Report

Title

Mild

Author(s)

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Acknowledgement

Our team would like to express our special thanks of gratitude to our project supervisors and ISEP's and INESCTEC teachers as well as our principal Benedita Malheiro who gave us the golden opportunity to do this wonderful project on the topic Smart Companion, which also helped us in doing a lot of Research and we came to know about so many new things we are really thankful to them.

Glossary

Abbreviation	Description
2D	Two-dimensional
3D	Three-dimensional
BP	Blood Pressure
EPS	European Project Semester
EMC	Electromagnetic Compatibility Directive
EU	European Union
FEM	Finite element methods

Abbreviation	Description
G-code	Geometric Code
HR	Heart Rate
HRV	Heart Rate Variability
IBI	Inter-beat interval
LVD	Low Voltage Directive
PCB	Printed circuit board
PDCA	Plan, Do, Check, Action
PLA	Polylactic acid
PPG	Plenthysmography
PMBOK	Project Management Book of Knowledge
RED	Radio Equipment Directive
ROHS	Restriction of Hazardous Substances Directive
TPU	Thermoplastic polyurethane
UI	User Interface
UX	User Experience

1. Introduction

The European Project Semester (EPS) is a project-based 'course'. The initial part of the EPS course is centered around a series of seminars and tutorials covering hard and soft skills, subject/project specifics, and language skills and needs. Lessons will be from a mix of classic styles to the more interactive (i.e. discursive) to the practical (inc. workshops). Seminars and tutorials, on the above content, particularly concerning the project, will also take place during the project part of the semester. In the following chapters, this report will give an insight into the work and results of a particular project that focuses on the development of a smart-mental-health companion. Also, the team and other backgrounds will be presented here.

1.1 Presentation

Students from 4 different countries have come together to achieve a common goal: the development of a smart companion for people who struggle with anxiety. Academic project developed within European Project Semester at Instituto Superior de Engenharia do Porto in the first semester of 2022. Although all members of the team come from different fields of study, with different interests, values, knowledge, and skills, the team is determined to work together for the same goal and to share information while developing the final project. Furthermore, during 5 months the team will have the opportunity to develop personally and professionally.

The background of each is presented in the following Table:

Table 1: Information about the team members

Name	Country	Course of study
Júlia Maria Lopes	Brazil	Design

Name	Country	Course of study
Gema Romera Cifuentes	Spain	Industrial Engineering
Jacobine Camps	Belgium	Graphic and Digital Media
Julian Alexander Bode	Germany	Shipbuilding and Maritime Technology

Figure 1: Team DSTRS

1.2 Motivation

Our motivation for this theme and project would most importantly be to help people with mental illness. We don’t know a lot about this topic and want to learn a lot more about it during this semester. The technical parts of the project will be a challenge as well, we will try to all go out of our comfort zones to manage this part of the project. We all want to grow in our major, human-being, and our ability to work together in groups. But we will also grow in what we can outside of our major.

1.3 Problem

We will work on mental health, and anxiety to be exact. Anxiety is a severe problem in this world, and because of the pandemic, the anxiety rates got even worse. In daily life, a lot of people struggle with this and we want to try to make daily life, with anxiety, more livable.

1.4 Objectives

Asking for help when having an anxiety attack happens to be a difficult measure when being in a situation like this. In the same matter pressing a button on the phone is one of the most common concepts when it comes to dealing with all kinds of problems nowadays. “Mild” is supposed to take this problem from the user and deliver an easy and discreet way of dealing with anxiety in public. The objective is to have a companion that gives a certain amount of relief quickly and whenever possible.

The design should be comparable to common devices that are on the market and seen being used in a normal way. It is supposed to be fashionable and not tell the story of the users' needs or problems. It should fit into a modern set of accessories with all devices that are needed to make “Mild” useful.

The production of “Mild” should be able to be carried without high complexity and with the use of integrated electronics when chips go into production. Using all common techniques of production and design organization like quality assurance and testing, the product should be considered as a high standard and working device with a good reputation in the market. To produce a physical display of “Mild” it is objected to producing a prototype with hands-on displaying functionalities.

1.5 Requirements

In consideration that all objectives are supposed to be reached it is for example necessary to comply with the following EU Directives:

1. Electromagnetic Compatibility Directive (EMCD);
2. Low Voltage Directive (LVD);
3. Machinery Directive (MD);
4. Radio Equipment Directive (RED);
5. Restriction of Hazardous Substances in Electrical and Electronic Equipment Directive (RoHS);
6. Mandatory adoption and use of the International System of Units (The NIST International Guide for the use of the International System of Units)
7. Use open source software and technologies

In specific the projects requirements are:

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* Prototype has to display the systesm functions.
* Productions techniques and used materials must be carried out in a
sustaibable way.
* Project Management has to be carried out after PMBOK or Scrum.
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1.6 Functional Tests

To verify the good functionality of the prototype, it is necessary to carry out checks and tests for ergonomics, hardware, and software according to **Table 2**.

Table 2: Functional Tests

Type	Item	Test
Ergonomics	Clay model case	Check if the shape developed for the product follows ergonomic standards.
Hardware	Plenthysmography (PPG) Sensor	Read analog value and display it. Checking for accuracy.
	Battery	Determine if the battery is charging and discharging as expected.

Type	Item	Test
Software	Mobile app	Check UX design in proof of the concept app. Check UI concept in design the prototype app.
	Communication Module	Check if sensors values can be transmitted from the wearable to the mobile app.

1.7 Project Planning

Project planning is developed according to PMBOK principles and SCRUM agile methodology. SCRUM is a process in which a set of best practices are applied regularly to work collaboratively, as a team, and to obtain the best possible result from a project. This project has been organized in Sprints. Sprints are equal periods throughout the whole project timeline, in which certain tasks should be completed. Here you can see how many sprints we divided our project and the date they start and finish. For further information, you can see the planning in our wiki.

Table 3: Global Sprint Plan

Sprint	Start	Finish
1	14/03/22	20/03/22
2	21/03/22	27/03/22
3	28/03/22	03/04/22
4	04/04/22	10/04/22
5	11/04/22	13/04/22
Easter break	14/04/22	18/04/22
6	19/04/22	24/04/22
7	25/04/22	01/05/22
Student week	02/05/22	08/05/22
8	09/05/22	15/05/22
9	16/05/22	22/05/22
10	23/05/22	29/05/22
11	30/05/22	05/06/22
12	27/06/22	12/06/22
13	13/06/22	19/06/22
14	20/06/22	26/06/22
15	27/06/22	03/07/22

1.8 Report Structure

Task	Description
1. Introduction	Presentation of the team, the motivation, the problem to be solved, objectives and its requirements, and the planning methodology.

