Vitality Squad
B2.1 Less Collective Stress, Better Workspace

# Project 2 Report

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# 00. Abstract

Work-related stress may result in under-performance and absenteeism of office workers. Employees often struggle to pause their work and reflect on their own stress level, resulting in a gap between one's perceived and one's actual level of stress. Therefore, there is a need to raise the awareness of office workers about their own stress levels.

To reach this goal, Stressvas (Figure 0.1) is introduced. It is an office interactive installation using motors and projections to represent heart rate variability data, collected by sensors embedded in office chairs. It aims to stimulate a healthier working attitude through a collective visualisation of employees' stress levels. The approaches used are data-enabled design as well as the personal informatics model. By anonymously displaying the differences among colleagues in a team, employees can reflect on their own mental health from a more objective perspective. Therefore, triggering behaviour change for healthier and better workspace.

*Figure 0.1: Stressvas*

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# 01. Introduction

According to CBS, 16% of the working population feel psychologically tired several times a month from work in 2017 (Centraal Bureau voor de Statistiek, 2018). Looking at the trend of people reporting their exhaustion from work to their GP has increased from in total around 190 thousand in 2011 to 260 thousand in 2018 (Volksgezondheidenzorg.info, 2020). This results in workers having bad mental health, which influences their working attitude and performance. Within only a single year of 2018, 35% of employees indicated that work-related stress was the main reason for their absence at work (Volksgezondheidenzorg.info, 2020). This results in underperforming employees. At the same time, 45% of all employees believe that it is necessary to take measures against work stress (TNO Innovation for life, 2019). This highlights the importance of having a healthy workspace for office workers.

This raises up a question: what is a healthy workspace? According to the World Health Organization (WHO) (World Health Organization, 2010), a healthy job is that the pressures on employees are appropriate considering several factors: 1) their abilities and resources; 2) the amount of control they can have over their work; 3) the support they receive from their colleagues (World Health Organization, 2010). The opposite of a healthy job is then a working environment with too much stress. Work-related stress is defined by WHO as 'the response people may have when presented with work demands and pressures that are not matched to their knowledge and abilities and which challenge their ability to cope'.

There are two types of causes of stress in the office environment. One is the work contents, namely about the workflow, work pace, working hours, etc. The other type of causes is work contexts, which are about personal career development; the position or the role in the company, the salary, etc (World Health Organization, 2010). Due to work-related health problems, it is said that there is an economic loss of 4% to 6% of GDP for most countries (World Health Organization: WHO, 2017). To prevent and minimise these issues, one of the strategies WHO is developed as: 'developing workplace health initiatives, tools, and methods for empowering companies and other work settings to take better care of health, without unduly relying on professional health services' (World Health Organization: WHO, 2017).

The problem is that people are not aware of their own stress levels. According to different sources (Segal et al., 2020) (Lamminen, 2019) (Better Health Channel - Department of Health & Human Services, 2012), there are existing websites that educate people about the symptoms and signs. This means that people need to self-assess themselves, to know if they are under stress or not. However, this might be incorrect, since self-assessment might not provide accurate information. Therefore, it is of the importance to use sensor-collected bio-data for determining whether a worker is under stress. Office seats with embedded sensors were developed in a prior project, which the collected data could directly be used in this project.

With collected bio-data, office workers can access their stress levels from a more objective perspective. The next important step, which is also the goal of this project: to raise awareness of office workers about their stress levels through design interventions.

This leads to the design challenge of this project to be: How can we raise the awareness of the stress level for office workers to have a healthier working environment?

# 02. Benchmark & Related Work

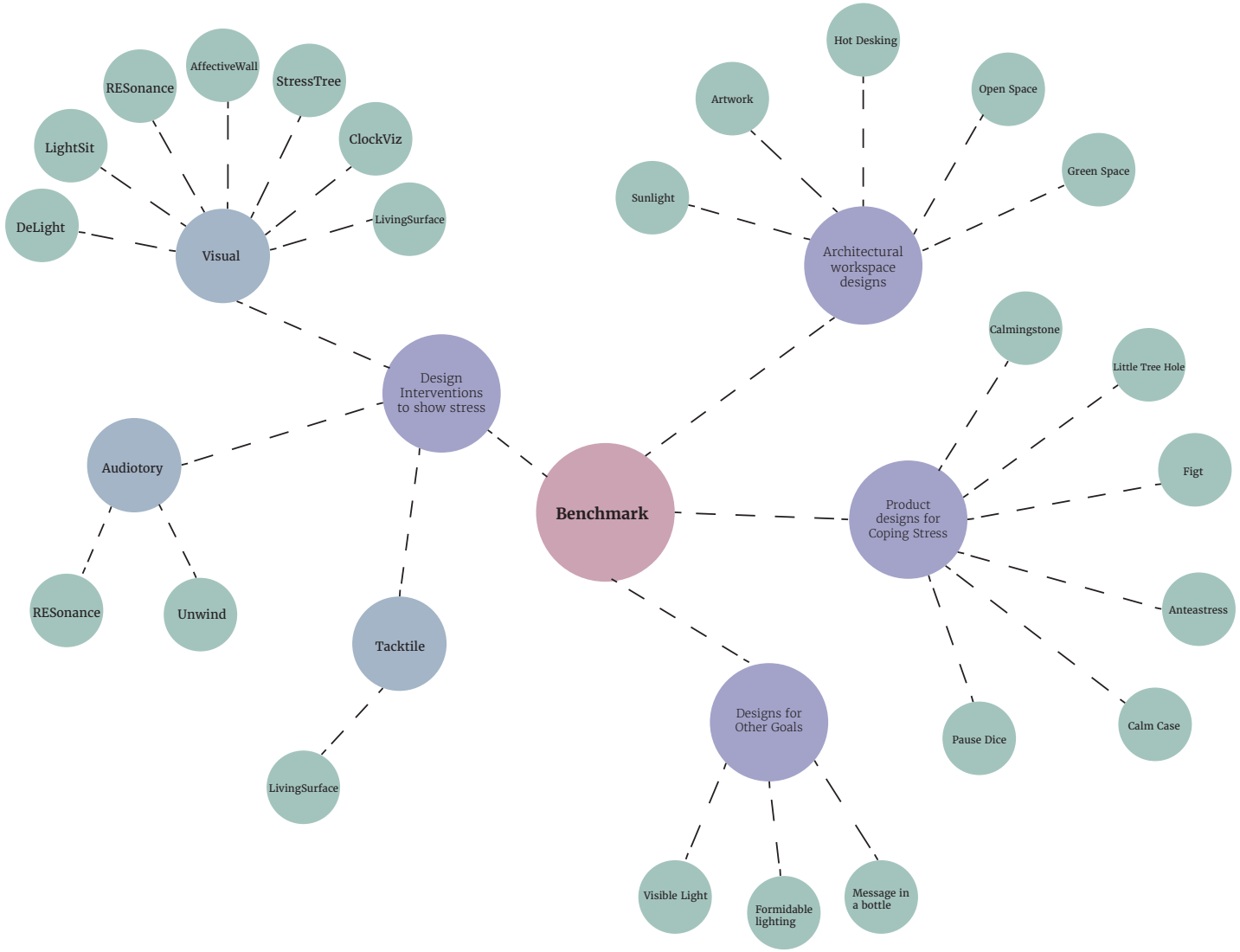


*Figure 2.0: overview of the benchmark research*

Figure 2.0 provides an overview of the benchmark research. The details are discussed in the following sections.

# 2.1 Benchmark Design Interventions to Show Stress

Presenting stress to people is the most direct way to raise their awareness. Therefore, designs that show stress are benchmarked. Research done here focuses on research publications from Eindhoven University of Technology.

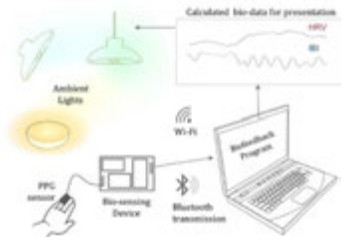

*Figure 2.1.1 DeLight*

**2.1.1 Delight (Yu et al., 2018)**
Sensation: visual
An ambient biofeedback display (Figure 2.1.1) creates a relaxing experience with decorative and informative lighting. The ambient lights change with breathing exercises as interaction.

*Figure 2.1.2 LightSit*

**2.1.2 LightSit (Ren et al., 2019)**
Sensations: auditory & visual
LightSit (Figure 2.1.2) includes a pad that detects sitting posture and heart rate variability and uses ambient lights to show stress. It guides for stretching and breathing exercises.

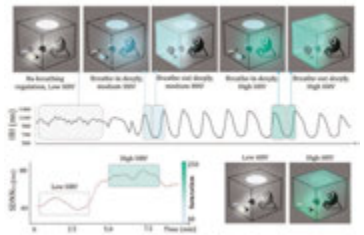

*Figure 2.1.3 RESonance*

**2.1.3 RESonance (Yu et al., 2018)**
Sensations: auditory & visual
RESonance (Figure 2.1.3) uses ambient lighting and natural soundscape to visualise the stress. It stimulates breathing exercises with the change in lighting and natural soundscape in the background.

*Figure 2.1.2 LightSit*

**2.1.2 LightSit (Ren et al., 2019)**
Sensation: auditory & visual
LightSit (Figure 2.1.2) includes a pad that detects sitting posture and heart rate variability and uses ambient lights to show stress. It guides for stretching and breathing exercises.

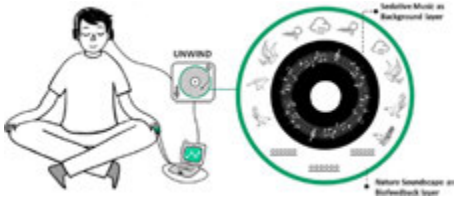


*Figure 2.1.5 Unwind*

**2.1.5 Unwind (Yu et al., 2018)**
Sensation: auditory
A biofeedback system (Figure 2.1.5) that combines nature sounds and sedative music. The sound-scape provides information, whereas music reduces anxiety and offers a relaxing experience.

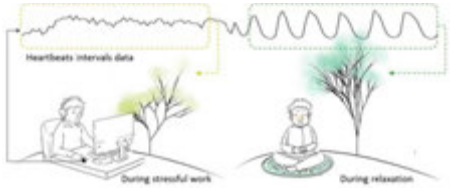


*Figure 2.1.6 StressTree*

**2.1.6 StressTree (Yu et al., 2017)**
Sensation: visual
StressTree (Figure 2.1.6) uses the metaphor of a tree representing health with heartbeat detection. Lush trees stand for a healthy state, whereas withered trees represent stressed.

*Figure 2.1.7 ClockViz*

**2.1.7 ClockViz (Xue et al., 2017)**
Sensation: visual
ClockViz (Figure 2.1.7) uses augmented reality to show the collective stress. It introduces static and dynamic visualization as interventions. It allows workers to help each other.

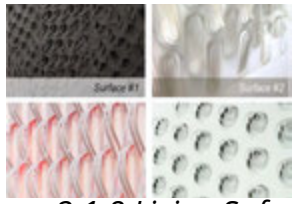

*Figure 2.1.8 Living Sufrace*

**2.1.8 Living Surface (Yu et al., 2016)**
Sensation: visual & tactile
A surface that changes shape to show different stress levels (Figure 2.1.8). Different motions are used: fast movements show tensive feelings and slow changes show relaxing feelings.

## 2.2 Benchmark Architectural Workspace Designs

An interesting finding was that the architectural layout of the workplace also improves the well-being of office workers. Based on different sources (Nightingale, 2019) (Spence, 2015) (Morgan Lovell, 2020), architectural elements such as providing sufficient sunlight, green space, and open space help workers to cope with stress. Another popular architectural design is hot desking (MindTools, n.d.). It aims at ensuring that workers. It also invites workers to interact with people from other departments.

## 2.3 Benchmark Product designs for Coping Stress

Compared to section 2.1, this section focuses on product designs that help to reduce stress without detecting and presenting the stress level. Research was done by browsing online sources.

*Figure 2.3.1 Calmingstone*

**2.3.1 Calmingstone (Telfer, 2016)**
A stone (Figure 2.3.1) that provides a sensation which echoes the heart rate so that the user could feel their breathing activities. The interactive audio experience provides guides for users to relax.

*Figure 2.3.2 Little Tree Hole*

**2.3.2 Little Tree Hole (Wong, 2020)**
A stress kit (Figure 2.3.2) with cards includes matching and problem-solving. It provides positive quotes and inspirations to guide people when they are lost.


*Figure 2.3.3 Figt*

**2.3.3 Figt (Kreis, 2015)**
A product (Figure 2.3.3) that allows people to release their stress by deforming its shape. It is an intervention that adds upon existing technologies by incorporating a computer mouse.

*Figure 2.3.4 Anteastress*

**2.3.4 Anteastress (Benedetto, 2020)**
A tea selection machine (Figure 2.3.4) in the office that detects the blood pressure of a person. Based on the collected data, it offers personalised choices for worker's teabags.

*Figure 2.3.5 Calm Case*

**2.3.5 Calm Case (Farrington-Arnas, 2020)**
A mobile phone case (Figure 2.3.5) that monitors the stress level of the user. The analysed data is presented as phone wallpapers. Added auditory feedback stimulates breathing exercises.

*Figure 2.3.6 Pause Dice*

**2.3.6 Pause Dice (Chandra, 2020)**
A cube (Figure 2.3.6) reminds people to take a break. It vibrates according to the average human breath rate, and includes a timer which notifies the user.

## 2.4 Benchmark Designs for Other Goals

While researching designs that show/deal with stress, many other designs don't necessarily serve with showing or dealing stress, but they could be used for a nice design for visualising the stress.

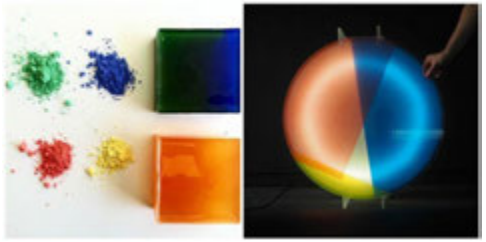

*Figure 2.4.1 Visible Light*

**2.4.1 Visible Light (Studiolabo S.r.l., 2017)**
A design (Figure 2.4.1) that uses colour and light to have a positive influence on the user. Rotating the plate results in a change in colour compositions. This provides interactions and playfulness for users.

*Figure 2.4.2 Formidable Lighting*

**2.4.2 Formidable Lighting (anonymous, 2019)**
Organic shapes are created for a hanging lamp with the use of fabric and tangible materials (Figure 2.4.2). It is noted that sound and music could be additionally included.

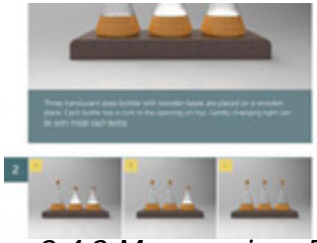

*Figure 2.4.3 Message in a Bottle*

**2.4.3 Message in a Bottle (anonymous, 2018)**
Sound in the environment is collected and then sets to a flask (Figure 2.4.3). Brightness changes according to the loudness of the environment. The user hears the audio when the bottle is opened, while the light is diminishing.

## 2.5 Personal Informatics System

The Personal Informatics System (Li et al., 2010, p. 558) is a system that supports people to collect and reflect on their personal information. A stage-based model (Figure 2.5) of the system is derived, including five stages, namely preparation, collection, integration, reflection, and action.
In this project, the assumption is made as the preparation and collection stages have finished. This means the data has been collected and is ready for being proceeded. An overview of these two stages will be discussed in Chapter 3.

This project focuses on the stage of integration. The collected information will be prepared and transformed for users. This will be done with the means of data visualization. Based on this, potential interactions are triggered, thus the project moves towards the reflection stage.

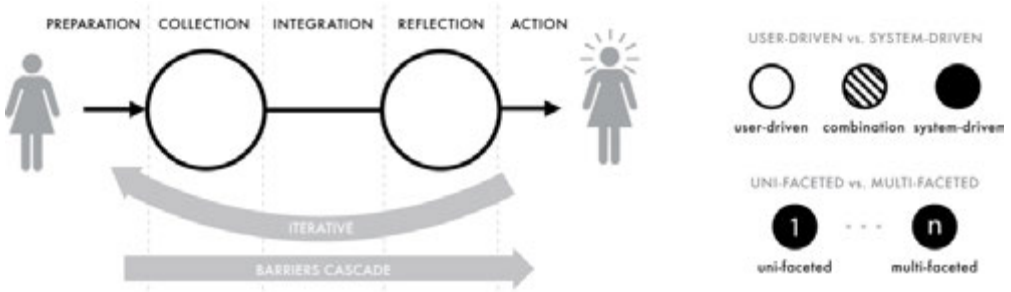


*Figure 2.5 Personal Informatics System*

## 2.6 Transtheoretical Model

The Transtheoretical Model (TTM) (LaMorte, 2019) presents the process of how an individual changes his/her behaviour through decision making, and eventually adopts new behaviour. This assumption made in TTM is that people do not change their behaviour easily, whereas it is a circular process. It contains six stages (Figure 2.6) as precontemplation, contemplation, preparation, action, maintenance, and termination.

This project mainly considers the first two steps of the Transtheoretical Model. By introducing data visualization, people are able to recognize their unhealthy behaviour and thus intending to change in the future. Therefore, the awareness level of their own stress is raised.

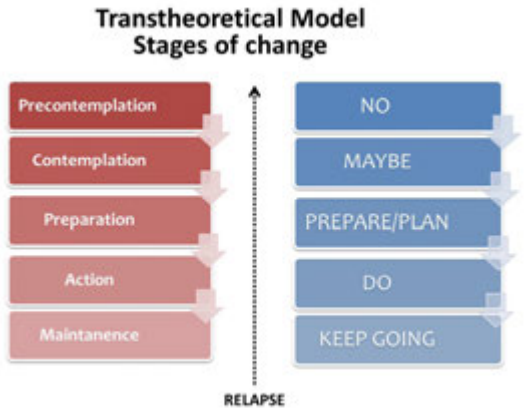


*Figure 2.6 Transtheoretical Model*

## 2.7 Data-enabled Design

The approach of data-enabled design (Kollenburg, 2019) is adopted. This project focuses on the steps of 'designerly explorations with data as creative design material' and 'adopting the situated prototypes (remotely)'. Other steps are developed in a related project, which will be discussed in Chapter 3. Figure 2.7 presents every stage and corresponding context.

## 2.8 Conclusion of Related Work

First of all, the understanding of the design field is deepened by looking at the existing work and designs. The theoretical background knowledge was researched, which could support the development of the design.

Based on the research done with existing designs, it is concluded that there are not a lot of designs currently focusing on the collective aspect of stress. Therefore, it remains an underexplored perspective for designs related to work-related stress. This provides opportunities for designing for dealing with stress in the office environment collectively.

