Experts (Chemical Engineers, Manufacturers)*	**See:** *Value Proposition Canvas*	*Website, Phone, E-mail, Maintenance technicians, Advisors* **Channels** *Online Website(s), Trade Fairs (Medica), Advertising, Advisors, Networking*	**People:** *Healthcare Professionals, Clinical chemist, General Practitioner* **Companies:** *Hospitals, General practitioners, Aid organizations*

Cost Structure		Revenue Streams	
Main Cost:	**Additional Cost:**	**Types of streams:**	**Frequence:**
- *Manufacturing of Device* - *Development of Reagents*	- *Validation Device* - *Promoting Device (Online/Offline)*	- *Products Sells* - *Fluid Sells (Reagents)* - *Accessories (Vessels)* - *Service (Maintenance)*	*Once* *Subscription* *Occasionally* *Contract*

Viable

Displayed at: TU/e ID

Selected for: TU/e CONTEST