Task	Description
2. The State of Art	Research articles and Study of products that already exist in the market and analysis of their weaknesses and strengths.
3. Project Management	Documenting the progress that has been made over time and overview of the different aspects of the project, such as costs, risks, quality metrics, people related to the project, and communication plan.
4. Marketing Plan	Documenting the business model canvas and identification of the product target audience to define the marketing strategy that will be used and applied in the solution.
5. Eco-efficiency Measures for Sustainability	Definition of sustainable aspects of the project based on social, economic, and environmental implications.
6. Ethical and Deontological Concerns	It aims to analyze the ethical challenges and limits of the solutions proposed.
7. Product Development	Project development from the ideation phase, concept creation, prototyping, and performance of final tests and their results.
8. Conclusions	Summary of all that has been achieved, stating what can be improved in the future.

2. State of the Art

2.1 Introduction

Mental health is a severe problem in the world, four out of ten people struggle with it. Anxiety is one of the most well-known, and most common diseases, that’s why we chose to work on this problem.

Anxiety is a natural response to stress in your body. It can happen to everyone, at all kinds of moments in life, but if your feelings of anxiety are extreme, last for longer than six months, and are interfering with your life, you may have an anxiety disorder. According to **[Holland K., 2020]**, ...

Anxiety is a key part of several different disorders. Like panic disorder where you experience recurring panic attacks at unexpected times. A person with panic disorder may live in fear of the next panic attack. Also, a phobia is an excessive fear of a specific object, situation, or activity. As well as social anxiety disorder, an extreme fear of being judged by others in social situations. Obsessive-compulsive disorder, is recurring irrational thoughts that lead you to perform specific, repeated behaviors. As well as separation anxiety disorder: fear of being away from home or loved ones, illness

anxiety disorder: anxiety about your health (formerly called hypochondria), and lastly post-traumatic stress disorder (PTSD): anxiety following a traumatic event. According to **[Holland K., 2020]**, ...

For all kinds of anxiety, e.g., severe, or less severe, we made sure to do our research, so we could get to know more about the subject, know more about how to 'solve' the problems, or be a help in this process.

We decided on gathering our research by doing a survey and by talking to professionals, like psychologists that know everything about the problem. This way we could decide on our target audience and have a better view of the problem.

Our research on mental health, the best practices on this subject, and our research are stated below.

2.2 Bibliography of Research

Table 4 ...

Table 4: Table of research

Title of work	Connection to the team's field of work	Reference
The lived experience of art-making as a companion to the mental health recovery process. Disability and rehabilitation	Research Paper on the mental recovery with art-making. Inspiration on the methods to be used in a smart device or that are being recommended by a smart device that is created in the project	**[Theresa Van Lith, Patricia Fenner, Margot Schofield, 2011]**
Smart Companion Agent for Mental Well-being through Deep Learning and NLP	Thesis on the development of a chatbot that is dedicated to holding a quality conversation with a patient suffering from mental illness in many ways. Can be used in terms of inspiration for a more qualified companion that is developed in the course of the EPS.	**[Rafiur Khan, Abdullah Al Sohel, Farhana Azad, Shreyashee, Shamima Hossain, Mahin Fiaz, 2021]**
The Therapeutic Effect of Bilateral Alternating Stimulation Tactile Form Technology on the Stress Response	Ratings of levels of emotional stress and bodily distress on a scale of 0 (no stress/distress) to 10 (worst stress/distress of one's life) before and after the application of Touchpoints for 30 seconds were entered into an app. Results showed a statistically significant reduction in the levels of both emotional stress and bodily distress, 62.26 %, and 50.50 %, respectively, after 30 seconds of BLAST technology was applied. This demonstrates a clear benefit of BLAST on the stress response, reducing both emotional stress and disturbing body sensations. This is one of the possibilities to be taken as an inspiration for a stress-relieving technology a mental health companion could have.	**[Amy Serin, Nathan S. Hageman, Emily Kade, 2018]**

Title of work	Connection to the team's field of work	Reference
Constantly connected - The effects of smart devices on mental health	Several studies have demonstrated the mental health implications of excessive Internet browsing, gaming, texting, emailing, social networking, and phone calls. However, no study to date has investigated the impact of being able to conduct all of these activities on one device. This study connects to the reason, that the development of a simple app is not wished to be done by the team. The usage of a smartphone to track and treat mental health issues can be counterproductive in many ways.	**[J. Harwood, J. J. Dooley, A. J. Scott, R Joiner, 2014]**
The effect of nature sounds and earplugs on anxiety in patients following percutaneous coronary intervention: A randomized controlled trial	this study aimed to determine the effect of nature sounds and earplug interventions on the anxiety of patients after percutaneous coronary interventions. The respiratory rates and the Visual Analog Scale and State Anxiety Inventory scores of patients in the natural sound and earplug groups immediately after and 30 minutes after the interventions were significantly lower than those of the control group ($p < 0.05$). No differences were found when comparing respiratory rates, Visual Analog Scale scores, and State Anxiety Inventory scores between patients in the natural sound group and patients in the earplug group ($p > 0.05$). No changes were observed in the pulse and systolic/diastolic blood pressure values of patients in the control and intervention groups ($p > 0.05$). Conclusions: It was determined that nature sounds and earplug interventions are effective in reducing the anxiety of patients following percutaneous coronary intervention.	**[Ertuğ N. Koç A Akarsu K, 2019]**

2.3 Research on what already exists/ best practices

We have analyzed the current market for mental health and devices that prevent loneliness, and have found the following cases interesting:

There are different types of proposals on the market for people suffering from mental problems such as anxiety, addictions, and panic attacks. These aids come in the form of an application or a smart device such as a toy for children, a headset for listening to music, a ring, or many other innovative devices, which we will discuss below.

- Mobile Applications:
    1. PACIFICA: It's an app that controls anxiety. It uses cognitive-behavioral therapy (CBT), relaxation and wellness principles to break the cycle of anxiety. By providing relaxation tips and goal setting.

Figure 2: Pacifica **[Igancio Buhigas, 2015]**

1. PALA-LINQ: It’s a mobile app with widgets and web components, that provide support for those trying to combat drug or alcohol addiction.
2. VIVETEEN: this app is a teen-orientated wellbeing companion which offers chat to counselors. It has mood tracking and psychological and social challenges through curated text and multimedia content. This app also rewards users for interacting with the companion. It uses tools to equip the user such as calming music, breathing exercises, decision making, healthy eating, and physical exercises. The aim is to create digital support networks within the user’s family or friend groups (anonymous communications about possible concerns shared with nominated people at schools). It was created in 2021.

Figure 3: Viveteen **[Jludik, 2021]**

- Smart Devices:

1. SPIRE: can detect moods, breathing patterns, and other psychological cues that indicate how its users are feeling. Then the device sends a notification to the mobile with suggestions on how to relax or wellness tips to improve mood.