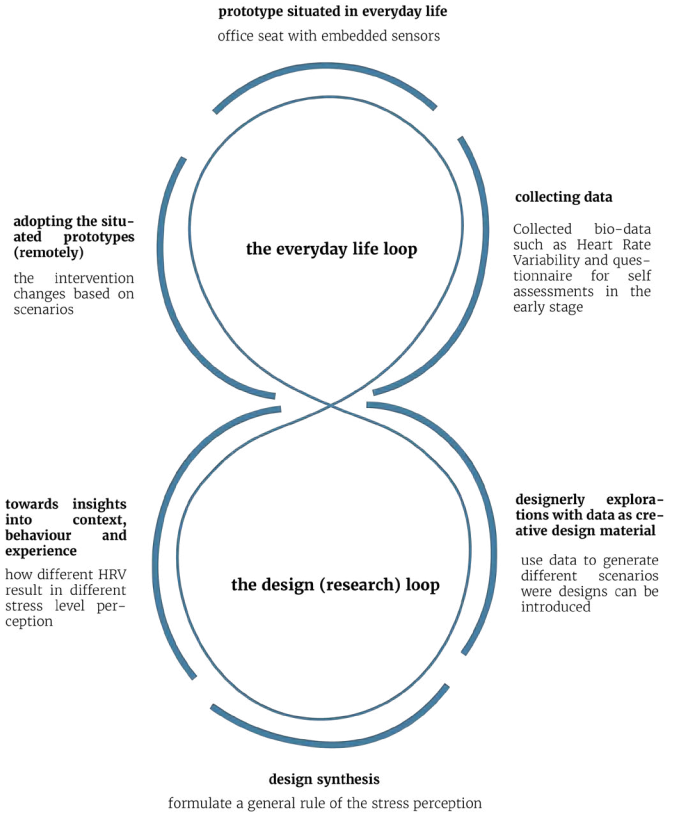


*Figure 2.7 The Project Approach Description with Data-enabled Design*

# 03. Related Technology

## 3.1 Data Collection

The data collection is done through cushions that could be placed on office seats (Figure 3.1). There are pressure sensors included in the cushion. This measures the vibrations of the body movements with several different collected data points.

## 3.2 Data Processing

There is a WIFI module included in a small bag which is attached to the cushion. It sends the data to a protected server. The server processes the vibrations of body movements through several filters to amplify the signals. Afterwards, workable data are generated. The workable data are the bio-data such as Heart Rate and Heart Rate Variability can be retrieved through an Application Programming Interface.

## 3.3 Data Usage

Another important step before introducing this project is to define the stress scenarios of office workers. Since stress is a psychological feeling, collected bio-data is compared to self-assessments. Thus, the correlation could be found. This was done through user testing with participants sitting on the cushion when working and filling self-assessment forms twice a day over a period of time (about two weeks). After that, a generalised rule could be developed: for instance, an office worker is under stress if his bio-data is within data range A; and not stressed with data range B. This rule could be applied to every individual so indications on stress levels can be given objectively without self-assessing.

In addition, the specific bio-data type is looked at as Heart Rate Variability (HRV). It is the variation in time between two consecutive heartbeats. This specific bio-data is chosen because it is a proven way of representing stress (FIRSTBEAT, 2019). HRV increases when people are relaxed, and decreases when people are stressed.

In this project, the assumption is made that the design intervention would be based upon two calibrated scenarios: showing when office workers are not stressed and stressed. The moment when office workers are not stressed is defined as when the Heart Rate Variability is on average lower than 300 over a period of time. The data used will be processed average or inferred data with a time-window and a delay. In the future, with more specifically defined data ranges for different stress levels, the change in people getting more or less stressed can be visualised more precisely.

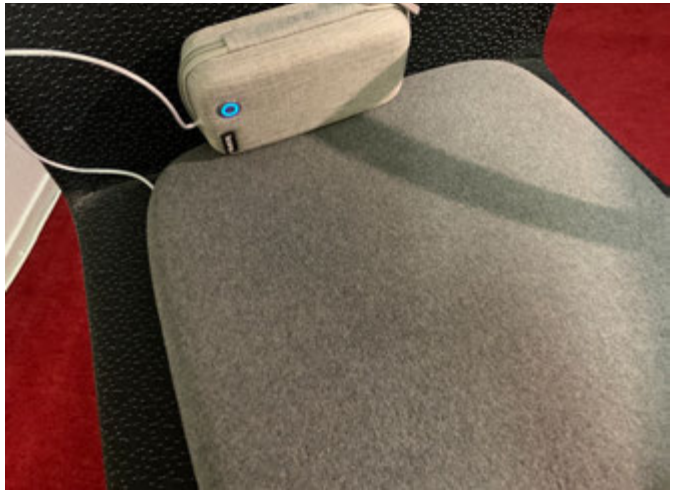

*Figure 3.1 The Cushion*

# 04. Design Process

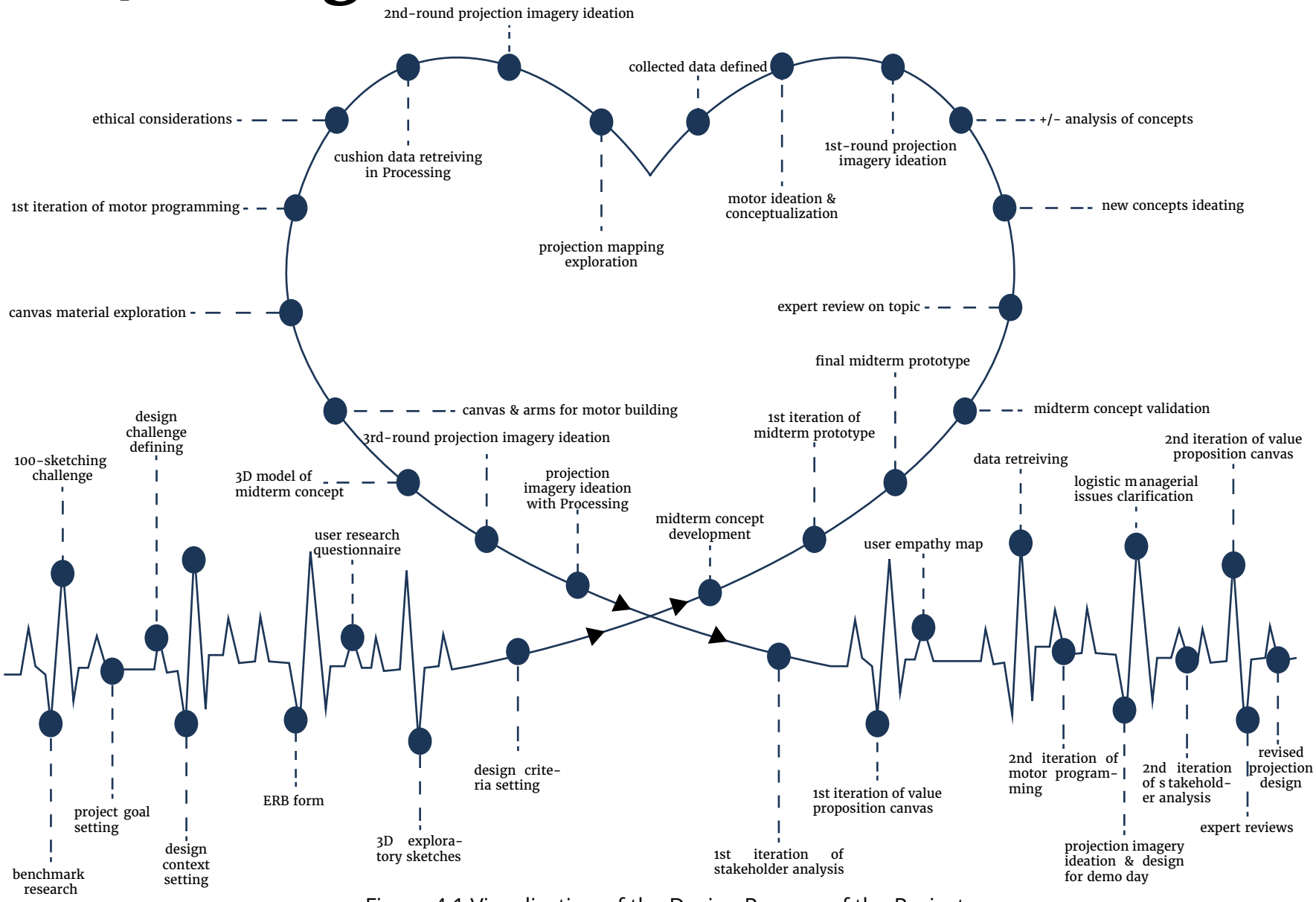


Figure 4.1 Visualization of the Design Process of the Project

Figure 4.1 presents the entire design process went through for this project.

## 4.1 Design Exploration

This was the first stage of the project. Multiple activities were undertaken to explore the design context and possibilities. Details are discussed in the follow-up subsections.

### 4.1.1 100-sketches Challenge

Sketches were used as a tool to understand the design topic and context. The goal was to look for existing designs and products to get aware of the potentials of design interventions that could be introduced for this project.

The challenge was done individually, then the results were shared among team members. (Note: the group started with three members, but one left after two weeks.) Some examples of the sketches are shown in Figure 4.1.1.1 - Figure 4.1.1.3. The completed 100 sketches could be found in Appendix A together with an overview. The main theme of sketches are 1) the causes of stress; 2) design interventions to present stress; 3) design interventions to release stress.

Figure 4.1.1.1 100-sketches Challenge - Yinying


Figure 4.1.1.2 100-sketches Challenge - Niels

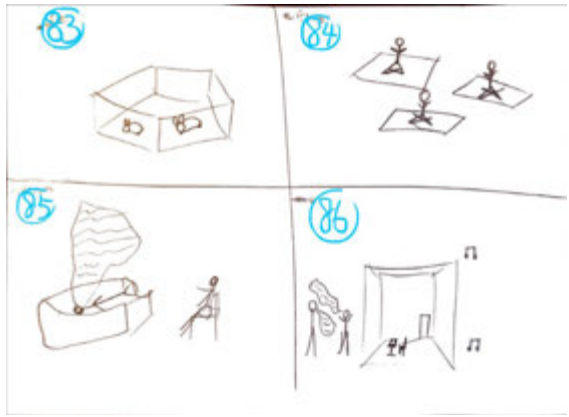

Figure 4.1.1.3 100-sketches Challenge - Joost

### 4.1.2 Design Challenge and Project Goal Setting

Some decisions were made to have a concrete design focus after step 4.1.1. First of all, it was decided to focus on presenting stress rather than releasing stress. This is because most people know how to deal with stress but have low awareness levels. In addition, individual stress will be focused on, and add collective aspects later. Moreover, a physical product in a real-office context was aimed at.

With the analysis above, the design challenge is defined as: *How can we raise the awareness of the stress level for office workers to have a healthier working environment?*

Based on these two steps, a set of design criteria, several 3D exploratory sketches, and a user questionnaire were developed. However, these three steps didn't stimulate the design process much. The details with these two steps are included in Appendix B, C, D.

# 4.2 Midterm Concept

### 4.2.1 The Concept

Based on previous steps, a tangible design that could visualise different stress scenarios of office workers was targeted at for midterm.

This design consists of a pumping system, a stand and a balloon with small material pieces inside (physical prototype: Figure 4.2.1.1 - Figure 4.2.1.3, 3D model: Figure 4.2.1.4 - Figure 4.2.1.5). The balloon is connected to an electric pump which will be placed under the office desk. The stand holds the balloon to prevent it from moving around. It could be placed at a corner on office desks (Figure 4.2.1.6 - Figure 4.2.1.7). Based on collected data of Heart Rate Variability through cushion seats, the system compares the individual's stress level to the average level in the same office environment. The balloon forms a round shape if the office worker is not stressed. This spreads the message of office workers being healthy. However, the size of the balloon reduces when the stress level of an office worker is above the average. Thus, a weird shape of the balloon is shown with the small material pieces inside. It represents that an office worker is struggling. In this way, office workers are able to access and assess their health performance easily while focusing on their work.

The concrete steps of the building process can be seen in Appendix E.

Figure 4.2.1.1 - 4.2.1.3 Midterm Prototype

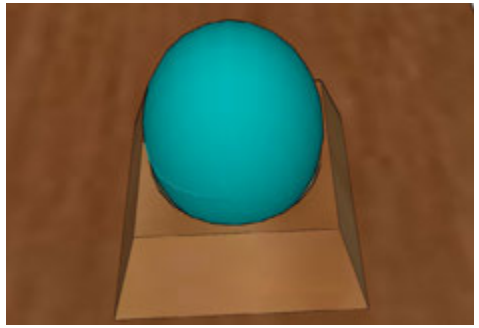

Figure 4.2.1.4 - 4.2.1.5 3D Models of Midterm Concept

Figure 4.2.1.6 - 4.2.1.7 3D Models for Showing the Context of Using

### 4.2.2 Evaluation

Firstly, the visualization of stress with shaping changing of a balloon needed to be validated. It was realised that the feedback provided might not be concrete enough and people might not be able to understand the meaning of the intervention.

In addition, the purpose of this design was only to visualise the changes in stress levels. However, the balloon design invited people to play and touch. This was not the purpose and might stop the system from working properly.

Lastly, the midterm concept only focused on the performance of individuals. This was out of the scope of the project brief, where the concept should be developed in regards to collective stress. This would be the biggest adjustment made after the midterm.

# 4.3 From Midterm to Final Concept

### 4.3.1 Concept Ideation and Analysis

Based on the evaluation points from 4.2.2, three concepts were developed. The concepts were canvas, flower garden, and a balloon wall. For every concept, a positive- and negative-points analysis was made. The complete analysis could be found as a table in Appendix F.

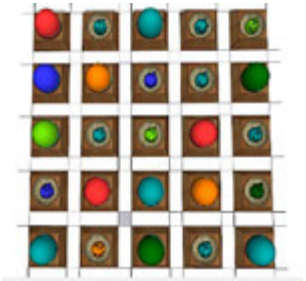

Figure 4.3.1.1 The Balloon Wall

Figure 4.3.1.2 The Flower Garden

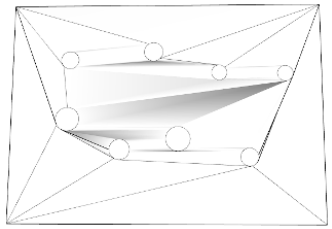

Figure 4.3.1.3 The Canvas

*The Balloon Wall*

This idea (Figure 4.3.1.1) builds upon the midterm concept but includes the collective aspect. Workers could be assigned to balloons with different colours or patterns. It is cheerful and enjoyable. It could trigger potential interactions. In contrast, it is not serious enough for an office and the balloons could be broken easily. Another disadvantage is the pumping system would make a lot of noise.

*The Flower Garden*

Flower Garden (Figure 4.3.1.2) uses different plants to represent individuals. The growth of flowers could show differences in stress among workers. Potential actions could be triggered. However, it might be challenging to realise. The design is also too colourful for an office. Another issue is that people can figure out each other since the differences are shown separately.

*The Canvas*

Figure 4.3.3 is a sketch that explains this idea. It is a collective representation that includes many single data points. Projections could be incorporated. Moreover, it could be long-lasting by using stretchable fabric and sustainable materials. A challenge is that people might find it hard to figure out the points that belong to themselves.

### 4.3.2 Projection Imagery Exploration

*Projecting Natural Landscapes*

The imagery exploration started with considering natural landscapes. This was because they have different altitudes. Thus, it adds another dimension to the 2D canvas surface.

To explore this, several boards were created (Figure 4.3.2.1 - 4.3.2.2). It was found that it would not be ideal to modify those images for showing different cases of stress levels. It was also challenging to draw natural landscapes since it would easily look fake.

*Projecting Natural Changes*

Since the scale of natural landscapes is large, brainstorming for more specific objects was done. A mind map was first created (Figure 4.3.2.3), followed by some sketches (Figure 4.3.2.4 - 4.3.2.5). The problem with those ideas was they are a bit too specific. Thus, it might be challenging for creating an aesthetically pleasing projection while it is close to reality. With this conclusion, the final choices are discussed in Chapter 5.

Figure 4.3.2.1 Sketches Board

Figure 4.3.2.2 Board with Physical Objects


Figure 4.3.2.3 Mind Map of Natural Changes

Figure 4.3.2.4 Skteches of Natural Changes (1)

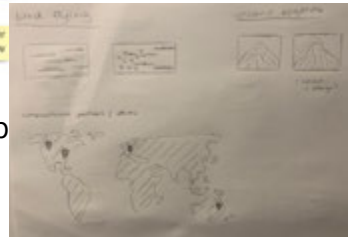

Figure 4.3.2.5 Skteches of Natural Changes (2)

# 05. Final Concept

## 5.1 Design of Stressvas

**5.1.1 The Concept**

Stressvas (Figure 5.1.1.1-5.1.1.2) is a canvas as an office interactive installation. The canvas shape varies with the use of stepper motors. Every individual shape on the canvas represents an office worker. The shape is connected to an arm and the arm is connected to stepper motors (Figure 5.1.1.3-5.1.1.4).

When an individual is stressed, the arm will protrude the canvas outwards (Figure 5.1.1.5). In addition, projection augmentation is incorporated with projecting different visualizations based on the stress levels of individuals. The visualizations are inspired mainly by phenomenons about physics, such as light refractions and freezing water.  Moreover, the visualization is aimed to be as abstract as possible. With a public display of presenting an overview of individuals' stress levels in the shared office area, the awareness of office workers on their own stress level could be raised.

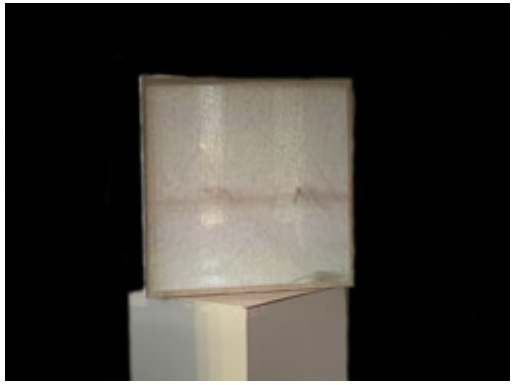

Figure 5.1.1.1 Stressvas Design

Figure 5.1.1.2 Stressvas Design and the Cushion Seat

Figure 5.1.1.3 The Back Side of the Canvas

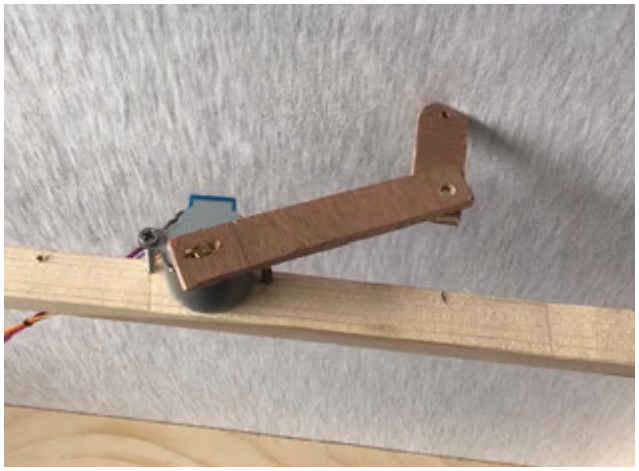

Figure 5.1.1.4 Motor and Arm at the Back Side

Figure 5.1.1.5 Canvas Shape Changing

### 5.1.2 The Usage

The visualization aims at providing meaningful information to office workers without disturbing their work too much. It should also be accessible. Therefore, the location should be where workers pass by frequently.

A worker can see the stress level among colleagues in the same space. To protect an individual's privacy, the numerical data is presented anonymously and abstractly with a canvas visualization.

In addition, the visualization will change daily. This prevents workers from getting bored with the visualization and people are less likely to find out who the points belong to. So far, several sample visualizations are designed (Figure 5.1.2.1 to Figure 5.1.2.6). A detailed explanation of those concepts could be seen in Appendix G.

### 5.1.3 Target Audience

The main target audience is office workers, as the direct users who interact with the design based on their biodata. Another target audience is managers or C-level board members. They are who purchase the product. Therefore, they are customers. As it is a collective office design, the decision on whether implementing the design will be made by managers. The managers invest in this design because they want their employees to stay healthy.

### 5.1.4 Target Context

If there are only two to three people in the office area, the possibility that people figuring out one another is high. Thus, the visualization will be turned off. Individuals can still access their personal data through a protected platform with a password.

If there are too many people in the same shared space, for example, more than fifty people, meaningful conclusions will be hard to draw with fifty points on one canvas. In that case, the office area could be divided into several sections. The division would be the best to put people who work together in a team, so they might understand the working circumstances of each other better.

Figure 5.1.2.1 Light Refractions

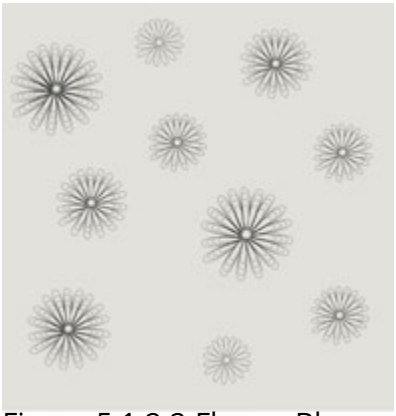

Figure 5.1.2.2 Flower Blooming

Figure 5.1.2.3 Shadows of Nature such as Plants

Figure 5.1.2.4 Doppler Effect

Figure 5.1.2.5 Ice Cube Forming and Melting

Figure 5.1.2.6 Meissner-Ochsenfeld Effect

# 5.2 Underlying Design Principles

### 5.2.1 Interaction Modalities

The input in this design is user interaction. An office worker sits on the cushion, the pressure results, and the body movements are detected. Based on data collection and processing, different scenarios are calibrated. The scenarios are namely whether an office worker is stressed or not over the last period of time.

The modalities in this design are the outputs. The changes in the collected sensor data result in different scenarios. Depending on the scenario, the shape of canvas changes. At the same time, the projection imagery varies accordingly with the change.

### 5.2.2 Material Qualities

The materials used can be categorised into four: electronics, wooden pieces, fabric, and projector.

First, the electronics are there for changing the shape of the canvas. Ada-Fruit Motor Shield was used for controlling the motors. A single motor shield allows connections up to two stepper motors (Figure 5.2.2.1). The offered power supply is up to 5V. Two stepper motors are used to turn the arms for pushing the canvas outwards. The motors are connected to the motor shield and operated with codes (see in Appendix H). It was noticed that these motors are not the best quality (type: 5v stappenmotor met ULN2003 driver). A better choice could be Generic Nema 17 4-lead Bipolar Stepper Motor.

In addition, wooden pieces were used (Figure 5.2.2.2). All the sides of the frame were built with one piece of material so that they all look the same and therefore reach some level of aesthetically pleasing. To give forces for motors to set on, an additional wooden strip was attached on the backside of the canvas. The wood pieces are pallet wood. They are all scrap wood pieces collected from a container.

Moreover, to build the canvas itself, a piece of fabric was chosen (Figure 5.2.2.3). Fabric materials are often tangible, allowing shape easily. Different fabric such as T-shirts and pillow covers were explored, and their stretchability is tested. Another identity of these materials is that they are not useful anymore with its initial purposes, for instance, an old dress. This means no new purchases needed to be made. In the end, a thin cotton piece was chosen. It was initially the backside of a T-shirt that was going to be thrown away. One future action could be that the wooden frame is finished better by adding an extra layer of wood pieces. In this way, the prototype could be more aesthetically pleasing.

Lastly, a projector was used. The projector was Vivitek QUMI Q5. It was a small one used for demonstration purposes. It was noticed that the light is not bright enough to see the projection clearly in daily life. Thus, when considering implementing the design in the real-life, a good-quality projector should be considered.

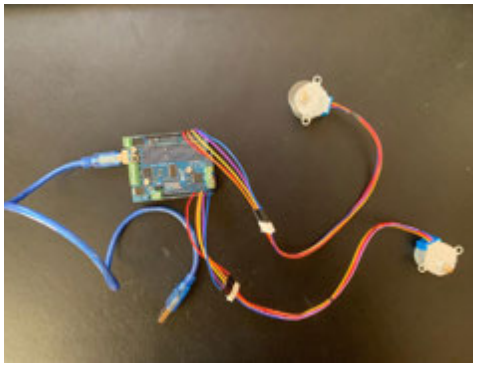

Figure 5.2.2.1 Connections of Steppers, Motor Shield, and Arduino Board

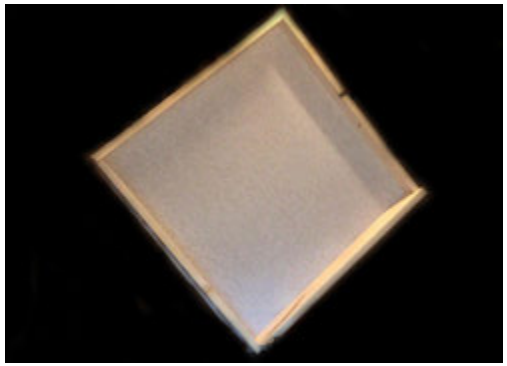

Figure 5.2.2.2 Wooden Pieces for the Frame of the Canvas

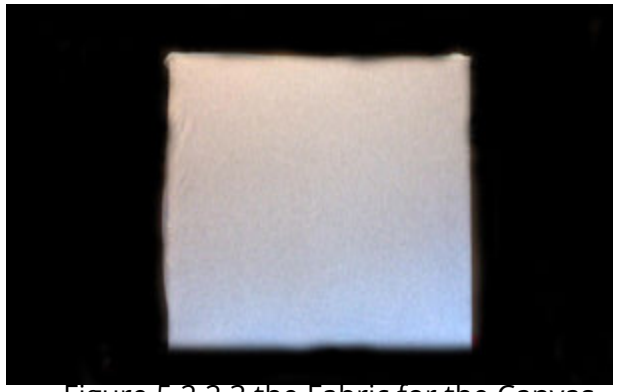

Figure 5.2.2.3 the Fabric for the Canvas

### 5.2.3 Design Rationales

The most significant design rationale used in terms of the final prototype is recycled materials. As mentioned previously, both the wood pieces and the fabric were not usable for its original purposes anymore. This is because the team valued sustainability a lot. With this prototype, the waste of wood and fabric was used and turned into a new product. It also highlights the value of waste.

In addition, another rationale applied was the choice of canvas colour. The choice was made considering the projection applied. A white surface reflects light well and doesn't impact the projection image. In this way, the quality of projection in terms of workers seeing it clearly could be ensured.

### 5.2.4 Design Principles

Two principles of design were used (Reid, 2020). First, the movement of the canvas communicates the message of the changes in the stress level of office workers. On top of that, the design aims to be minimal. Not a lot of colours were used to provide a neat view of the design.

## 5.3 Technology and Realization

### 5.3.1 Material List

- cotton cloth with a size of 70cm by 70cm
- 1 wood plank with a length of 126cm, a width of 5cm and a height of 2cm
- 1 wood plank with a length of 126cm, a width of 8cm and a height of 2cm
- 8 six-point screws with a depth of 6cm
- A screwdriver
- 32 staples
- A staple gun
- 1 wood plank with a length of 67cm, a width of 4cm and a height of 2cm
- 2 stepper motors (5v stepper motor with ULN2003 driver; Type: 28BYJ-48)
- 1 Arduino
- 1 Adafruit motor shield
- 4 wood planks with a length of 5cm, a width of 1.2cm and a height of 0.4cm
- 10 screws with a depth of 4cm

### 5.3.2 Data Usage and Motor Programming

As described in Chapter 3, the data is collected through a cushion and retrieved through Application Programming Interface (API) to Processing software. The code of retrieving the data with two specific cushions used in this project can be found in Appendix I. Based on the data collection, it was transferred to Arduino and then the code of the motor was written. This code could be found in Appendix H.

### 5.3.3 Building Process of the Demonstrator

1. Two wood planks were sawed with a length of 62cm, a width of 8cm, and a height of 2cm.
2. Two wood planks were sawed with a length of 62cm, a width of 5cm, and a height of 2cm.
3. The ends of longer wood planks were connected to the ends of shorter wood planks with 90 degrees in between, creating a square frame.
4. Two screws with a depth of 6cm were used for each connection point in Step 3.
5. A cotton fabric with a size of 70cm by 70cm was laid on the frame.
6. The cotton fabric was attached to one side of the frame with 8 staples by using a staple gun.
7. The cotton fabric was attached to the other three sides and stretched before stapling it to the frame.
8. A thin wood plank with a length of 64cm, a width of 4cm, and a height of 2cm were attached to the centre of the backside of the frame by two screws with a depth of 4cm.
9. Two steppers were attached to the wood plank at the backside with 2 screws with a depth of 4cm for each stepper.
10. An Arduino Uno board was attached on the top of the bottom wooden frame with 6 screws with a depth of 4cm.
11. The Adafruit motor shield was connected to the Arduino Uno board.
12. The wires were connected from the Adafruit motor shield to the steppers.
13. Two long wood planks were sawed with a length of 8cm, a width of 1.5cm, and a height of 2mm.
14. Two short wood planks were sawed with a length of 4cm, a width of 1.5cm, and a height of 2mm.
15. A hole was made on both sides of each sawed wood plank in step 13.
16. A hole was made on one side of each sawed wood plank in step 14.

17. One long wood plank was connected to one short wood plank with a rivet, where the short wood plank was at the top.
18. Step 17 was repeated for the two pieces of wood plank left in step 13 and 14.
19. The long wood planks were placed on the steppers with the use of the holes made in step 13.
20. The other side of short wood planks was attached to the canvas fabric with the use of a needle and thread.
21. The code was uploaded to the Arduino Uno and the power was plugged in.

### 5.3.4 Technical Challenges and Solutions

*Coding*

One technical challenge was that the arms couldn't move in the correct direction with the code piece at first. This was mainly because the library used is a general library for stepper motors and it didn't have the function for defining the directions. The problem was solved by using the library specifically for Adafruit Motor Shield.

The other main challenge was that there was a lack of knowledge on how to send data from Processing to Arduino. Fortunately, with some help from another student, the team was competent to achieve the data sending.

*Canvas building*

There were some challenges throughout the building process.

First, it was hard to find the right and strong screws while making sure the wood would not be split while screwing. The method applied is first find the screws strong enough and drill the holes, then have the screws drilled in.

In addition, it was challenging to make sure that the fabric was stretched equally in every direction and stapled accordingly. The challenge was solved by trials and errors. Every small step was done carefully and was double-checked afterwards.

Moreover, there were some difficulties in specifying the location of the steppers. When designing, it was aimed that the canvas will protrude outwards with two specific locations. However, with the use of arms, the steppers have to be placed a bit towards the left to have the canvas protrude outwards at the right position. The locations were found by testing out. However, it was not very precise in the end.

Last but not least, the steppers were not strong enough for providing a large force. It was solved by weakening the tearing strength of fabric by thinning the fabric around where the arm would touch upon it.

# 06. Value Proposition

Based on the concept, a stakeholder onion map was created (Figure 6.1) to illustrate the stakeholders that are related. On top of that, a power-interest grid analysis was conducted (Figure 6.2). The two main stakeholders that will be discussed are office workers and managers. This is because they will probably be the end-user and the purchaser of this product. By keeping in mind these two important stakeholders, two value proposition canvas (Figure 6.3 - 6.4) was filled in.