Figure 4: Spire **[Marc Hagen, 2018]**

2. MARCo: it is a robot companion that assists mental illness as a therapeutic. It works as a support tool but cannot prevent, treat, cure or mitigate these illnesses. It collects data and stores it while turned on. It can treat mental illnesses such as depression, general anxiety disorder, and bipolar disorder. It costs around 720 USD and there are different models.

Figure 5: MARCo **[William McGhee, 2017]**

3. FISHER WALLACE STIMULATOR: It is headband-shaped device stimulates the brain to release serotonin and dopamine, thereby reducing stress and increasing feelings of happiness.

Figure 6: Fisher wallace simulator **[Fisher Wallace, 2022]**

4. OURA RING: The Oura ring focuses on the importance of sleep in helping mental health disorders. The ring has been created solely for the benefit of its users and operates to maximize their mental states. The ring has been designed to improve the circadian rhythm of users. Oura is also used to collect a range of data that is useful for professionals to treat mental disorders. It has different types of options such as heart rate monitoring, temperature sensors, guided sessions, and sleeps analysis. It costs around 320 €.

Figure 7: Oura ring **[Oura ring, 2022]**

1. SERENITY LEAF: It is a minimal anxiety tool for people suffering from a generalized anxiety disorder. The device is a two-part design that goes over your clothing connected by two strong magnets, placed flush on the inside of the device. The device sticks to the person's skin with reusable adhesive and measures their heart rate when their blood pressure is high the device buzzes. Then they can remove a component from the device and watch the light sensory expand up and down to help pace their breathing. When the person is calm they can return the component to the other half of the device.

Figure 8: Serenity Leaf **[Katherine Rybinski, 2017]**

1. DEVICE TO ASSIST PEOPLE GOING THROUGH ANXIETY AND PANIC ATTACKS: The main problem addressed by the product was the symptoms exhibited during panic and anxiety attacks. Mainly, shortness of breath uneasiness, light-headiness or dizziness, and needing to escape. The product has two main functions: to use light signals to help the user to regulate their breathing as well as vibrations and help the user distract themselves and try to get out of the

panic headspace.

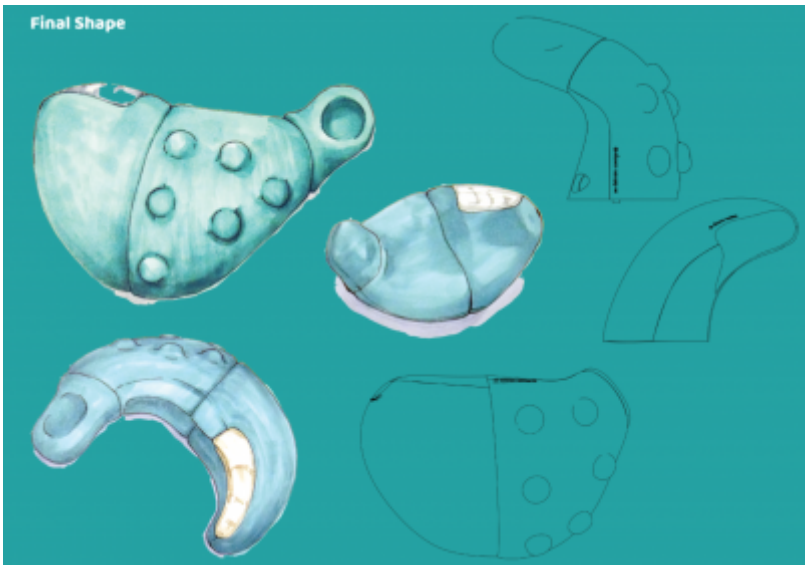

Figure 9: Device to assist people going through anxiety and panic attacks **[Flávia Albert, 2019]**

2. SPECTRUM: People with autism suffer a lot in social situations. They have heightened sensory issues, especially oversensitive hearing, which makes it harder for them to focus on one specific audio at a time. This extreme sound input leads to overwhelming conditions such as seizures and panic attacks. Spectrum is a noise-canceling headphone that features an optical heart rate monitoring system that constantly monitors the heart rate, detects anxiety attacks & relieves the user from the attack. It also has cardioid microphones that automatically detect and enable only the closest audio by neutralizing the background noise. Only when a nearby person calls out the user's name or mentions any conversation starters (hey, excuse me, etc.) does the speak-only feature get enabled.

Figure 10: Spectrum **[Monica bhyrapa, 2021]**

2.4 Conclusion

From reading research articles and studying products already on the market and analyzing their weaknesses and strengths, it can be concluded that although there are some products on the market aimed at helping people with anxiety, it can be said that they are not as efficient as they should be or do not offer the practicality necessary for everyday life use. Therefore, from the study of the existing market and other academic research, the challenge for the project, besides the best use of sensors to detect anxiety attacks and relieve the user from the attack, was to create a smart companion that would promote a better user experience. For this, research was conducted on existing sensors to promote the best possible solution for capturing data that could detect anxiety attacks from human body signals.

For the development of the project, the team chose between two sensors that offer the best solutions available so far: Electrochemical sensors for cortisol detection from tiny volumes of sweat, and photoplethysmography (PPG), which is a simple and low-cost optical technique that can be used to detect blood volume changes in the microvascular bed of tissue. Although the electrochemical sensor for cortisol detection from sweat offers more advantages within the context of the project, this solution, which was created recently, is not available on the market yet, therefore, the team decided to adopt the PPG as the sensor.

Furthermore, to create a soft and mild concept, the team decided to adopt squishy shapes as the main concept for the development of the product design. Moreover, it is important to mention that for this project to work and succeed as a team, organization and prior planning are required. In this sense, the next chapter talks a bit about this, called “Project Management”.

3. Project Management

3.1 Scope

The Scope defines ultimately the boundaries of a project, not regarding whether a product, service, or process is developed. Project scope describes the deliverables in types of work that are needed to be done next to the product scope which describes the physical components that make up the final product and also need to be created or assembled. The scope helps a project team at achieving a global vision of all deliverables that might have been done or that are yet to be completed. The visual attribute of the Scope is the work breakdown structure as is seen in **Figure 11** and in **Figure 12**. It provides the overview that is needed to continuously stay in sight of the state of work.“When the project team creates their project schedule and/or budget without first creating a WBS, they increase the risk of producing unsubstantiated and inaccurate schedules and budgets because they lack information about the product solution deliverables that will meet the objectives of the project **[Paul Burek, 2022]**.”

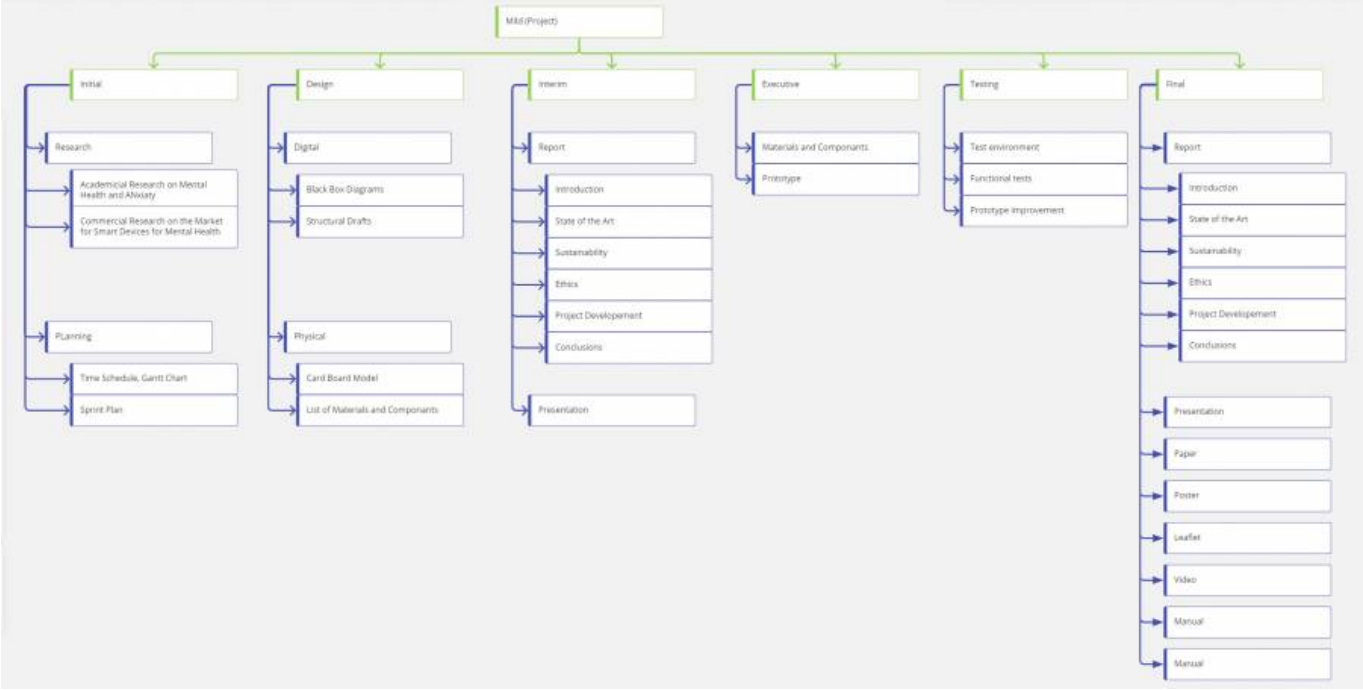

Figure 11: Work Breakdown Structure of Project Scope

Both kinds of WBS are shown here specifically for the project “Mild”. The Project WBS **Figure 11** strictly follows the requirements of EPS@ISEP which display similar requirements in real business projects in addition to EPS-related tasks as a final presentation or the interim report. Next to that the Product WPS **Figure 12** follows the patterns that are guided by all actual components that are physically included in “Mild” and that need to be either purchased or produced as well as assembled. Here the hierarchy orientates itself after the three main components of the product. Beneath that it is divided into its functions and the components that provide this function.

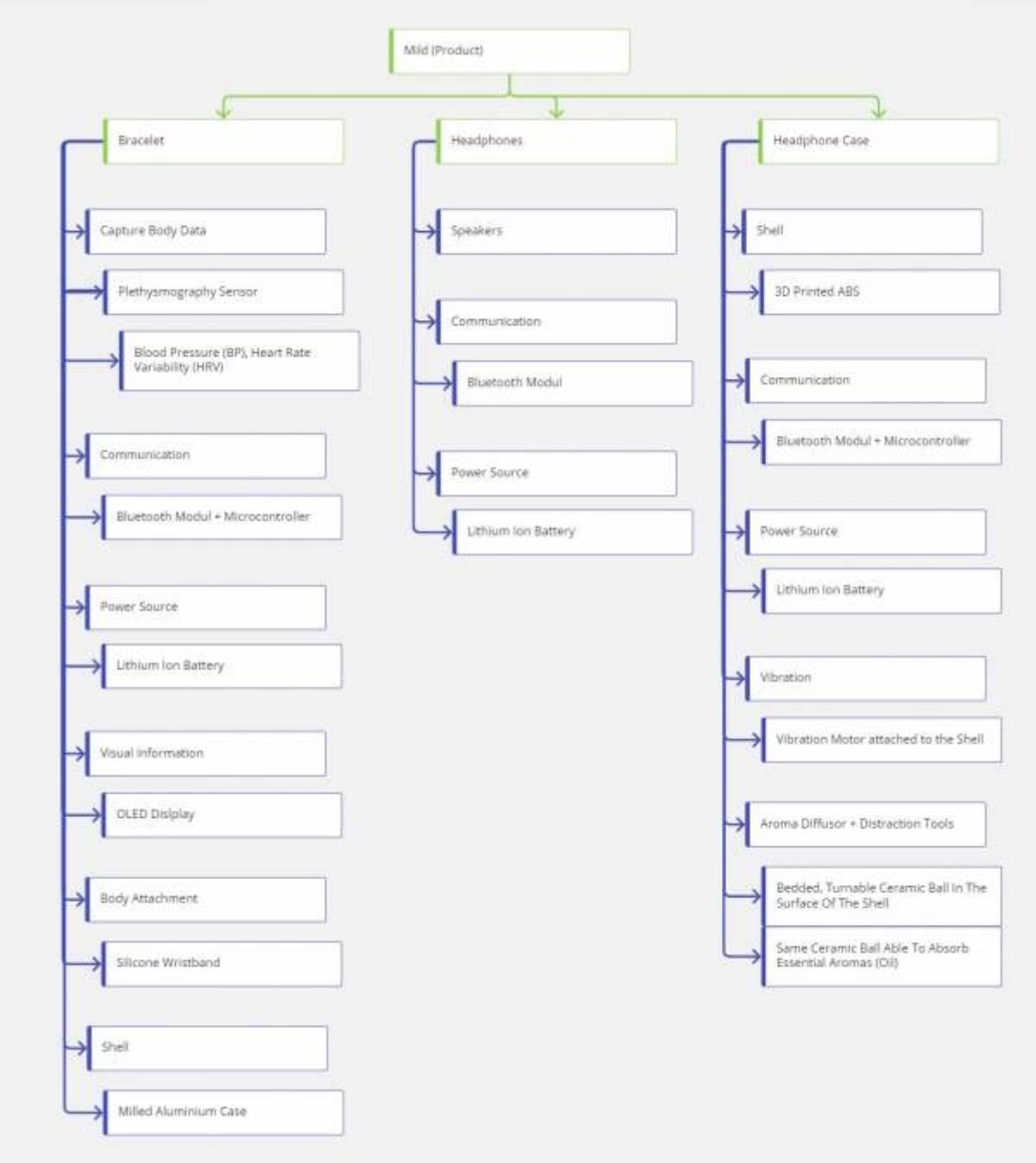

Figure 12: Work Breakdown Structure of Product Scope

3.2 Time

Keeping track of self-set or external set deadlines is key to a successful outcome of a project. The visualization of the Gantt Chart (after Henry L. Gantt (1861–1919)) is one of the most known tools in project management. It enables the user to see real-time progress and consideration of project complexity and effort for individual sections of the project.