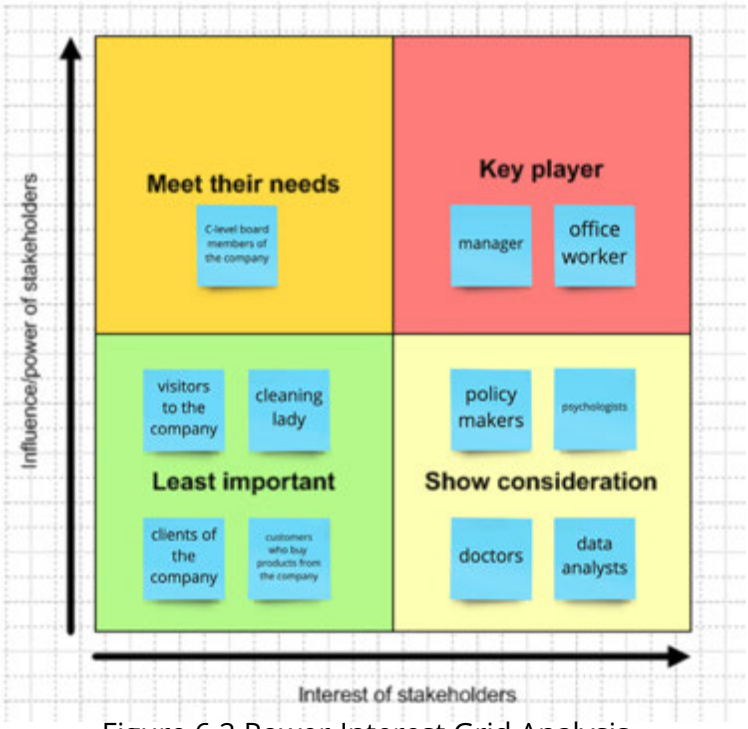


Figure 6.2 Power-Interest Grid Analysis

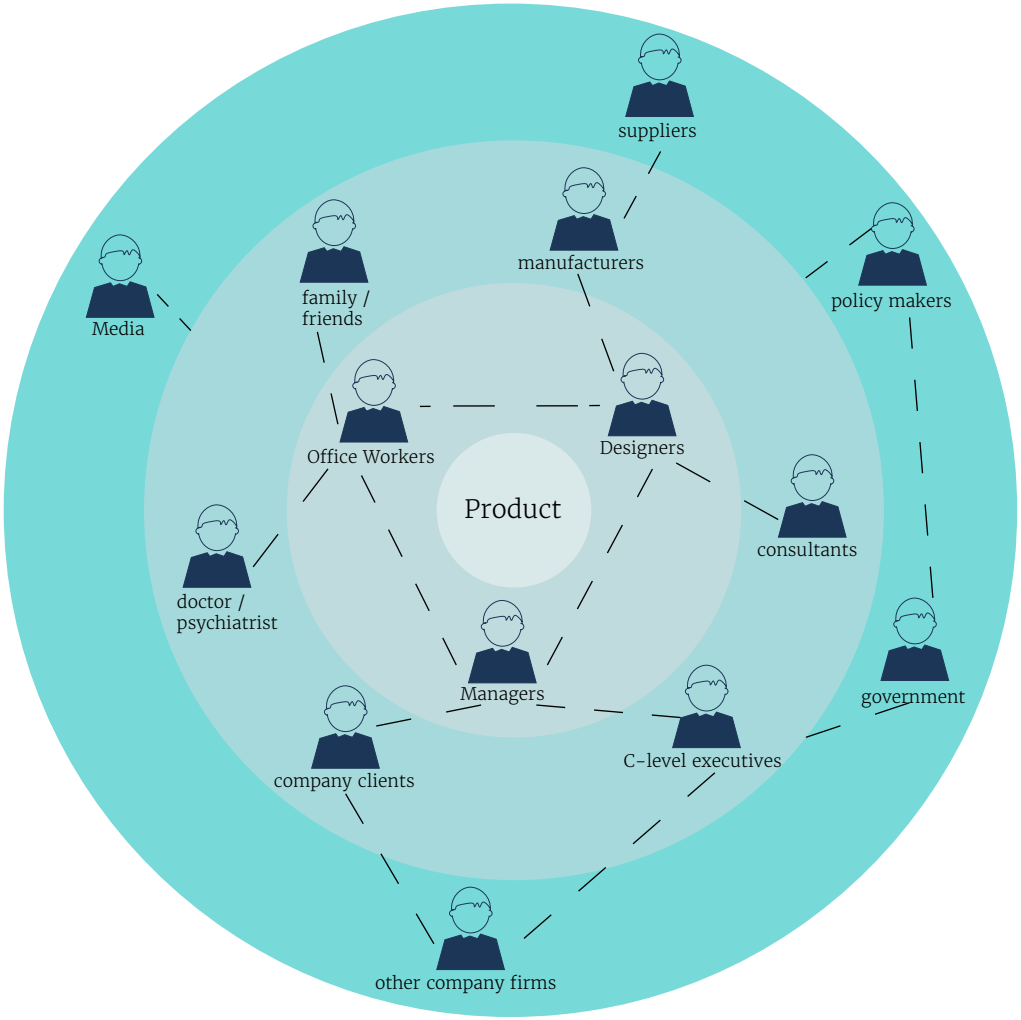


Figure 6.1 Stakeholder Onion Map

# BMI • Value proposition canvas

Persona: office workers

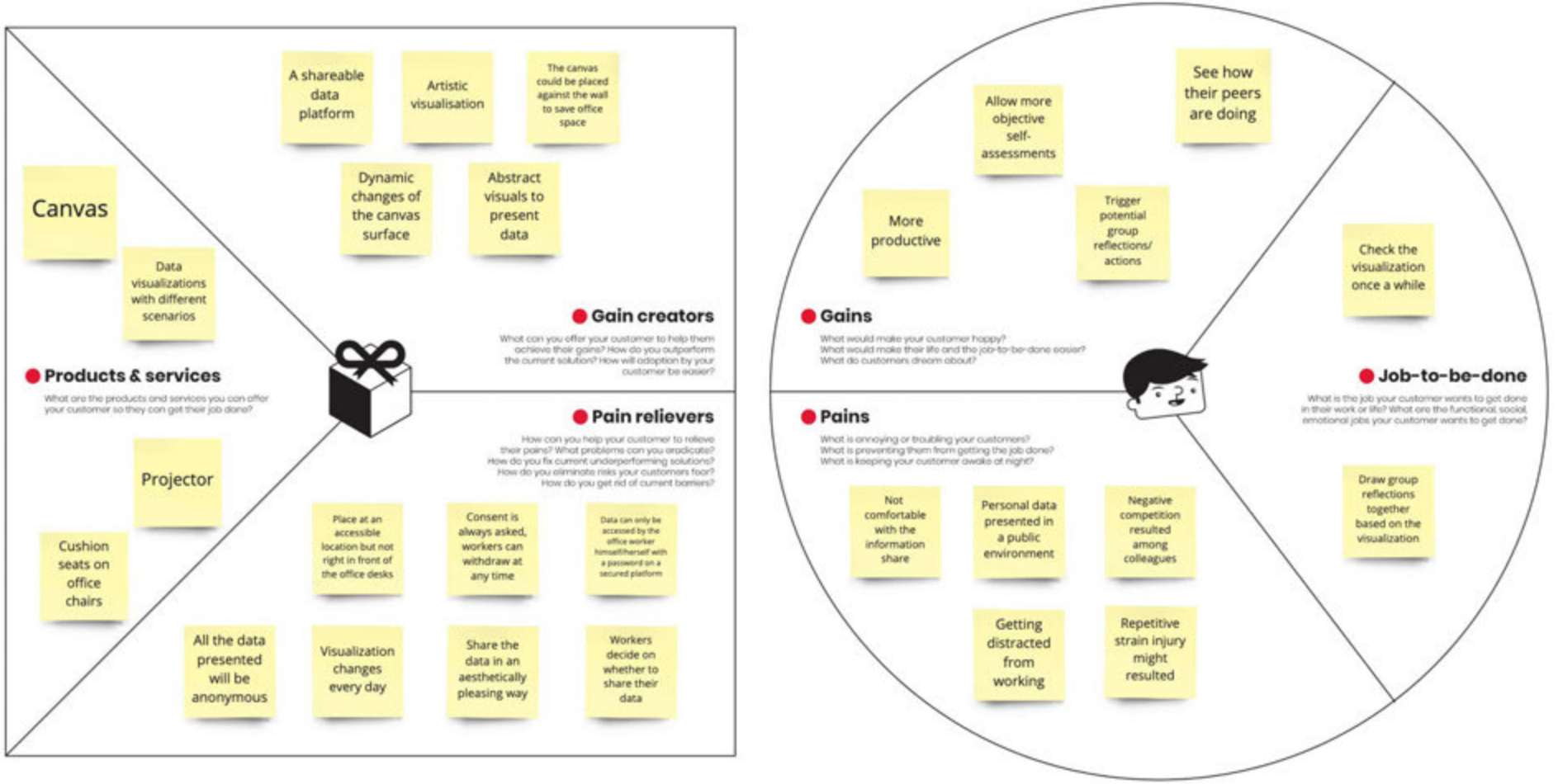




Figure 6.3 Value Proposition Canvas with Office Workers as the Persona

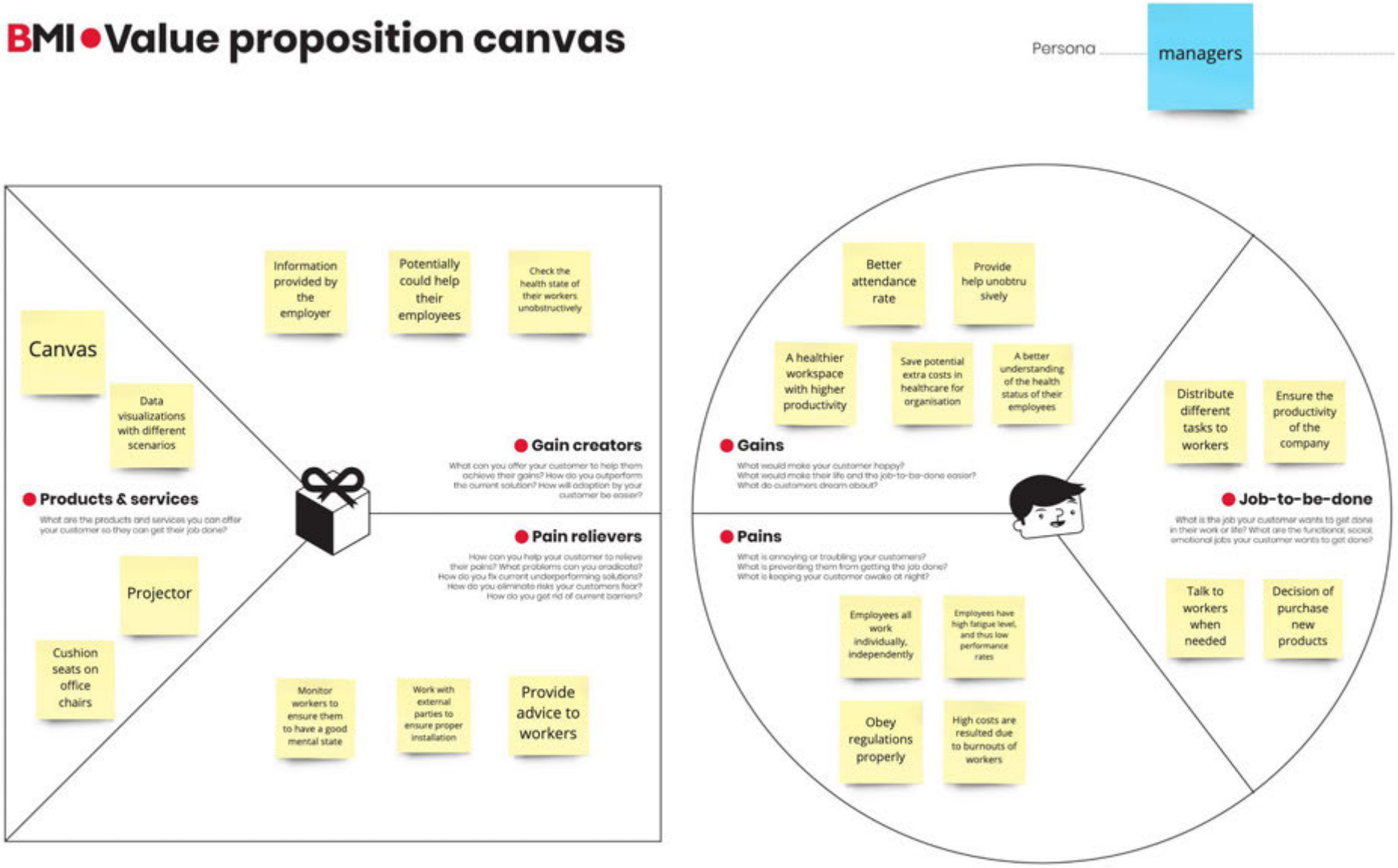


Figure 6.4 Value Proposition Canvas with Managers as the Persona

Compared to designs which help people to cope with stress independently, the largest value of this concept is that being a group intervention. Group interventions have the following benefits: 1) efficient to use (Swancutt et al., 2019); 2) realise individuals are not alone (Tartakovsky, 2016); 3) experience with shared social identities (Swancutt et al., 2019); 4) form meaningful psychological connections with each other (Swancutt et al., 2019); 5) enhance well-being performances; 6) encouraged to give and receive support (Tartakovsky, 2016). And collective coping is more efficient in reducing employee's stress than coping individually (Rodríguez, Kozusznik, Peiró, & Tordera, 2019). Therefore, theories in socio-psychological field implied the need of developing group intervention tools to facilitate collective coping with stress. By introducing a public visualization in the office, it provides a general impression of the psychological performance of workers in the working area. Group reflections could be triggered, and co-workers could help each other out. In this way, the design can help with establishing better interpersonal understandings as well as community feelings in the office environment.

Beside looking at the values on the group level, there are also added values on the individual level for office workers. Under stressful conditions, employees might struggle to pause and reflect on their own stress levels. There is often a gap between one's perceived and one's actual level of stress. With this design intervention, office workers can assess their own work-related psychological behaviour more objectively. It helps people to stay self-conscious, without asking them to think a lot before concluding whether they are stressed. In the long-term, the design could help workers to avoid potential health problems and thus save extra costs in healthcare.

This design will not only benefit the office workers, but also the office managers. Eventually, office managers will be the decision-maker whether the interventions will be installed in their offices or not. They are the direct customers who purchase for the intervention. The added value for them is that they could help their employees to be more conscious of their health performances. Therefore, they could indirectly make sure the absence rate of their employees stays low. This means workers could contribute to the company more sustainably for a long time.

The canvas is aimed to be used together with collected personal data of office workers. It needs to ensure the values added to office workers are more than potential problems that might result. Office workers will be the group of people who are the key players where their interest and the power of the stakeholder will be both high. Thus, it is essential to design the user experience around the intervention in detail. Office workers will need to give full permission of how their data will be shared and to whom they feel comfortable to share with.

First of all, office workers will be fully informed about what data will be collected, how their data will be collected, and where their data will be stored. Before visualising their data in the office, they will need to give consent by signing a form. The data will be stored on a secured server. The data set of an individual will be given with a unique identifier. Only the office worker who belongs to the data could access his or her own data, with the use of a user-name and a password to log in to the server. The data will be needed to be revised before presenting on the canvas. Once they review the data and give permission to present their data, the data will then be presented to the public anonymously. Only the employees themselves could decide on whether to show their data to the public or not. It also has to make sure that managers are not forcing or providing incentives to their employees for sharing personal information. Furthermore, at the end of the day, all the data collected during the day will be automatically deleted from the server.

To reflect the business model, the following points are addressed. First, it is clear from the value proposition model that there might be some pains that could be resulted from the design. Thus, the entire data collection, processing, and visualization process and procedure should present to employees as clear and transparent as possible (Dijk, 2018). Permission from employees should be given for each step. On top of that, the system has to make sure that no private information that might be able to tack back to certain individuals easily will be shown on the display. The visualization and the locations for representing individuals will be changed daily. This limits the possibility of people figuring out each other. It also needs to ensure that there are sufficient numbers of points so that people can get a general impression without self-disclosure easily. However, the sample size should also not be too large as then the information might be hardly recognizable for the individual user. Lastly, office workers who have burnout experiences should be excluded. The purpose of that is to not remind bad memories of them.

# 07. Ethical Considerations

## 7.1 Designer's Intention

Collective coping is more efficient in reducing employee's stress than coping individually (Rodríguez, Kozusznik, Peiró, & Tordera, 2019). Therefore, theories in socio-psychological field implied the need of developing group intervention tools to facilitate collective coping with stress. In HCI field, a majority of stress management explorations use biofeedback or personal informatics systems for individual stress coping. Few works had addressed social facets of stress and develop collective coping techniques. An opportunity is seen in combining the benefits of group interventions in sociology and HCI stress management technologies, to develop socio-technical solutions to facilitate stress coping from a collective point of view.

Currently, office workers need to self-assess themselves individually to determine whether they are stressed. However, they are often busy, thus sometimes might not have time for reflecting. By introducing a public visualization of stress levels collectively, it saves time and stimulates office workers to draw reflections together. Thus, the goal of raising the awareness of office workers about their stress levels could be achieved.

## 7.2 Potential Unethical Situations

Some potential unethical situations are considered. Firstly, since data is presented in the public, managers can see office workers' personal data. Although the data is anonymous, managers can still get a general impression. This might result in some workers not feeling comfortable. Additionally, if someone is already relaxed or stressed, they might not feel well when seeing the display. In addition, managers might be not satisfied if they see employees not performing healthily. They will raise concerns about employees' work.

On top of that, there are several wrongs or weird situations that have been taken into consideration. First, the data used might not be a perfect representation, because stress is a personal and psychological feeling. Besides, there is a possibility of people figuring out individual representations of the data points and might make jokes about other people. Moreover, the cushion could be incorporated in the seats which would not be obvious to workers. Hiding the cushion without informing the person who sits on the chair would be unethical. Lastly, not enough workers present would allow people to figure out each other easily. This is not ideal as personal data can be related to the person.

Since the projection imagery is incorporated, over some time the visuals might be repetitive. Thus, it will be less attractive. Another potential problem is that the motor shield or arms might be broken. This means it should be checked once upon a time.

In addition, it would be unethical to use the data for a different purpose apart from allowing office workers to understand their own performances collectively. With situations such as data being used for a study or other people accessing the data, permission for the worker should be given.

# 08. Evaluation

The evaluation of the project was done by conducting two expert reviews. One expert has a background with collective stress visualizations and the other has a background with biofeedback for managing stress. The sessions were conducted separately by one team member and each session took about one hour. The team member went through the entire design process briefly with the expert. Figure 8.1 includes some of the slides used, the complete slides can be found in Appendix J. Afterwards, the expert gave feedback on the general process and provided suggestions. The feedback could be looked into with four aspects: first iteration, ethical considerations with collective design, the final concept, and the next steps.

The first aspect is the first iteration of the design. The idea was liked because it was related to stress balls and used a tangible interface. However, one tip was that people could understand the shape-changing differently - which situation represents stress and which one not. Moreover, it was suggested that with the use of a harder material for the ball, then the issue of balloons being easily broken could be resolved. Furthermore, the experts agreed with the fact that the balloon invites people to interact which is not the purpose.

Another point revised is ethical considerations. It was advised to make sure how the data is collected and processed, and how the system works are as transparent as possible to users or participants. They should be well-informed. At the same time, the data should be stored safely and not be presented individually. In addition, it was suggested that the target group could be clarified further with an excluding criteria of not designed for workers who have burnout experiences to not remind them. Moreover, a recommendation got is different strategies could be proposed with different group sizes. Based on the expert's research, people are relatively willing to share data with those they know but not with strangers. Therefore, in the future, the intervention could be improved by focusing on small group workers.

On top of those, the canvas design itself was evaluated. Both of the experts thought this was a good direction. It was thought that the design could be more collective. This means a big visualization showing only the average performance, but allowing workers to individual's stress level through a secured platform. Additionally, the pattern visual was believed could be more abstract to hide details. Moreover, the idea of using an actuator for a third dimension was liked. One tip was that the actuator could be used to show the average stress level and small visualizations such as dots could be used to show individual stress levels. This also would solve the problem of having too many actuators. On top of that, the data updating frequency was discussed. To show the changes clearly, it was suggested that the frequency should be around every 30 minutes and show the average performance of the past 10 minutes. This enables people to adjust their activities on time.

Lastly, experts provided some suggestions for future work if the project continued. It will be included in Chapter 10.

Overall, experts believed that the project is in a good direction with the combined use of shape-changing factors and digital interfaces. The combination is new which makes it valuable.

Figure 8.1 Some of the Slides for Expert Reviews

# 09. Conclusion

With the given time and resources, an iterative process was applied and multiple expertise areas were successfully taken into consideration. Although the project is largely based on data and technologies, considering the aesthetics, conducting user research, exploring the business opportunities were also integrated to some extent. In addition, the learning points from the first iteration were taken into account in the second iteration. In general, the entire process was quite smooth.

There are still a few improvements that could be made. First of all, the ideation process was relatively short in both of the iterations. This was mainly due to the development goals of the team focused on the realisation of the design. However, since this is a design project, more ideation and conceptualisation could be incorporated. In addition, it was realized that the understanding of related technology was important. Although the entire process was clear in the end, it could be done at the start which might also support the design process even further. Furthermore, the process of coming up design sketches was tough. It would be better if a brainstorm session was planned at the start.

All in all, the goal of raising awareness of stress levels among office workers collectively has been fortunately worked out with the final concept (Figure 9.1-9.3 as recapping the concept).

Figure 9.1-9.3 Final Concept Recap

# 10. Future Work

One follow up step of the project could be testing the design. To test the design, the collaboration with stakeholders of managers or company C-level members would be done. This could help with looking at the design not only the office workers' perspectives. Based on expert reviews, it seemed to be important to co-design with the managers. The design shall match the office culture of the company, at the same time to have a healthier workspace. On top of that, deployments of the design could be made in the office. This could check the emotions of office workers and thus conclude the acceptance level of office workers.

In addition, with more time, the design of the visualization could be explored and detailed further. One expert believed that the visualization could be more subtle and abstract, and thus not directly link to objects in daily life. On top of that, technologies such as programming could be used for the visualization. This would allow the deployment to be easier and the visualization could be changed automatically. Moreover, as mentioned in Chapter 8, the motor and the visualization could be used for two different sets of values - one shows the average performance whereas the other shows individual performance. In this way, the design could be more collective.

Lastly, this project only focuses on visualization. After testing the visualization, possible side-interventions could be developed to help people to draw reflections collectively. This would reach the stage of reflection in the Personal Informatics Model and the preparation stage of the Transtheoretical Model. Further from this, the effectiveness of reflection could be tested with the actions triggered.

All in all, the work could proceed with testing the design in a real-life context, cooperating with office managers and workers, and following through the stages of behaviour models.

# 11. Acknowledgements

First of all, we would like to acknowledge our project coach, Jun Hu, who helped and guided us a lot throughout the design process. The feedback was always valuable, concrete, and motivational. In addition, we appreciate experts who revised and validated our project work: Xiang Yu, Mengru Xue, and Bin Yu. Moreover, we value a lot for the extensive technological support and help with value proposition analysis from Matthijs Hoekstra. Lastly, we would like to thank Carine Lallemand and Daphne Menheere for helping us with the text and the visual of the demo day poster.