For the project of “Mild” the Gantt-Chart as seen in **Figure 13** is made up of deliverables that are required by the rules of EPS@ISEP.

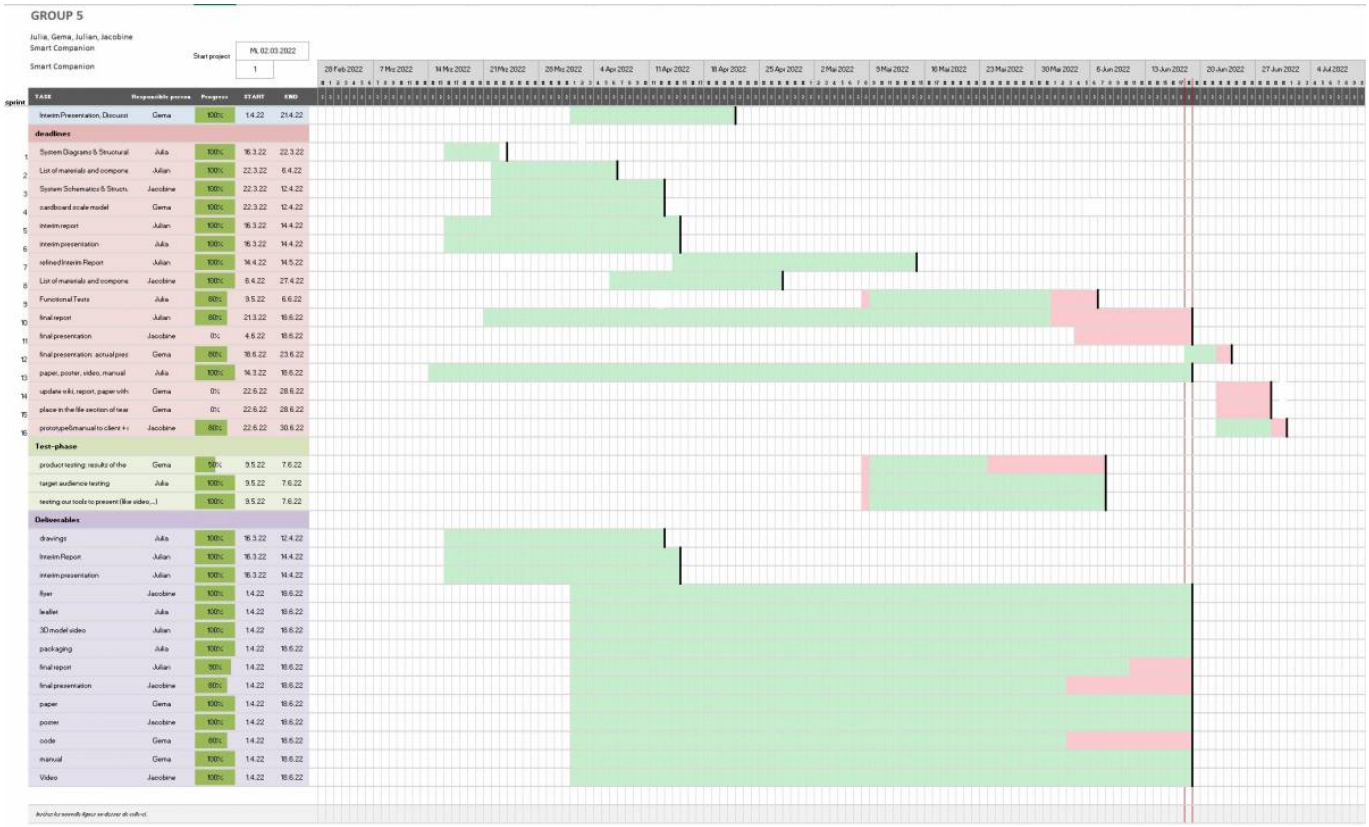

Figure 13: Gantt Chart “Mild”

3.3 Cost

Cost Management is crucial to project managers to stay inside of the approved project budget. A cost management plan must take into account the variables that impact the budget, whether materials or labor. These two must be calculated to know what the financial commitment to the project will be. A mainly used technique to stay within budget is a triple constraint consisting of three processes:

- Estimate Costs
- Determine Budget
- Control Costs

Estimating the costs of developing and producing “Mild” is done in the early stage of the project. It consists of the two main variables materials and labor costs. Ultimately it is followed by the creation of a budget by distributing an amount to each task and part that is needed in the project. The cost estimate of the “Mild” project will not recognize the variables that a real-life project would be exposed to as listed in Risk Management for example pandemic or war. In the early stage of the project, an estimated budget is appropriate which should be succeeded then by a more detailed one. The following tables show the costs for labor after **[18]** of the current project team in an economic environment like Porto as employees for entry-level engineering **Table 5**and the planned costs for developing “Mild” with all the factettes that are required in the EPS@ISEP including the costs for needed components as seen as in **Table 6**.

Table 5 below presents the labor cost per month and year for entry-level engineers in the Porto region. Here it is assumed that in a more realistic scenario a related project would consume a full labor week of all four team members.

Name	Salary (Per Month)	Cost (Per Semester / 6 months)
Jacobine	2865 €	17190 €
Gema	2865 €	17190 €
Júlia	2865 €	17190 €
Julian	2865 €	17190 €
Total Cost	**11460 €**	**68760 €**

Table 5: Labor Cost

Nr.	Item	Part Of Device	Provider	
1	1 x iHaospace MAX30102	Puls-Oximeter – Bracelet	BotnRoll	7.50 €
2	2 x Lithium Ion battery	Power Source – Bracelet	BotnRoll	11.80€
3	2x Charging Modul	Power Source – Bracelet	BotnRoll	5,60 €
4	1 x Bluno Beetle	Micro Controller – Bracelet	BotnRoll	17.90 €
5	TPU 3D Printer Filament Material	Shell - Bracelet	ISEP	0.00 €
6	1 x USB A to Micro Cable	Programming – Bracelet/Headphone Case	Already owned	0.00 €
7	1x Vibration Motor	Functional part – Headphone Case	BotnRoll	2 €
8	1 x Transistor MOSFET	Electronical Part – Headphone Case	Mauser.pt	0.15 €
9	1 x LOLIN 32 Lite	Micro Controller – Headphone Case	Already Owned	0.00 €
10	ABS 3D Printer Filament Material	Shell – Headphone Case	ISEP	0.00 €
Total		**42,95 €**		

Table 6: Product Cost

3.4 Quality

Quality Metrics

- Costumer Experience Quality
- Data Security
- Malfunction Frequency
- Material Quality
- Battery Life

The Team of DSTRS uses common product quality metrics as talked about in **[Tom, 2022]** to provide the user with the assurance of quality and to have success in the market of Smart Mental Health Devices. As we implemented the following metrics and created the prototype of our product, various metrics can be tested on this prototype or the way of testing each metrics' performance value can be determined by various methods. The tolerance of failure in each metric will be decided in accordance with users' needs and the appropriateness of production processes.