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# 13. Appendices

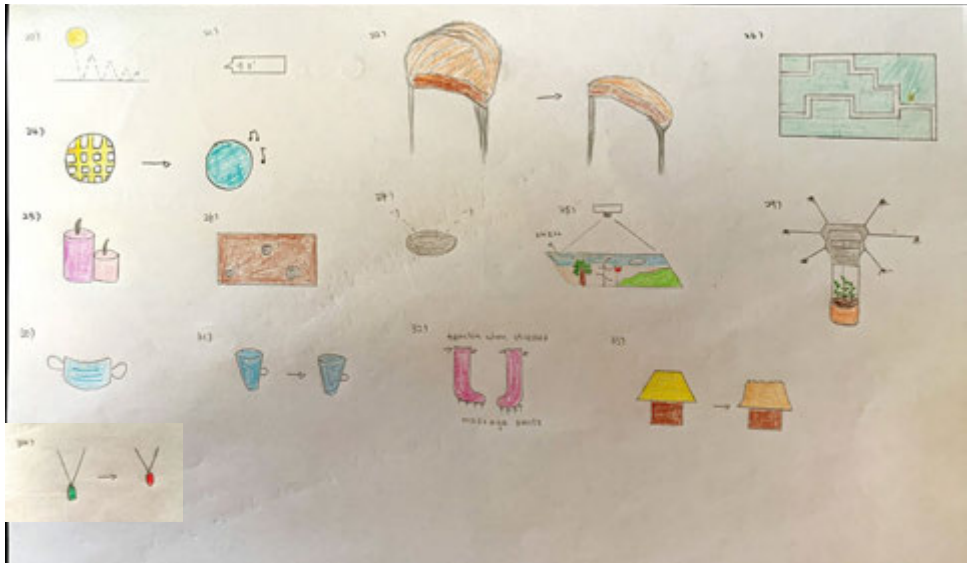
## A. 100-sketches Challenge

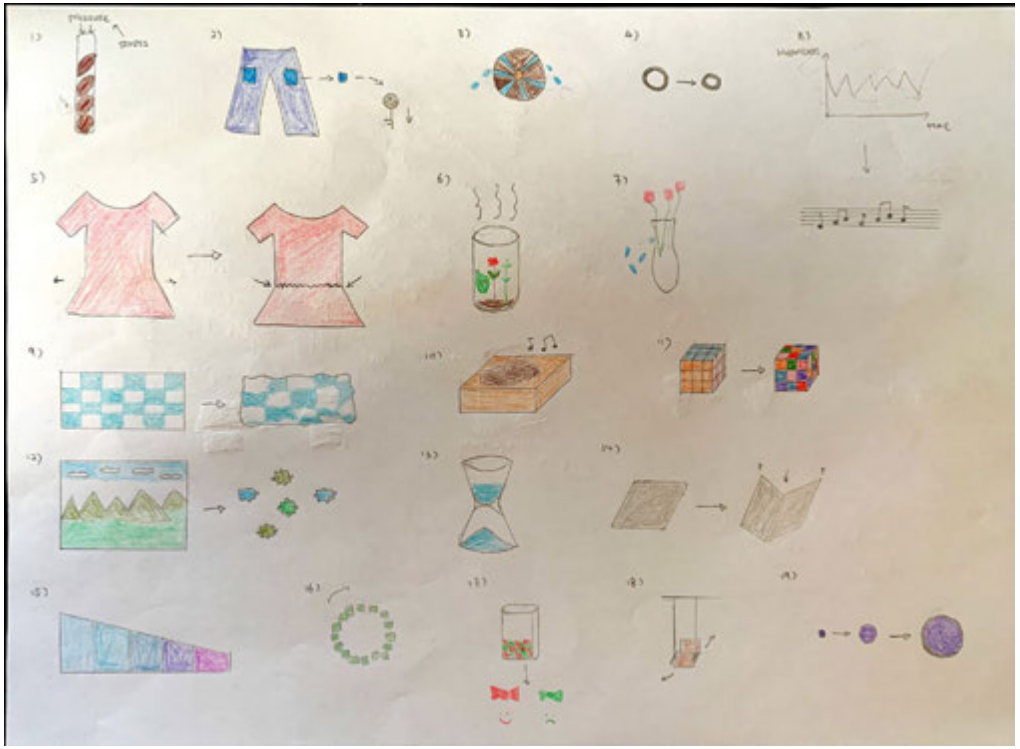
**Overview of 100-Sketches Challenge**

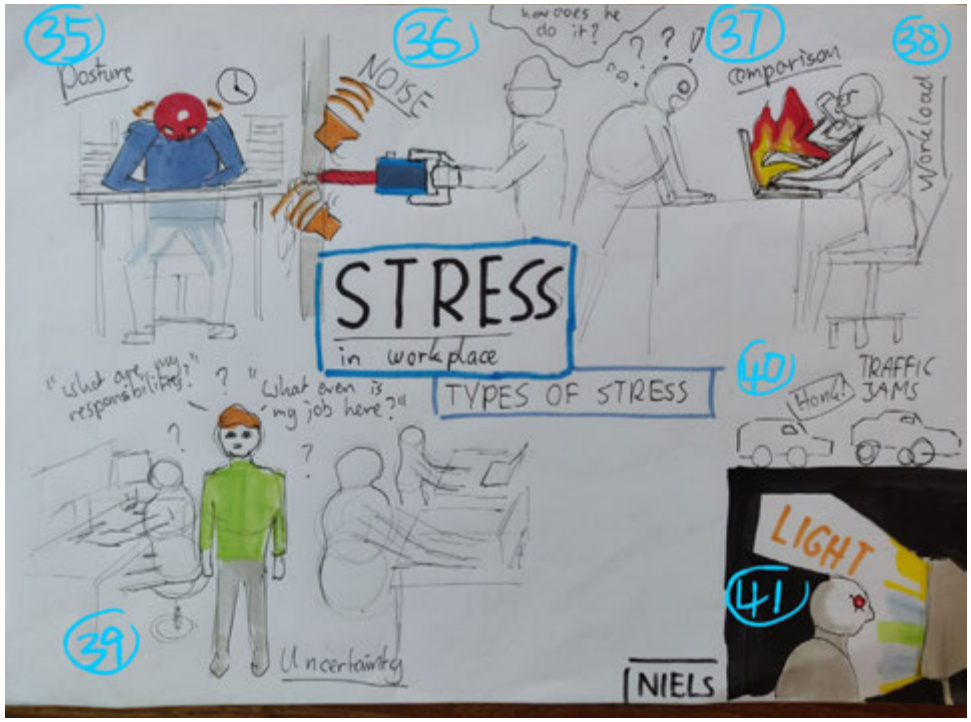
| No. | Description |
|---|---|
| 1 | Coffee beans generator by the heartrate (stress level) |
| 2 | Pocket-size reduces when more stressed, keys fall out |
| 3 | Water wheel spinning and produce the sound of flowing water |
| 4 | The ring on the finger gets tighter when stressed |
| 5 | The dress gets tighter when stressed |
| 6 | Small forest ecosystem has the nature smell when opening (stressed) |
| 7 | Turning on the watering system for flowers when stressed |
| 8 | Music generator based on the heartrate |
| 9 | Deformation of fabric on the table |
| 10 | Music generator according to a worker's memory |
| 11 | The Rubik's Cube – the order messes up when stressed |
| 12 | Puzzle breaks when people are stressed |
| 13 | Hourglass – the sand at the bottom represents the stress levels |
| 14 | Deformation of the seat to inform people about stress |
| 15 | Folded slider opens up when average stress level is getting higher |
| 16 | Dominos fall, create a sound effect when a group is stressed |
| 17 | Sweet/sour candy bag generator based on the average stress level |
| 18 | Swinging chair when people are stressed, otherwise the chair would be stable |
| 19 | Yoga ball expands when people are stressed, encourages people to do exercise |
| 20 | Ping-pong ball bouncing creates sound when stressed |
| 21 | An encouraging voice message from who you care a lot/mean a lot to you |
| 22 | More collective working space when workers are stressed |
| 23 | Creating a walking path for meeting by the stress |
| 24 | Light bulb turns into a disco ball when stressed |
| 25 | Candlelight and smell to create the peacefulness for relaxing |
| 26 | Fabric pieces collect the sound of you working, and send to another worker |
| 27 | A talking stone to share thoughts, an anonymous worker would reply |
| 28 | A projection to see virtual nature and creates the smell of the nature |
| 29 | Moving plants on domes to ask workers to water them |
| 30 | Masks that provide a smell of nature, covers the eyes for relaxing |
| 31 | Adding stress level and results in a change of cup colour |
| 32 | Socks that have a reminder and massage function |
| 33 | The light changes the material by turning to another side (hard and soft lighting) |
| 34 | Necklace changes the colour and becomes shorter |
| 35 | Types of stress – the posture |
| 36 | Types of stress – the noise |
| 37 | Types of stress – comparison |
| 38 | Types of stress – workload |
| 39 | Types of stress – uncertainty |
| 40 | Types of stress – traffic jams resulted in late for working |
| 41 | When stressed, workers need light and guidance |
| 42 | Event based analysis |
| 43 | Temperature colour change |
| 44 | A slide for excitements to reduce stress |
| 45 | "bed of nails" to feel the pain, in order to show stress |
| 46 | The feel of an electric shock when stressed |
| 47 | The smell of tea spreads when the workers are stressed |
| 48 | Presenting and discussing stress with a group |
| 49 | Music generated by heart rate |
| 50 | Sand scales with scenarios too stressed, perfect, and too released |
| 51 | Fireplace (visual, heat, sound) |
| 52 | Thermochromic cup – cold (together with No. 53) |
| 53 | Thermochromic cup – hot (together with No. 52) |
| 54 | Thermochromic plate / table |
| 55 | Plant growing (together with No. 56) |
| 56 | Water system for plants (together with No. 55) |
| 57 | Black ball representing stress on an interface |
| 58 | Anonymous break – message on a screen (together with No. 59) |
| 59 | Anonymous break – tangible interface to show (together with No. 58) |
| 60 | Feedback <> action |
| 61 | Indication bar on navigation page of the laptop screen |
| 62 | Stress exchange – visualizations (together with No. 63) |
| 63 | Stress exchange – story writing (together with No. 62) |
| 64 | Stressed connection – internet connection gets worse |
| 65 | Measuring stress over a period of time – adding up of several workers |
| 66 | Measuring stress over a period of time – individual levels |
| 67 | Mind map of having positive emotions |
| 68 | When people are stressed, they need – help |
| 69 | When people are stressed, they need – time |
| 70 | When people are stressed, they need – explanation |
| 71 | When people are stressed, they need – holidays |
| 72 | When people are stressed, they need – compliments |
| 73 | When people are stressed, they need – security |
| 74 | Intervention – correct posture with the chair |
| 75 | Intervention – a screen lock on the computer |
| 76 | Intervention – producing a smell (bad) |
| 77 | Intervention – a help line service |
| 78 | Intervention – a coffee alarm |
| 79 | Reason of stress – too much work |
| 80 | Reason of stress – low performance/efficiency rate |
| 81 | Reason of stress – the manager asked for a talk |
| 82 | Visualization – building structure falling apart |
| 83 | Intervention – taking care of the VR pet garden |
| 84 | Intervention – Yoga |
| 85 | Visualization – booming effect |
| 86 | Intervention – a music room for relaxation |
| 87 | Intervention – folding and expanding imagery |

| | |
|---|---|
| 88 | Intervention – a program that gives compliments to what you have done |
| 89 | Visualization – stress map in the office |
| 90 | Intervention – running treadmill |
| 91 | Intervention – locking screen to trigger exercises |
| 92 | Intervention – relaxation room |
| 93 | Intervention – trigger to do sports |
| 94 | Intervention – easy tasks to release stress |
| 95 | Intervention – archery |
| 96 | Intervention – documenting why yourself is stressed |
| 97 | Intervention – anonymous message |
| 98 | Visualization – dial plate for stress levels |
| 99 | Visualization – a hall for VR experience of being in nature |
| 100 | Visualization – music disc turns on when workers are stressed |

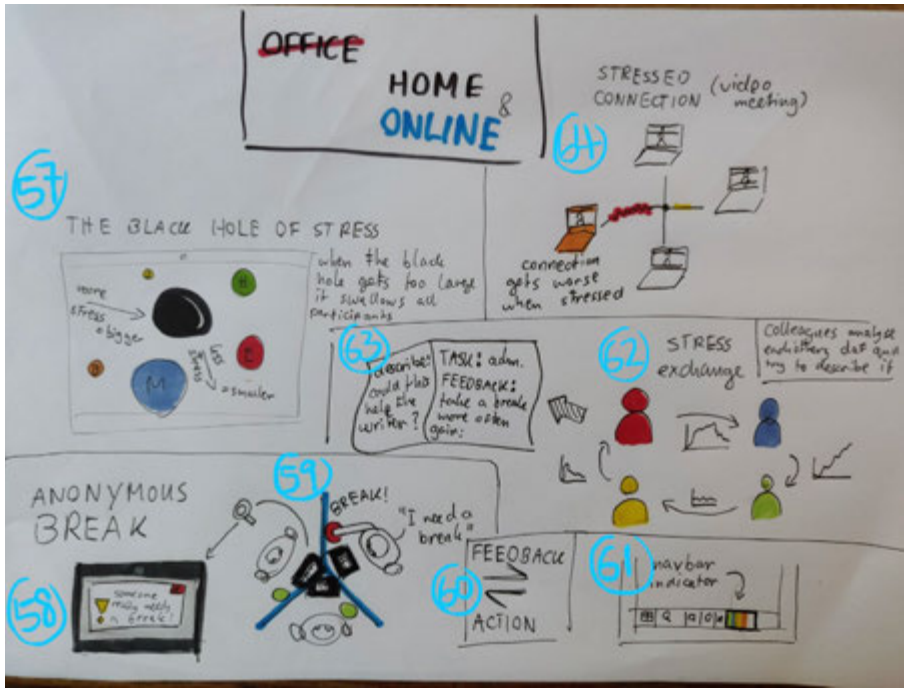
1-34: Yinying; 35-67: Niels (left the group after 3 weeks); 68-100: Joost

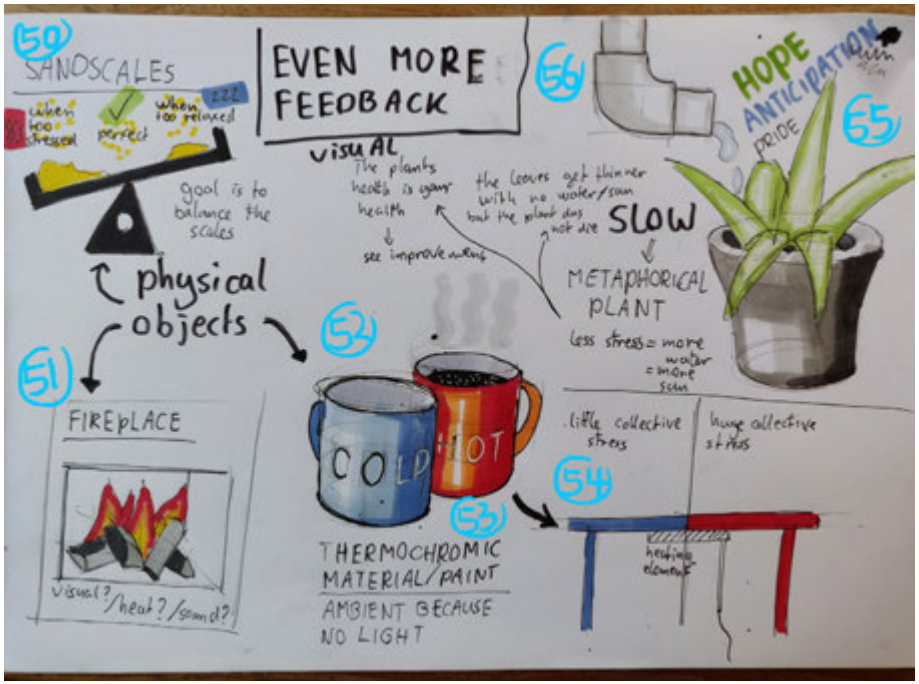


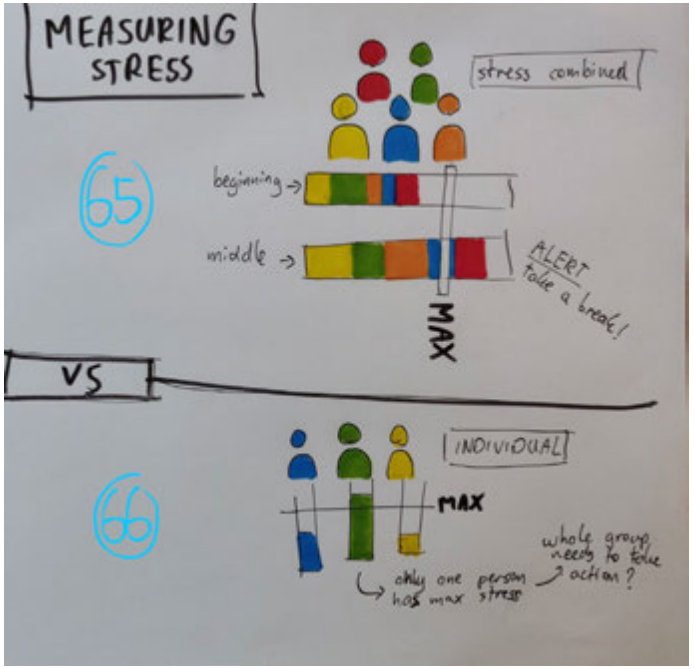


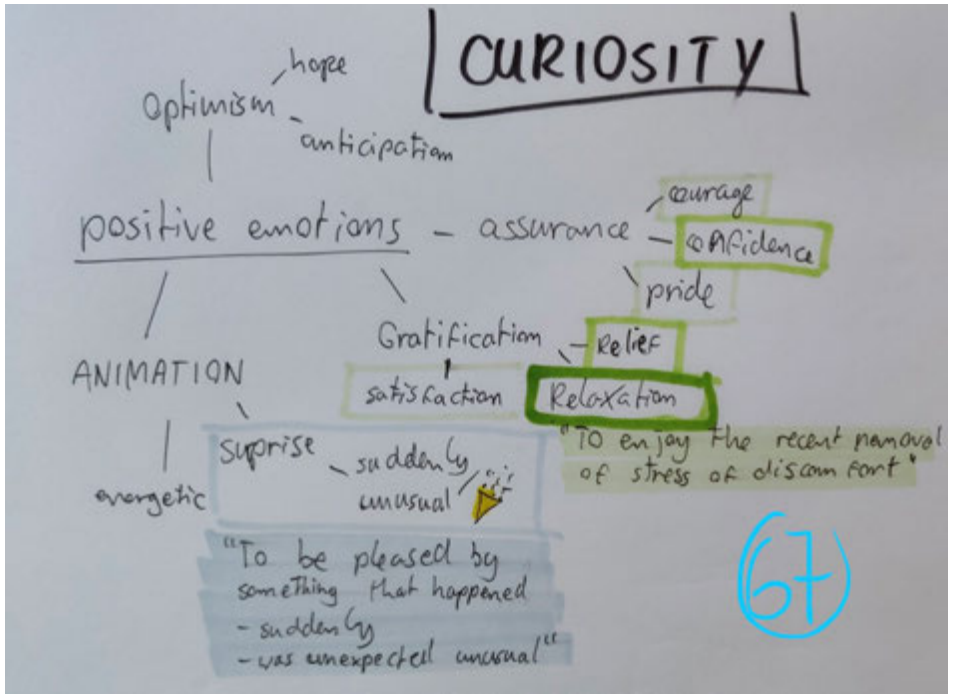


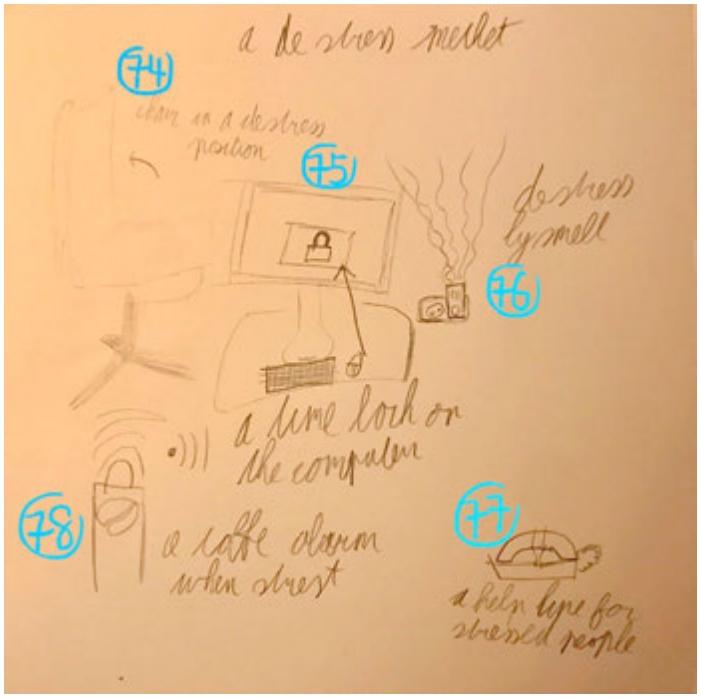

event based analysis
meeting with boss
deadline
stress
time
HEART RATE MUSIC
who is it?
reflection on energizer
stress alarm
is it him?
is it me?
not me!
Let's do something about it
Let's take a break!
leader
FEEDBACK ON STRESS
temperature
too stressed
too relaxed
OTHER solutions
can this kind of excitement take away stress?
THE SLIDE
electric shock (Hongeveld)
replace stress/ acupressure
"bed of nails"
convert distress to eustress
the smell (spreads by itself)
TEA
NIELS


OFFICE
HOME & ONLINE
STRESSED CONNECTION (video meeting)
THE BLACK HOLE OF STRESS
more stress = bigger
less stress = smaller
when the black hole gets too large it swallows all participants
connection gets worse when stressed
describe: could this help the writer?
TASK: adm.
FEEDBACK: take a break more often again.
STRESS exchange
Colleagues analyse each others data and try to describe it
ANONYMOUS BREAK
BREAK!
"I need a break"
FEEDBACK
ACTION
navbar indicator