Customer Experience Quality The “Mild” Product aims for well-being and an improvement of the

user's Mental State while dealing with anxiety. The similarity of “Mild” to Treatment of an Illness is high. The performance of those treatments is normally assessed through surveys and tests with large quantities of probands. Therefore, an appropriate scale of assessment in the metric of user experience and effectiveness will look like a performance scale from 1 to 5 points given by the interviewed proband. Each proband should have at least used “Mild” for one month.

Data Security As laws and regulations are on the rise in terms of data privacy, the use of a digitally and well-connected product like “Mild” should provide the least amount of security for the user's data. Especially the data that is used by “Mild” as it is the very sensitive body and health data which is a valued target for data theft and of high interest for various industries. “Mild” should be equipped with a high standard of security measures that do not allow any infiltration of hostile parties. This should be tested in multiple stages on the software that is used in “Mild”.

Malfunction Frequency The fact of produced products having malfunctions or failures in any way is mostly inevitable. This is the case in any production process for example manufacturing chips for microcontrollers or manufacturing plastic parts for bracelets and headphone cases. In terms of observing the number of failed products the percentage of failed products should not exceed 5% of all self-manufactured parts and delivered parts. Adjusting the range of providers to this requirement and the ways of self-produced parts is neither cheap nor an easy process. The process will end in our favor by providing a small amount of wasted material and production budget.

Material Quality When defining the state of the used material to manufacture “Mild” certain measures of waste prevention should be adopted. Often malfunctions of products are due to bad badges of material that find their way into a final product. The amount of material that is used in the manufacturing process that can not be taken for any further production of any “Mild” part anymore should not exceed 5 % of the total amount of used material. To prevent the use of this material in the final product, a testing mechanism should be implemented that prevents the finished product from being shipped to the customer.

Battery Life One important part which could also be counted in terms of user experience is the duration of use before charging. To be able to observe the user's mental state for a whole day the used power source should work correctly. Here the testing of the prototype is an appropriate measure to test the endurance of the product since the same batteries are used for each product.

Table 7: Product Metrics

Metric	Requirement	Frequency	Report
Customer Experience	At least 3/5 points for 80% of interview users	Per 100 products	Implemented user interview in “Mild” App
Data security	No information leak	Per product	Monthly Assessment of data of sold app
Malfunction Frequency	< 5% of 100 produced products	Per production of 100 products	As achieved
Waste Material	< 5 % based on total material used per prototype	Per product	As achieved
Battery life	1 day	Per prototype	As achieved

Quality Metrics Review

While producing “Mild” in high amounts, the responsibility and level of difficulty for holding self-set

standards are raising. A system for organized review regularly is required. When reviewing products that are being manufactured in mass production it consumes too many resources to make a review for each product. When applying the self-set quality metrics, it is then appropriate to set the amount of reviewed products lower than 100 %. Responsibilities are with the persons that oversee the production management. They also educate employees of DSTRS Company on the quality standards. The system to review the product's quality is giving each metric tolerances and ways of reviewing the outcomes as described in **Table 7**.

3.5 People

The end of the Project Management principles often comes down to managing people. For a project manager, it is vital to know and understand the people that are being worked with. In the EPS@ISEP the People that are involved are mainly the team members who are the creators of their projects. Then supervisors take responsibility for giving EPS@ISEP a structure and providing the working teams with enough resources, feedback, and organizational work. While teachers provide knowledge and guidance throughout the project’s duration in the end sponsors from ISEP, users, and survey probands are all stakeholders in the project. When it comes down to looking at the project team members, the distribution of Project Backlog Items is of high interest. The responsibility for each PBI is distributed and each task is reviewed and participated by the whole team. Responsibility for the tasks are described in **Table 8**.

Table 8: Project Backlog

PBI	Title	Responsibility
A	Define project backlog, Gantt chart,...	Jacobine
B	Research and inspiration	Julia
C	Defining Topic	Gema
D	Blackbox	Jacobine
E	List of materials 1	Julian
F	System systematics & structural drawings	Julian
H	Cardboard scale model	Gema
I	Interim report and presentation	Julia
J	List of materials and composer	Julian
K	Functional tests	Julian
L	Final report	Julian
M	Final presentation	Julia
N	Doing the final presentation	Jacobine
O	Flyer	Julia
P	Leaflet)	Julia
Q	3D model	Julian
R	Packaging	Julia
S	Paper	Gema
T	Poster	Jacobine
U	Code	Gema
V	Manual	Jacobine
W	Video	Jacobine

3.6 Communications

It is found that communication is the most important success factor in project work. Communication is a core competency connecting project team members to a common set of strategies, goals, and actions. Further research indicates that 56 percent of dollars spent on projects are at risk due to ineffective communications. This effectiveness of communication reaches every part of the organization of a project. As described in chapter 3.9 that stakeholder management is only doable in a proper way with various kinds of communication techniques. The variety of channels that are available for project work makes it easy to access each other while working on a long-term or short-term project. In every kind of project team members need to communicate and will create miscommunication that needs to be removed again by using channels of communication. Also, the exchange of information not only between team members but also between teams or organizations makes the use of various channels vital. The right way of practicing makes teams high performing and lowers the risk of failing for the whole organization. Various examples of miscommunication have led to the failure of large projects. This might be due to the intercultural or interlingual communication that makes it necessary to translate not only words but also ways of communicating. **[PMI, 2013]**

Attending the EPS@ISEP, intercultural communication is a crucial part of the challenges in this project. PMI recommends the definition of a Communication Management Plan, documenting the communication methods, models, technologies, and frequency. To ensure effective communication throughout the whole project and team, this communication plan needs to be developed at the start.

The main aspects of this communication plan are channels:

- Meeting in presence in the group room 515.
- Meeting online (Zoom or Teams) to communicate when not all members can attend a meeting in person.
- Sharing information and files (Teams, Whatsapp) to make each other work transparent
- Archive the content of every meeting and make them available in a shared database (Teams).

3.7 Risk

Defining the term “risk” touches on a widely spread discussion among professionals occurring at the moment. The term “risk” can mean both opportunity and threat. The latest edition of the Guide to the Project Management Body of Knowledge (PMBOK Guide) published by the Project Management Institute (PMI) in December 2000, states that “Project risk is an uncertain event or condition that, if it occurs, has a positive or a negative effect on a project objective … Project risk includes both threats to the project's objectives and opportunities to improve on those objectives.” **[Project Management Institute, 2022]**

In all projects, a minimal amount of uncertain events can or will occur from a multiplicity of sources. It is also clear that if uncertainty occurs, it can have a range of effects on the achievement of project objectives, from the total disaster to the unexpected welcome surprise. This leads to the discussion of the term “risk” to have a positive and negative definition. As a result, it is common to put effort into identifying and managing threats, while opportunities tend to be overseen. To manage these uncertainties properly, risk management is an important part of any project. It involves the following steps:

- Risk identification (Identify risks and their sources)
- Risk evaluation (Evaluate their probability and impact in a risk score as it can be seen in figure **Figure 14**)
- Risk handling (Plan risk responses)
- Risk controlling (Monitor and control risks)

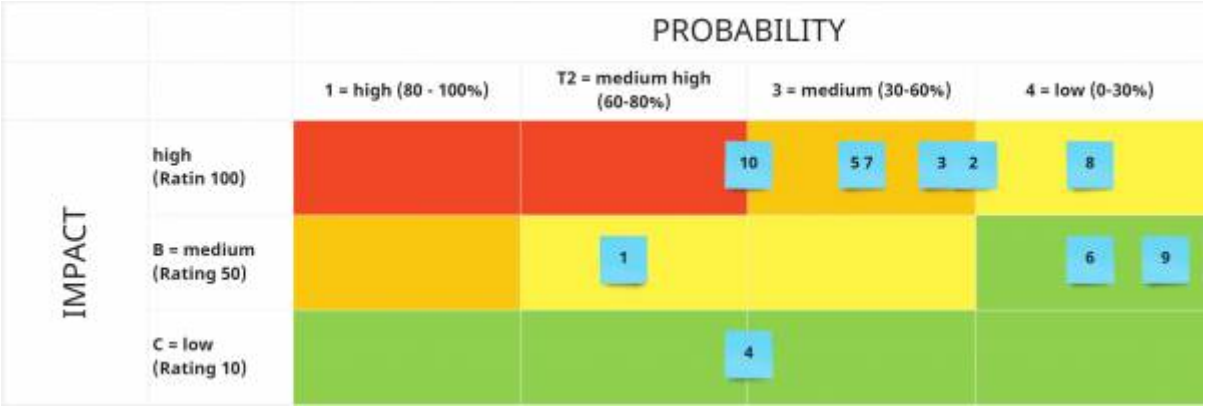

Figure 14: Impact-Probability Matrix “Mild”. Risk Exposure or Risk Score is the value determined by multiplying the Impact Rating with Risk Probability.

The list of risks occurring for “Mild” including the first three steps of risk management and their characteristics are displayed in the **Table 9**. After **[David Hillson, 1999]** an adequate Risk Response can go in various directions. This risk management guideline recognizes four types of strategies for responding to identified risks.

- Avoid (seeking to eliminate uncertainty)
- Transfer (passing ownership and/or liability to a third party)
- Mitigate (reducing the probability and/or severity of the risk below a threshold of acceptability)
- Accept (recognizing residual risks and devising responses to control and monitor them)

The intention is to provide a strategic framework of response types, which can then be transformed into actions for dealing with the risk in the correct way.

Table 9: Risk assessment table

Key	Risk	Cause	Detection	Risk Exposure Score	Response
Internal risks					
1	Anxiety is badly treated in public, therefore, it is hard to let the customers identify themselves as “Mild”. → This could lead to an ineffective marketing strategy for the product.	Social problems. Closed society.	Bad selling of product	40	Start marketing the product as good and healthy to place in the conversation. Encourage customers and possible buyers to talk about it more.

Key	Risk	Cause	Detection	Risk Exposure Score	Response
2	Production failures (Bad assembly of components)	Workers or machines/facilities not working properly.	Costumers give bad reviews	30	Increase the amount and detail of testing and increase maintenance of facilities.
3	Product not effective. “Mild” does not reach the desired effect in impacting anxiety attacks as it is advertised.	Design poorly executed. Lack of knowledge in development.	Costumers give bad	35	Redesign the product.
4	Fluctuation of team members or production personnel	Lack of motivation in production/design departments.	Productions scores shrink, Houman resources shrink.	5	Raise payments or do teambuilding measures more frequently.
External risks					
5	National/international emergency	Epidemic, natural catastrophe, war, etc.	News alerts	40	Proceed with the project to the best of our capabilities in the situation
6	Supply shortages or supply of faulty components	Badly chosen suppliers / Supply market not working well.	Not being able to buy components	10	Enquire the supplier about product availability and quality, change the component to a similar one available one, or change the supplier.
7	Software failure	Lack of tests in all execution stages	Later testing	40	More and detailed testing in production
8	Sabotage of production like hacking and data theft	Insufficient encryption when transferring data to cloud	Hard to detect unless exposed	20	Limiting sensitive data being sent to the cloud, ensure the data is properly encrypted
9	Price lowering in the market	Overavailability of resources. Good connections to suppliers.	Production costs decrease	5	Accept
10	Sales success	Product designed and project executed with close to no failure.	Great selling	50	Accept

3.8 Procurement

It is essential for an internal supply chain that a certain system for suppliers and procurement is implemented in a producing company. Every supplier should be treated equally with the same set of requirements and rules. These rules are internal decided standards that all supplying stakeholders should comply with. Every supplier is supposed to have an information file with contracts, agreements, and requirements. By keeping these standards, it is an easier task to compare different suppliers and have a similar treatment for any supplier. Also, one of the more important purposes of this strategy is to optimize the current budget frequently. While keeping track of each supplier's data, it is easier to keep up with changes in different markets for certain supply parts of "Mild" products. For each part, it is useful to keep in touch with various suppliers. For the parts that needed to be purchased to produce the "Mild" prototype different requirements were applied. In detail, it was important to keep the costs of shipping low and stay inside of the project schedule. This ultimately leads to buying only products from Portuguese suppliers. Also, to keep costs low, renowned and large companies were selected that can deliver in time and keep the costs low. A variation of suppliers was selected before ordering:

- Mauser.pt
- Bot'n'Roll
- PtRobotics
- Electrofunk
- Digikey

These suppliers give a general good and reliable supply of electrical parts and components to produce the "Mild" prototype. It is still required to control each batch of delivered material for failures and if needed resend it to the supplier. The parts that are being purchased to produce the "Mild" prototype are listed in System Architecture When considering "Mild" to be produced in high amounts it is inevitable to consider principles of logistics. A "just in time" principle for produced parts to keep the amounts of parts that must be stored small is important here. Here another decision of buying or making is to be made for every part of "Mild". The providers of electronic parts that are listed above are used for all parts that do better when purchased rather than produced in-house. Important parts and services to be created and produced by DSTRS Company are listed in the following. Contracts with external software developers and product designers could have been made but were decided not to be done as part of a strategy to keep valuable knowledge inside the Company. In the following **Table ##REF:ownproducts ##** the items that create the core value for "Mild" of DSTRS Company are listed.