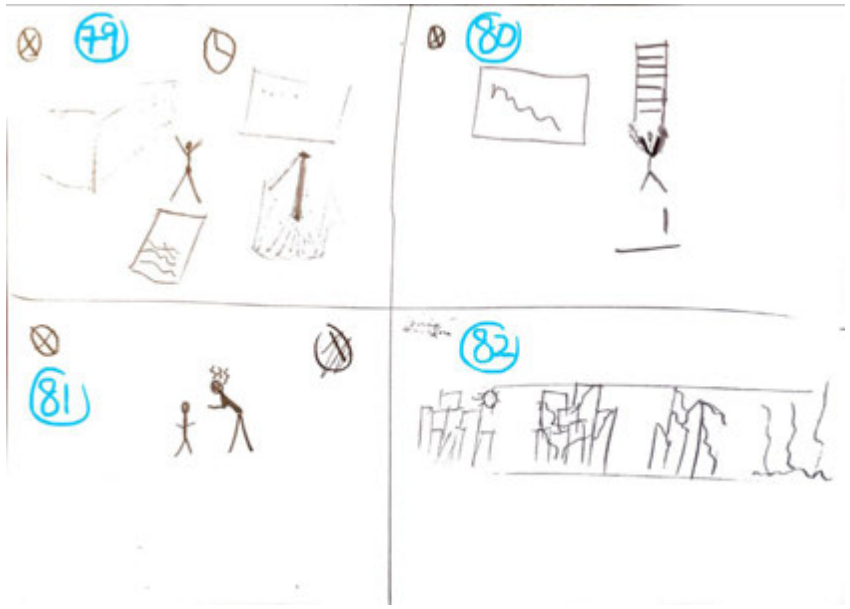

SANOSCALES
when too stressed
perfect
when too relaxed
goal is to balance the scales
physical objects
EVEN MORE FEEDBACK
visual
The plants health is again healthy
see improvements
the leaves get thinner with no water/sun but the plant does not die
SLOW
METAPHORICAL PLANT
less stress = more water = more sun
HOPE
ANTICIPATION
PRIDE
FIREPLACE
visual? / heat? / sound?
COLD
HOT
THERMOCHROMIC MATERIAL/PAINT
AMBIENT BECAUSE NO LIGHT
little collective stress
huge collective stress
heating element

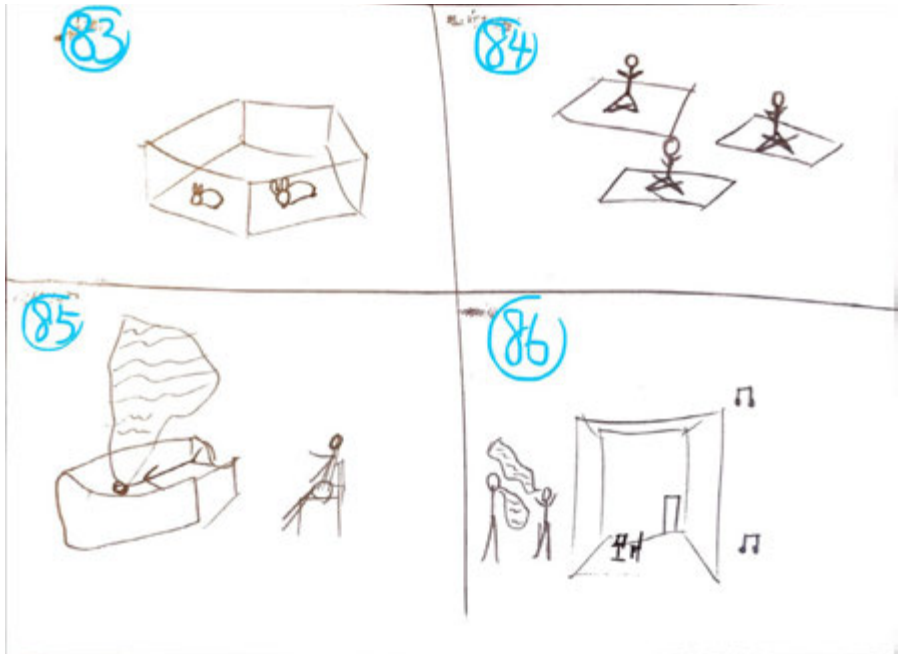

MEASURING STRESS
stress combined
beginning
middle
ALERT take a break!
MAX
VS
INDIVIDUAL
MAX
only one person has max stress
whole group needs to take action?

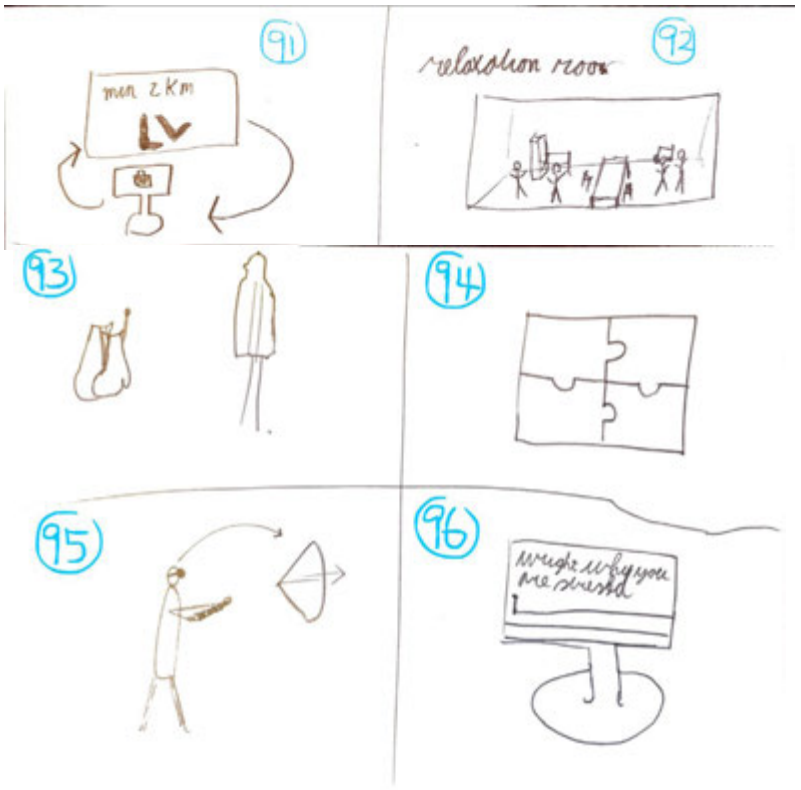

CURIOSITY
Optimism
hope
anticipation
positive emotions
assurance
courage
confidence
pride
Gratification
relief
satisfaction
Relaxation
"To enjoy the recent removal of stress of discomfort"
ANIMATION
energetic
suprise
suddenly
unusual
"To be pleased by something that happened
- suddenly
- was unexpected unusual"
67


a de stress mellet
74
75
76
78
77
a time lock on the computer
a coffe alarm when stress
a help line for stressed people

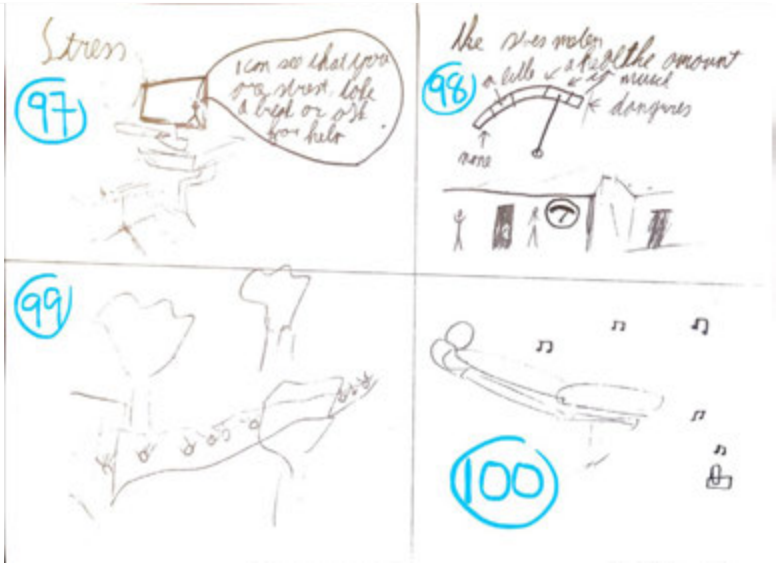

68
69
70
explanation
71
help
time
hobby's
73
72
a compliment
security


79
80
81
82


83
84
85
86


91
men 2 km
92
relaxation room
93
94
95
96


87
a relaxing program
you did:-
88
89
10 min
90

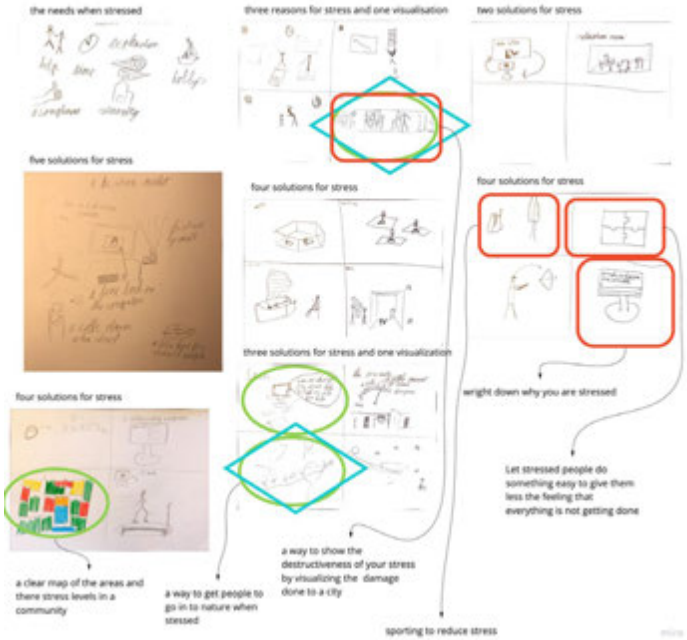

Stress
97
98
99
100

# SKETCHING CHALLENGE

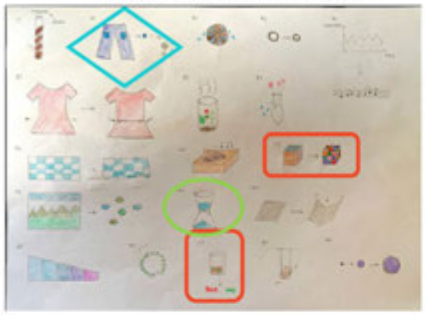
We put our sketches into Miro and explained them to eachother.

We them selected our favorite sketches using the following indicators:

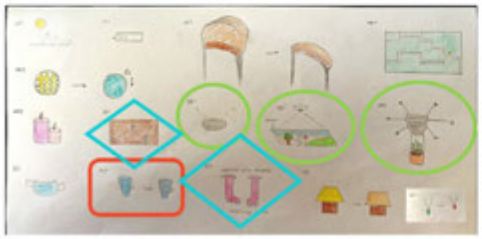

Joost - 33/100 sketching challenge




Yinying - 34/100 sketching challenge

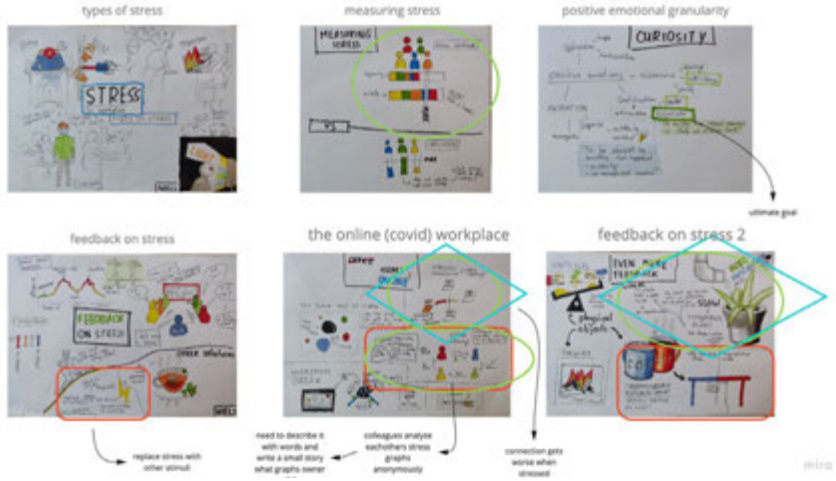


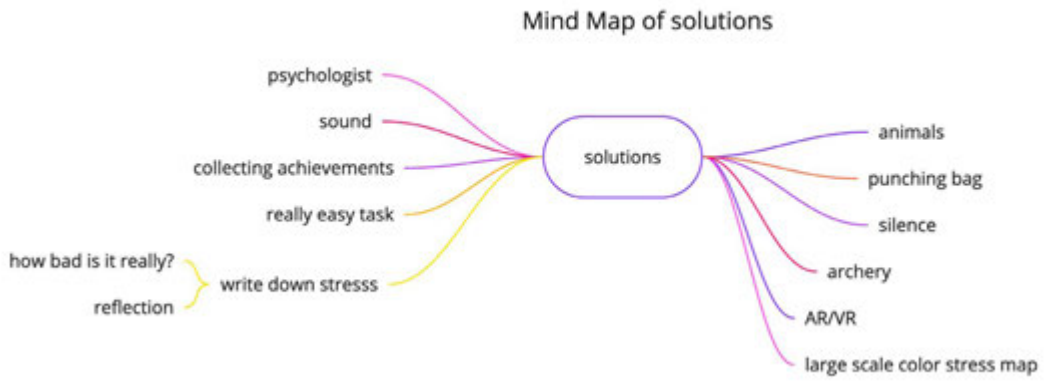
1. Coffee beans generator by the heartbeat (stress)
2. More stressful, pocket-size reduces, keys fall out
3. More collective stress, the water wheel starts to spin, and spins more and more quickly and produce the sound of watering
4. The ring on your hand becomes tighter when you get more stressed
5. The dress gets tighter when you are under stress
6. Small forest ecosystem brings the smell of nature when people are stressed (it opens)
7. Higher stress level opens up the watering system for flowers
8. Music generator based on heartbeat
9. Deformation of fabric on the table when people are stressed
10. Music generator according to one employee's memory when someone is under stress
11. The Rubik's cube – when you are stressed, the orders will mess up
12. Puzzle breaks when people are stressed
13. Hourglass – bottom part presents the stress level
14. Deformation of the seat to let people be aware of their stress
15. Folded slider opens up when people's stress level getting higher
16. Dominos falling creating a sound effect when a person / a group is under stress
17. Sweet/sour generator based on stress (above the average / lower than the average)
18. Swing chair when people are stressed, otherwise, the chair would not move
19. Yoga ball expands when people are stressed and encourages people to do exercises

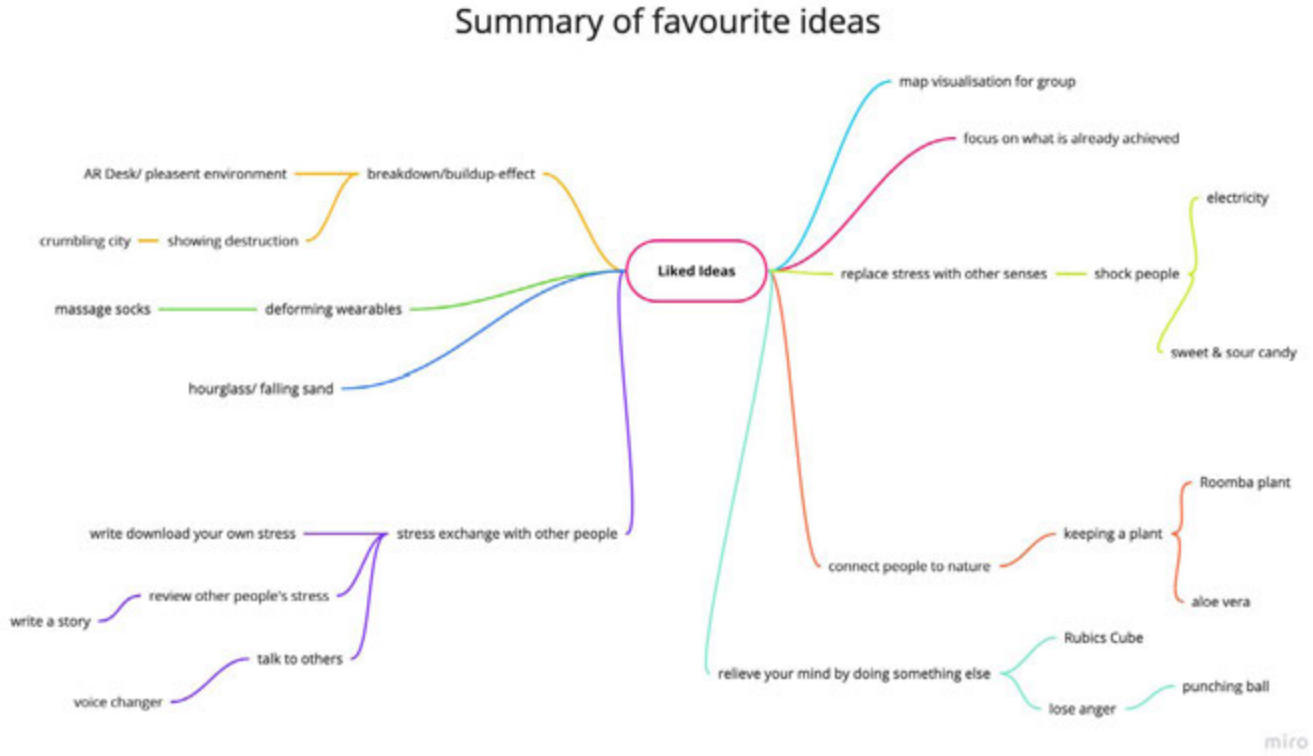


20. Ping-pong ball bouncing (sound frequency)
21. A voice message from someone who you care a lot / mean a lot to you for encouragement
22. Personal working space vs. more collaborative working space
23. Creating a walking path for meeting by the stress
24. Light bulb becomes to a disco ball
25. Candle lighting and smell – peacefulness and for relaxing
26. The fabric piece that collects the sound of you working and send to another collogue
27. A talking stone: you can share your thoughts and difficulties with the stone, it will send to another collogue anonymously, and they will help you anonymously too
28. A projection on your desk to let you feel the virtual nature and provide a smell of nature
29. Moving plants on domes asking for you to water them
30. Masks that provides a smell of nature; it covers the eyes for relaxing
31. Stress level add together, resulting a change in the cup looking
32. Socks that has a reminder and massage function
33. The desk light changes material (by having it with two sides), good lighting for work -> soft lighting for relaxation
34. The necklace changes the colour and becomes shorter

Niels - 33/100 sketching challenge




Mind Map of solutions
psychologist
sound
collecting achievements
really easy task
how bad is it really?
reflection
write down stresss
solutions
animals
punching bag
silence
archery
AR/VR
large scale color stress map


Summary of favourite ideas
map visualisation for group
focus on what is already achieved
AR Desk/ pleasent environment
breakdown/buildup-effect
crumbling city
showing destruction
Liked Ideas
replace stress with other senses
shock people
electricity
sweet & sour candy
massage socks
deforming wearables
hourglass/ falling sand
write download your own stress
stress exchange with other people
review other people's stress
write a story
talk to others
voice changer
connect people to nature
keeping a plant
Roomba plant
aloe vera
relieve your mind by doing something else
Rubics Cube
lose anger
punching ball
miro

# B. Design Criteria

The design criteria were developed based on literary benchmarks and designers' intuition. The goal for this step was to define the requirements that should/could be realised in the design. Criteria could also be used to reflect the concept later.

First, usability and user experience goals were chosen from the book Interaction Design: Beyond Human-Computer Interaction (Helen Sharp et. al., 2019). Four usability goals were: effectiveness, efficiency, utility, and learnability; and four user experience goals focusing on desired aspects were: helpful, engaging, motivating, and enhancing sociability. Afterwards, the specific ways to reach these goals were defined and categorised into MoSCoW (must be, should be, and could be) list. The completed list is the following:

*Usability Goals → MoSCoW element*

- Effective to use
  - To present the stress **clearly** → SHOULD
  - The visualization creates a clear **distinction** between people stressed or not → SHOULD
  - People can **check** their performance later on with saved data → COULD
- Efficient to use
  - To be **fixed** at a certain **place** (i.e. at the left-top corner of the table) → COULD
  - Easy and quick to **access** your **data** → MUST (/ SHOULD)
  - **Minimal** steps or even **automated** for users to take → MUST
  - Not take a lot of extra space → SHOULD
- Utility
  - Provide the **desired functions** → SHOULD
  - Show the stress → MUST
  - Deal with the stress → COULD
  - Users can **interact** with it → SHOULD
- Learnability
  - **Easy** and **clear** to users how to **set it up** → SHOULD
  - Easy to learn about the **meaning** of different **signals** → MUST

*User Experience Goals (focus on desirable aspects) → Moscow element*

- Helpful
  - **Inform users** about their stress level → MUST
  - Stimulate behavior change → SHOULD
  - **No obstacles created** for normal activities to users → MUST
- Engaging (& motivating)
  - Users **interact** with the design → SHOULD
  - Using visuals, sounds, smells, feelings, or tastes → MUST
  - Providing interesting **information** (i.e. 'facts' to educate people) → COULD
  - Showing **collective** and **individual** stress → SHOULD (/ COULD)
  - **Shape change** - different scenarios of stress levels result in the change in the shape of the product → SHOULD
  - Have a nice outlook → SHOULD (/ COULD)
- Enhancing sociability - especially important under the current situation of the Coronavirus
  - Providing **'collective' information** → SHOULD (/ COULD)
  - Personally **ownable / sharable** → (SHOULD) / COULD
  - 'Connecting' with others and helping each other → COULD

The criteria clarified some important aspects that the design should include. It could also be used to evaluate the design later on. One remark is that the user group was not very specific. With a more detailed target group, the needs could be clarified further based on the group's characteristics.

# C. 3D Sketching Exploration

This part of the process started right after the 100-sketches challenge, with integrating some sketches into CAD designs. The goal was to explore and ideate potential design concepts in a more realistic way.  Figure C.1 - C.3 presents some of the results for this process.

One concern was whether those designs could be realised in real life. The decision was made to focus on tangible designs and consider the technical feasibility of prototype development.

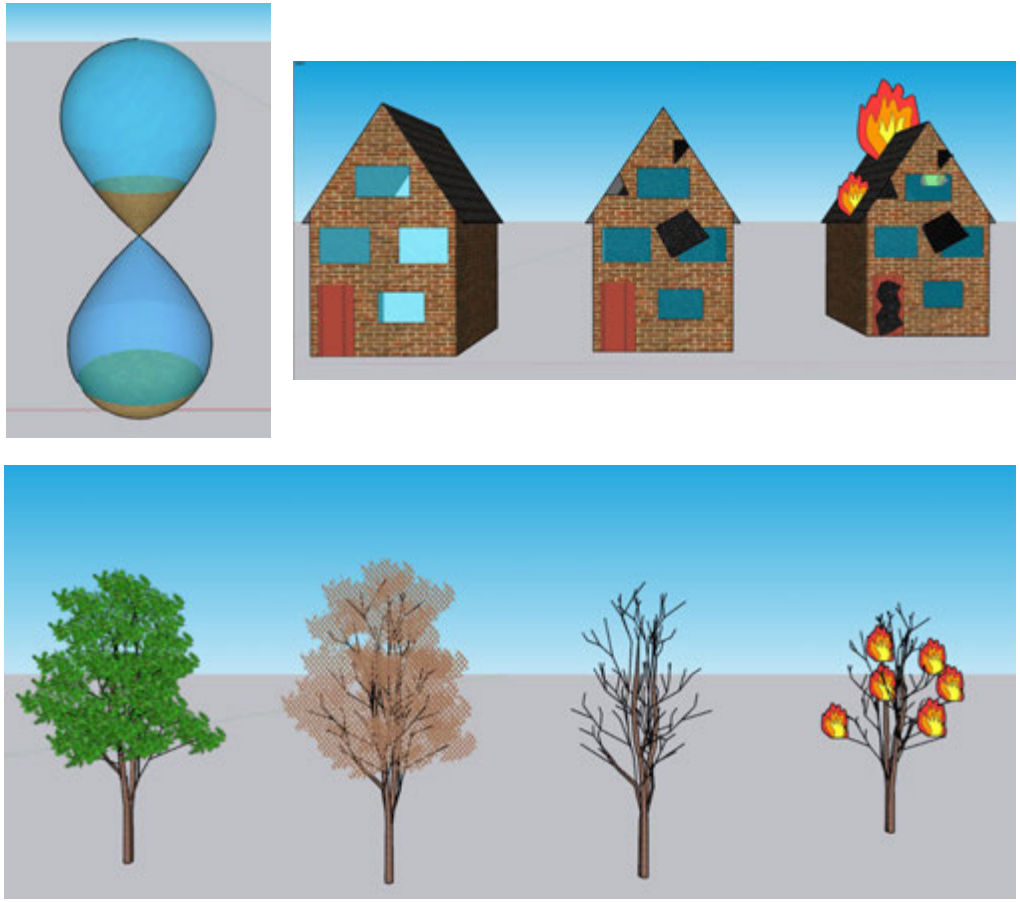


Figure C.1-C.3 3D Sketches for Midterm Concept Exploration

# D. First User Research

To further specify the target group and understand their needs, a questionnaire was developed to collect opinions from potential users.

The questionnaire is designed with four elements. First of all, demographic questions were asked to know about the working environment of the participant. It was followed by the experience of being stressed considering the frequency and the situations. Afterwards, due to COVID-19, the perception of the home office was investigated. Lastly, participant's attitude towards stress visualizations was explored. The complete questionnaire is presented in Figure D.1 - D.7.

This phase of user research didn't progress well. This is because the distribution of the questionnaire was highly dependent on personal networks, which were small for students. In addition, it was concluded that questionnaires were not the best way to reach people for gaining meaningful insights.

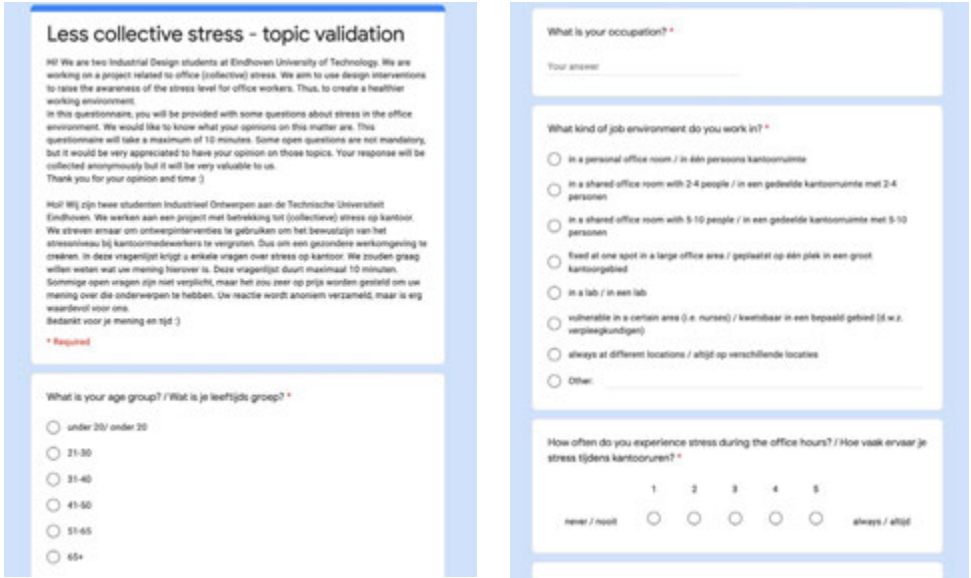



Figure D.1-D.2 User Research Questionnaire - part 1


Figure D.3-D.6 User Research Questionnaire - part 2

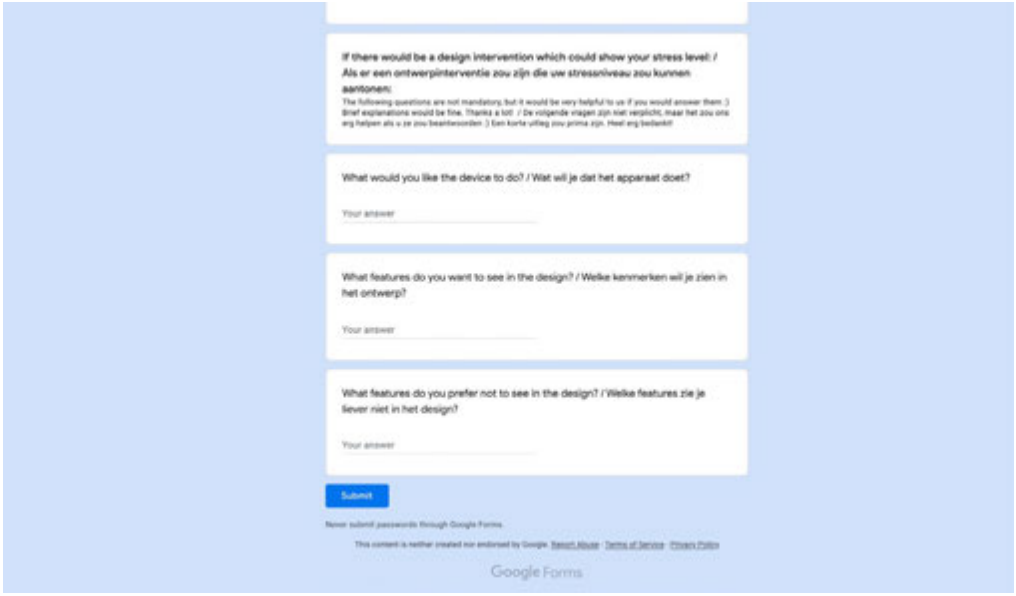



Figure D.7 User Research Questionnaire - part 3

# E. Building Process of Midterm Prototype

1. A large wooden beam was picked.
2. The wooden beam was sewn down a size with a length of about 22cm and a width of about 13cm.
3. A circle with a diameter of around 10cm with the center of the circle being the center of the wood piece was drawn.
4. A hole with a diameter of around 10cm and a depth of around 5cm was carved out with a chisel and hammer.
5. Another small hole was drilled through the wooden beam with a winged drill for connecting to the air pump for the balloon.
6. Small pieces of materials with irregular shapes were put into a balloon.
7. One side of the tube is connected to the balloon and the other side is connected to an electric air pump through the hole made in the beam.
8. The bottom side of the beam was angled for a more natural shape of the design on a desk.

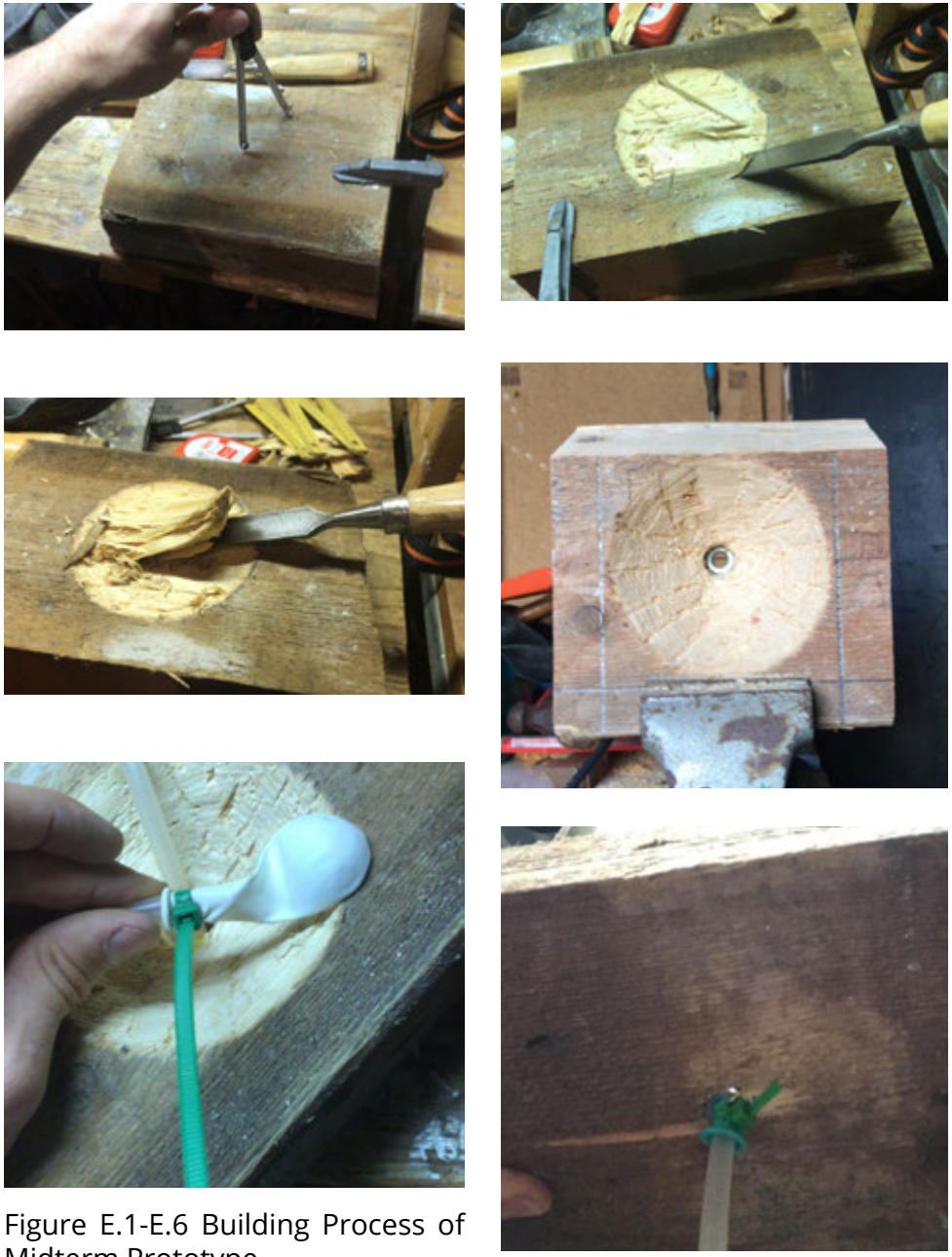
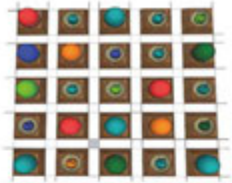


Figure E.1-E.6 Building Process of Midterm Prototype

# F. Positive / Negative-point Analysis of Concepts

| The Canvas | Flower Garden | Balloon Wall |
|---|---|---|
|  |   |  |
| + use vertical space | - hard to realize (maybe requires the use of VR?) | - not serious |
| + can be combined with projections | + related to nature | - can break easily |
| - a lot of actuators | - plant choices | + cheerful / enjoyable |
| + material exploration / stretching | - only horizontally | - doesn't fit with office environment |
| - show which point belongs to you (maybe using objects on the canvas to define the person) | + define the person with the flower types | - too loud with pumping (not favourable in an office environment) |
| - hard to remember; extra action if changes everyday | - hard to remember; extra action if changes everyday | + concept is clear |
| + not very possible for other people to recognise the others | - easier than the canvas idea for people to figure out | + effective to show |
| + use push notification to inform people about the change | + possibility in action triggering | + using vertical space |
| + really collective - representing different people's stress on one canvas | - create confusion if no interaction is intended to be triggered | - a lot of actuators |
| + possible to show something else when it is not needed to show stress | - might be too colourful for an office environment | + define the person with the balloon colour / pattern |
| | | - similar to a benchmark idea (a visual in the coffee room) |
| | | - dependent on how many workers in the room → how many balloons needed |

# G. Explanations of Visualization Concepts

Note: these visualizations were done with considering scenarios of small office working groups.

**G.1 Glass Pyramid and Light Refractions**
One pyramid represents one person. When an individual is stressed, the triangle gets larger while the motor pushes the canvas outwards. This shows the bottom layers of the glass pyramid. With a larger surface of the glass, there will be more refractions resulting from the light passing through. On the other hand, when someone is not stressed, the triangle will be small. This shows the top layers of the glass pyramid. With a smaller surface of the glass, there will be a smaller chance for light passing through the pyramid and resulting in refractions. Instead, there will be more light traveling straight, not getting bent.

**G.2 Flower Blooming**
When office workers are not stressed, the flower will be presented with a small pistil and short petals. One flower represents one individual. The centre of the flower will be where the arm is placed, which is connected to the motor so that this point of the canvas can protrude outwards. When the individual becomes more stressed, the pistil will expand. At the same time, the petals will become longer. With larger pistil and longer petals, different flowers might touch upon each other, and present a view of the flower garden.

**G.3 Shadows of Nature such as Plants**
The shadow of one single leaf represents one individual. When the office worker is not stressed, no shadows will be resulted. Therefore, the canvas will be shown as white. However, when someone gets stressed, the leaf grows while the motor turns the arms protruding outwards at the exact place where the leaf grows.

**G.4 Doppler Effects**
When an office worker is not stressed, then the visualization of showing a static sound source will be used to represent this specific individual. On the other hand, when the worker is stressed, the visualization will be turned into presenting a moving sound source so that the Doppler effect is introduced. The visualization will also increase in size as well as protruding outwards.

**G.5 Ice Cube Forming and Melting**
When nobody is stressed, a flat water surface will be projected. When office workers get stressed, small ice cubes will be formed. Every ice cube represents an individual. At the same time, with a protruded canvas, a 3D view of the ice cube can be given. When people get less stressed, the ice cube will melt and thus form a flatter water surface again.

**G.6 Meissner-Ochsenfeld Effect**
The physical effect is resulted when a superconductor is transiting to the superconducting state. The superconducting state could symbolise a stressful worker. When a worker is under stress, the superconducting state is reached and therefore the magnetic field lines change the directions. When a worker is not stressed, the superconductor is at its normal state, with the magnetic field lines being vertical lines.

# H. Coding for Motor Operation

```
//This code was done by checking the sample code from Adafruit MotorShield library
//This code was done with help from Matthijs Hoekstra
//This code was written and complied by Yinying Miao for Project 2 motor usage in prototype

#include <Wire.h>
#include <Adafruit_MotorShield.h>

int sensorReading1; //needs to be changed to analogread from the data
int sensorReading2;
int motorSpeed;

Adafruit_MotorShield AFMS = Adafruit_MotorShield();

Adafruit_StepperMotor *Stepper1 = AFMS.getStepper(200, 1);
Adafruit_StepperMotor *Stepper2 = AFMS.getStepper(200, 2);
int stepCount = 0;

//SERIAL
int currentValue = 0;
byte values[] = {0, 0};

void setup() {
  Serial.begin(9600);           // set up Serial library at 9600 bps

  AFMS.begin();


  Stepper1->setSpeed(30); //30 rpm
  Stepper2->setSpeed(30); //30 rpm
}

void loop() {
  processData();
}

void processData() {
  if (sensorReading1 < 300 & sensorReading2 > 300) { //partcipant 1 is stressed whereas partcipant 2 not
    stepperoption1();
```

```
void processData() {
  if (sensorReading1 < 300 & sensorReading2 > 300) { //partcipant 1 is stressed whereas partcipant 2 not
    stepperoption1();
    delay (10000);
    processData();
  }

  if (sensorReading1 > 300 & sensorReading2 < 300) { //partcipant 2 is stressed whereas partcipant 1 not
    stepperoption2();
    delay (10000);
    processData();
  }

  if (sensorReading1 < 300 & sensorReading2 < 300) { //partcipant 1 and 2 are both stressed
    stepperoption3();
    delay (10000);
    processData();
  }

  if (sensorReading1 > 300 & sensorReading2 > 300) { //partcipant 1 and 2 are not stressed
  }
}

void stepperoption1() {
  Stepper1->step(100, FORWARD, INTERLEAVE);
  delay (8000);
  Stepper1->step(100, BACKWARD, INTERLEAVE); //turning it to the original place

}


void stepperoption2() {
  Stepper2->step(100, FORWARD, INTERLEAVE);
  delay (8000);
  Stepper2->step(100, BACKWARD, INTERLEAVE); //turning it to the original place
}

void stepperoption3() {
```

```
  if (sensorReading1 < 300 & sensorReading2 < 300) { //partcipant 1 and 2 are both stressed
    stepperoption3();
    delay (10000);
    processData();
  }

  if (sensorReading1 > 300 & sensorReading2 > 300) { //partcipant 1 and 2 are not stressed
  }
}

void stepperoption1() {
  Stepper1->step(100, FORWARD, INTERLEAVE);
  delay (8000);
  Stepper1->step(100, BACKWARD, INTERLEAVE); //turning it to the original place

}


void stepperoption2() {
  Stepper2->step(100, FORWARD, INTERLEAVE);
  delay (8000);
  Stepper2->step(100, BACKWARD, INTERLEAVE); //turning it to the original place
}

void stepperoption3() {
  Stepper1->step(100, FORWARD, INTERLEAVE);
  Stepper2->step(100, FORWARD, INTERLEAVE);
  delay (8000);
  Stepper1->step(100, BACKWARD, INTERLEAVE);
  Stepper2->step(100, BACKWARD, INTERLEAVE);
}
```

# I. Coding for Cushion Data Processing

```
// This code is largely based on the previous work done by Matthijs Hoekstra.
// The code is adopted for a project 2 team consists of Joost Buining and Yinying Miao.
// The adoption for the code is done by Yinying Miao.

// For clairty purpose: in this code, participant 1 would have the cushion that Yinying has.
// Partcipant 2 would have the cushion that Joost has.
// In this way, we could test whether the code works.

import java.text.SimpleDateFormat;
import java.util.*;

//-----------------------------------------------------------------------------------------------------------------------------
//
// Code to get realtime (only realtime) data from sensor-equiped cushions
//
// TODO:
// - History - pull logged data on the server
//
// Written by: Matthijs Hoekstra - matthijs.hoekstra@live.nl

//-----------------------------------------------------------------------------------------------------------------------------

//Necessary: HTTP-Requests-for-Processing - https://github.com/runemadsen/HTTP-Requests-for-Processing - Findable in libaries
import http.requests.*;

Map<String, Cushion> cushion = new HashMap<String, Cushion>();
int lastMeasureTime = 0;
int timeBetweenMeasurements = 4000;

String accesstoken = "f9780f59cf9d4629807057a31c69bd3b";

String snCushion1 = "BBFE0312000D9F7C"; // participant 1
String snCushion2 = "BBFE031200048820"; // participant 2

//start - code for connecting to arduino
import processing.serial.*; //import processing serial library
Serial port; //link to serial port
//end - code for connecting to arduino
```

```
39
40
41 void setup() {
42   //Create for P1 (participant 1) a cushion (SN: <snCushion1>) with accesstoken and no debug information (in this case - Y)
43   cushion.put("P1", new Cushion(snCushion1, accesstoken, false)); //participant 1
44   cushion.put("P2", new Cushion(snCushion2, accesstoken, false)); //participant 2
45
46   //start - code for connecting to arduino
47   String Arduinoport = Serial.list()[0]; //needs to be checked
48   port = new Serial(this, Arduinoport, 9600);
49 }
50
51 void draw() {
52   if ( port.available() > 0)
53   {  // If data is available,
54     println(port.readStringUntil('\n'));         // read it and store it in val
55   }
56
57   if (millis() > lastMeasureTime + timeBetweenMeasurements) { //Make sure we only get data every 4 seconds
58     lastMeasureTime = millis();
59
60     int[] dataP1 = cushion.get("P1").getHealthData(); // return int[] with size 4 - containing statuscode, heartrate, HRV, beats per minute
61
62     println("SN data: " + snCushion1 + " -- data -- status code: " + dataP1[0] + " , heartrate: " + dataP1[1] + " , HRV: " + dataP1[2] + " , Respitory rate: " + dataP1[3]); //Received data
63     if (dataP1[0] == 400) { //HTTP CODE 400 - means everything OK and there is data
64       int heartRate = dataP1[1];
65       int HRV = dataP1[2];
66       int breathRate = dataP1[3];
67     }
68
69     int[] dataP2 = cushion.get("P2").getHealthData();
70
71     println("SN data: " + snCushion2 + " -- data -- status code: " + dataP2[0] + " , heartrate: " + dataP2[1] + " , HRV: " + dataP2[2] + ", Respitory rate: " + dataP2[3]);
72     if (dataP2[0] == 400) {
73       int heartRate = dataP2[1];
74       int HRV = dataP2[2];
75       int breathRate = dataP2[3];
76     }
77
78
79     int value0 = (int) map(dataP1[2], -1, 600, 0, 254);
80     int value1 = (int) map(dataP2[2], -1, 600, 0, 254);
81
82     int out[] = new int[2];
83     out[0] = value0;
84     out[1] = value1;
85
86     println("Serial write : " + out[0] + " , "  + out[1]);
87     port.write(out[0]);
88     port.write(out[1]);
89   }
90 }
```

**Cushion API code used**

```
class Cushion {
  String sn;
  String accesstoken;
  boolean statusDebug = true;

  int lastRequestTime = 0;
  int maxTimeBetweenRequests = 3500; // 4 seconds

  Cushion(String sn, String accesstoken, boolean statusDebug) {
    this.accesstoken = accesstoken;
    this.sn = sn;
    this.statusDebug = statusDebug;
    println(now() + "Added cushion -- SN: " + sn);
  }

  //public void getStatus (String sn) {
  //  GetRequest get = new GetRequest("http://httprocessing.heroku.com");
  //  get.addHeader("Accept", "application/json");

  //  get.send();
  //  println("Reponse Content: " + get.getContent());
  //  println("Reponse Content-Length Header: " + get.getHeader("Content-Length"));
  //}

  public int[] getHealthData() {
    if (millis() <= lastRequestTime + maxTimeBetweenRequests) {
      if (statusDebug) println(now() + "[ERROR] No request send, request to quickly after another");
      return createReturnArray(429);
    } else {
      lastRequestTime = millis();
      String url = "http://131.155.27.54:8011/get/realtime/data?sn=" + sn;
      GetRequest get = new GetRequest(url);

      get.addHeader("Content-Type", "application/json");
      get.addHeader("accessToken", accesstoken);

      get.send();

      return getHealtDataJSON(get.getContent());
```

```
39        return getHealtDataJSON(get.getContent());
40      }
41    }
42
43    private int[] getHealtDataJSON(String jsonRaw) {
44      if (statusDebug) println(now() + "[NOTICE] Raw health data from SN: " + sn + " -- " + jsonRaw);
45
46      if (jsonRaw == null) {
47        println(now() + "[ERROR] Cushion SN: " + sn + " -- no data - null");
48        return createReturnArray(200, -1, -1, -1);
49      }
50
51      boolean online = false;
52      int heart = -1;
53      int breath = -1;
54      int hrv = -1;
55
56      try {
57        JSONObject json = parseJSONObject(jsonRaw);
58
59        JSONObject data = json.getJSONObject("data");
60
61        online = boolean(data.getInt("online"));
62
63        heart = data.getInt("heart");
64        breath = data.getInt("breath");
65        hrv = data.getInt("hrv");
66      }
67      catch(RuntimeException exception) {
68        println(now() + "[ERROR] Cushion SN: " + sn + " -- no heartrate data received");
69        return createReturnArray(200, -1, -1, -1);
70      }
71
72
73      if (online) {
74        if (statusDebug) println(now() + "[NOTICE] Cushion SN: " + sn + " -- online - succesfully received realtime health data");
75        return createReturnArray(400, heart, hrv, breath);
76      } else {
77        println(now() + "[ERROR] Cushion SN: " + sn + " -- offline - no realtime health data available");
```

```
    if (online) {
      if (statusDebug) println(now() + "[NOTICE] Cushion SN: " + sn + " -- online - succesfully received realtime health data");
      return createReturnArray(400, heart, hrv, breath);
    } else {
      println(now() + "[ERROR] Cushion SN: " + sn + " -- offline - no realtime health data available");
      return createReturnArray(200, -1, -1, -1);
    }
  }

  public void setDebug(boolean status) {
    statusDebug = status;
  }

  public void setTimeBetweenRequests(int time) {
    this.maxTimeBetweenRequests = time;
  }


  private int[] createReturnArray(int code, int heart, int hrv, int breath) {
    int[] returnArray = new int[4];

    returnArray[0] = code;
    returnArray[1] = heart;
    returnArray[2] = hrv;
    returnArray[3] = breath;

    return returnArray;
  }

  private int[] createReturnArray(int code) {
    int[] returnArray = new int[4];

    returnArray[0] = code;
    returnArray[1] = -1;
    returnArray[2] = -1;
    returnArray[3] = -1;

    return returnArray;
  }
```

```
112
113   public String now() {
114     // get a calendar instance, this instance should contain the time and date
115     Calendar cal = Calendar.getInstance();
116
117     // create a new simple date format, this will indicate how the time and date should be shown as a string
118     SimpleDateFormat sdf = new SimpleDateFormat("HH:mm:ss");
119
120     // finally return the time and data in the correct format
121     return sdf.format(cal.getTime()) + " -- ";
122   }
123 }
```

# J. Expert Review Slides

TU/e Industrial Design Project 2

**Less Collective Stress, Better Workspace**

Expert Review

Made by Yinying Miao

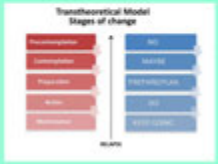
## introduce myself ...

## our goal

- To raise the awareness of the stress level for office workers to have a healthier working environment
- Through data visualization
- COLLECTIVELY

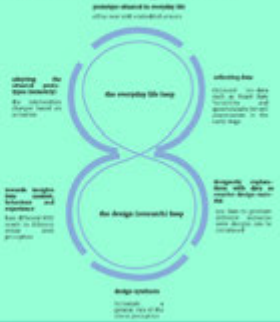
## approaches - theoretical background

- Personal Informatics System --> stage of integration
- Transtheoretical Model --> from Precontemplation to Contemplation
- Data-enabled Design




## approaches - theoretical background

- Personal Informatics System --> stage of integration
- Transtheoretical Model --> from Precontemplation to Contemplation
- Data-enabled Design



## technical background

- collected data through cushions
- processed data

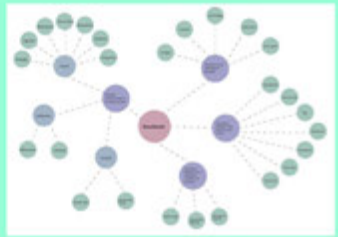

## 1st iteration of the design

- -> **100 sketches challenge**
- -> benchmark research
- -> set up project goal
- -> set up design criteria
- -> a user questionnaire
- -> 3D sketches
- -> final midterm concept

Main focuses:
1) the causes of stress
2) design interventions to present stress
3) design interventions to release stress

## 1st iteration of the design

- -> 100 sketches challenge
- -> **benchmark research**
- -> set up project goal
- -> set up design criteria
- -> a user questionnaire
- -> 3D sketches
- -> final midterm concept



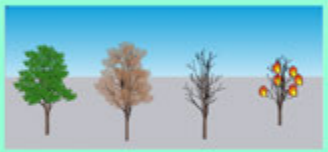
## 1st iteration of the design

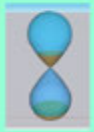
- -> 100 sketches challenge
- -> benchmark research
- -> set up project goal
- -> set up design criteria
- -> **a user questionnaire**
- -> 3D sketches
- -> final midterm concept


- why? -> define target group
- unsucessful, not the best way to appraoch people

## 1st iteration of the design

-> 100 sketches challenge
-> benchmark research
-> set up project goal
-> set up design criteria
-> a user questionnaire
-> **3D sketches**
-> final midterm concept





## 1st iteration of the design

-> 100 sketches challenge
-> benchmark research
-> set up project goal
-> set up design criteria
-> a user questionnaire
-> 3D sketches
-> **final midterm concept**

## 1st iteration of the design - evaluation

- is the concept understandable?
- balloon invites people to touch and play --> interactions
- is the balloon a good choice? --> playful in the office
- missing collective aspect of presenting the stress
- target group not defined --> hard to conduct user tests / evaluation

## 2nd iteration of the design

-> **concept ideation**
-> canvas prototype
-> projection
-> ethical considerations
-> final concept
-> value proposition

| The Canvas | Flower Garden | Balloon Wall |
|---|---|---|
|  |  |  |
| + use vertical space | - hard to realize (maybe requires the use of VR?) | - not serious |
| + can be combined with projections | + related to nature | - can break easily |
| - a lot of actuators | - plant choices | + cheerful / enjoyable |
| + material exploration / stretching | - only horizontally | - doesn't fit with office environment |

## 2nd iteration of the design

-> concept ideation
-> **canvas prototype**
-> projection
-> ethical considerations
-> final concept
-> value proposition

## 2nd iteration of the design

-> concept ideation
-> canvas prototype
-> **projection**
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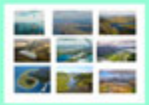
-> final concept
-> value proposition



## 2nd iteration of the design

-> concept ideation
-> canvas prototype
-> projection
-> ethical considerations
-> **ethical considerations**
-> final concept
-> value proposition

- Is it ethical to show stress collectively?
- Is it ethical to come up with general rules for individual stress level?
- How would people feel if they see themselves to relaxed?
--> think from the managerial perspective
  - the visualization changes every day
  - present stress in an artistic way
  - all the data will be annoymous
  - consent will be asked, office workers decide on whether to show their stress or not

- What if nobody wants to show the stress level?

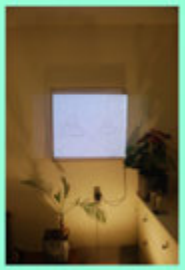
## 2nd iteration of the design

-> concept ideation
-> canvas prototype
-> projection
-> ethical considerations
-> **final concept**
-> value proposition









## 2nd iteration of the design

-> concept ideation
-> canvas prototype
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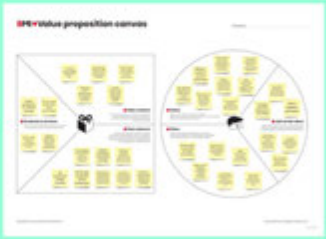
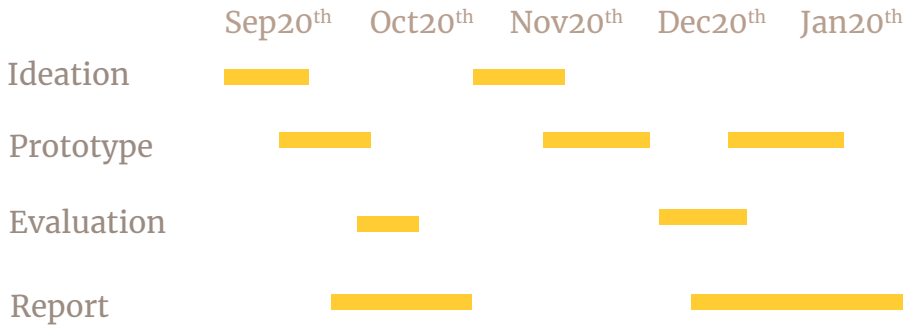
-> final concept
-> **value proposition**



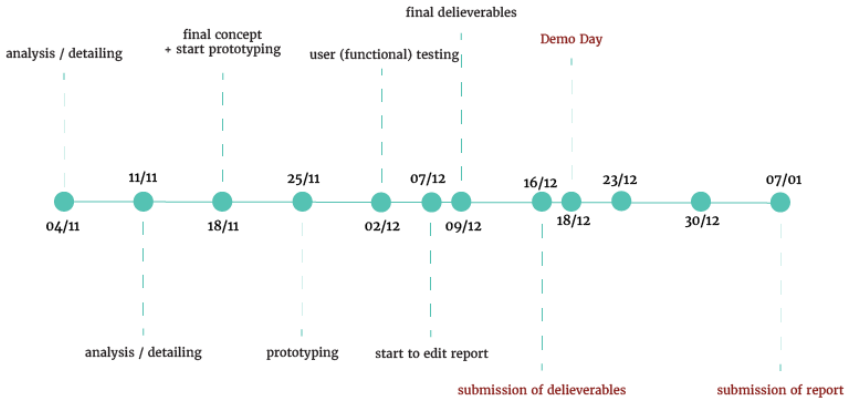
# K. Planning

## Project 2 - Less Collective Stress

--Flow Chart




* This is only the first version of the general planning, further adjustments might be made




## Project 2 - Less Collective Stress

--Planning

### September 21st – September 27th

**What to work on:**
- Define a direction: visualizing / dealing the stress → visualizing the stress
- Define the general project goal → Joost
- Make a planning until mid-term → Yinying (Michelle)
- Discuss / Read the feedback from coaches → further research as inspirations
- Brainstorm promising designs (maximum 5 from each person)
- (Potentially) a questionnaire for investigating the needs of the target group

**Expected outcome:**
- A chosen design challenge for the second iteration

### September 28th – October 4th

**What to work on:**
- Brainstorm about the chosen promising design
- Features to be included (usability & UX goals)
- Functionalities of the design – what does it do?
- Conceptualizing the features and functionalities of the design
- (afterwards) → mood board for the project + Stramien for report / poster

**Expected outcome:**
- A conceptualized concept for mid-term demo day
- Sketches / quick prototypes that present the concept

### October 5th - October 11th

**What to work on:**
- Prototype out the concept (low-fi ~ mid-fi; maybe foam core)
- Start with the mid-term demo day deliverables
- Poster text + a general layout
- Taking video shots + writing and recording the text for voice over

**Expected outcome:**
- A finished prototype that is ready for mid-term presentation
- Have all the materials needed for poster and video

### October 12th - October 15th

**What to work on:**
- Finish up poster and the video
- Get a start with the report
- Have a clear report structure
- Divide the tasks of writing the report

**Expected outcome:**
- (minimal) the deliverables for the mid-term demo day
- (minimal) 1/3 ~ half-way finishing up the content of the report

**Mid-term demo day: October 16th**

### October 16th - October 23rd

**What to work on:**
- Finish the text part of the report (latest October 21st)
- Finish the layout the report (October 21st – October 23rd; preferably finished on October 22nd)

**Draft Report: October 23rd (needed to be double checked)**

### ...

# L. Task Division

## Joost Buining

- Midterm and final physical prototypes
  - Material explorations & decisions
  - Testing & ideation in the prototyping process
  - The form giving & size of the prototypes
- 3D modelling
  - Concept exploration & ideation
  - Demonstration of midterm and final concepts
- Demo Day
  - Final demo day pitch
  - Photos and videos taking for all the deliverables
- Report
  - Chapter 5.3.1 & 5.3.3 writing

## Yinying Miao

- Business analysis
  - Stakeholder analysis
  - Value proposition analysis
- Final prototype
  - Programming for motor & data processing
  - Projection imagery
- Demo Day
  - Posters and videos
  - Midterm demo day pitch
- Report
  - Chapters writing except chapter 5.3.1 & 5.3.3
  - Graphics and layout