Table 10: In House Creations

Nr.	Item	Kind of product	Alternative Provider
1	Headphone Case – Shell	Produced Item	Various
2	Headphone Case – Design	Service	None
3	Bracelet – Shell	Produced Item	Various
4	Bracelet – Design	Service	None
5	"Mild" – Sofware	Service	None

3.9 Stakeholders Management

Stakeholders are individuals or organizations that are somehow involved in the process of completing the achievements of a project. Theoretically, they are ordered after their amount of power on the project as well as the support they might give to the progress of the project. This is summed up in the Interest/Influence chart that is used to determine the importance of every stakeholder that is identified. Primarily it has great importance to identify the stakeholders in the right way and characterize them with the right amount of power and support they might have. Once the stakeholders are identified in the right way their impact can be influenced by a proper way of management to ensure a positive outcome of the project. The most important aspect here is to listen to the stakeholders to understand their issues and concerns and prohibit misunderstandings that would impact the outcome of the project negatively. Occasionally stakeholders might have higher knowledge and high power in the project's business environment which makes it necessary to value their interests even more **[P. Serrador, 2009]**.

In the case of project management for “Mild” it is necessary to profile each stakeholder after these certain points:

- Power
- Support

Table 11: Stakeholder Analysis

Key	Stakeholder	Role	Power (1-5)	Support (1-5)
A	Business Costumers (e.g. Health Insurance Companies	Buying the product	5	4
B	Users	Using and testing the product, assessing its value	3	4
C	Psychologists Associations	Provide Help and Knowledge. Gain a higher variety of mental health products. Support for bringing Products to the market.	3	2
D	Sponsors (Providers of Facilities, ISEP)	Supporting and housing the project	2	4
E	Team of Coaches and Teachers	Supporting the project	3	5
F	Competitors in Market	Competing	3	1
G	Suppliers	Supplying materials for the product	3	2

The Analysis of the stakeholders [A] shows a clear picture of supporters that have an impact on the outcome of the project. It shows most importantly the that business customers have. Their purchasing power is the highest in this comparison, what them the most powerful and possibly supportive individuals. If managed correctly the product can be brought to many users at once by these stakeholders and the outcome of the project can be supported positively. On the other hand, the least supportive stakeholders are competitors [F] in the market. Their interest would be to bring their product to a better market position than “Mild”, whereas their power over the project itself is limited since they do not have a direct impact on the project. In conclusion in this analysis, it is not found one stakeholder in the high-risk area of the Interest/Influence Chart which indicates successful results of “Mild”.

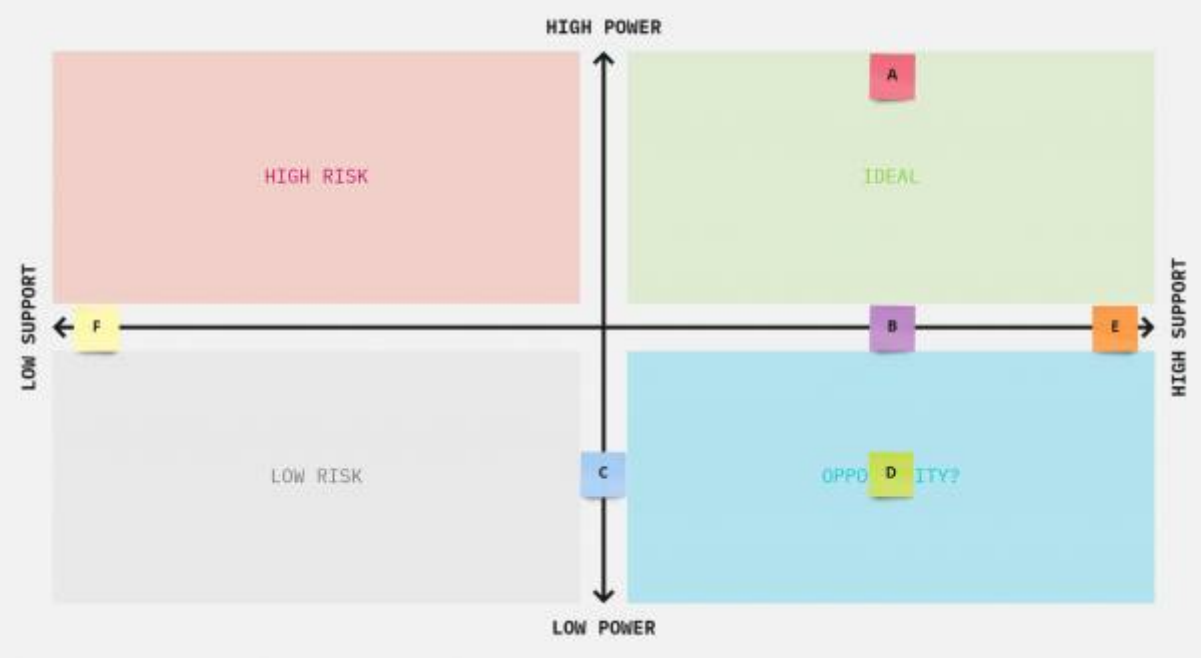

Figure 15: Influence/Interest Chart

3.10 Sprint Outcomes

EPS@ISEP is to be carried out in an AGILE environment with SCRUM methodology from the point of being introduced to SCRUM in Week 6. Scrum is described as a 'framework within which you can employ various processes and techniques, rather than a process, or a technique, for building products. Each project is delivered in a highly flexible and iterative manner where at the end of every sprint of work there is a tangible deliverable to the business. Because of this requirement in carrying out the project a "Global Sprint Plan" **Table 3** had to be determined. Each Sprint occurs over a period of time from one to four weeks and contains a reasonable value of tasks which are called User Stories. The DSTRS Team decided on a sprint duration of one week to keep a high level of reviews and possible adjustments to the User Stories. The Project Backlog is the list of user stories that is regularly updated by the team while being distributed into several sprint periods. Global Sprint Plan:

Table 12: Global Sprint Plan

Sprint	Start	Finish
1	14/03/22	20/03/22
2	21/03/22	27/03/22
3	28/03/22	03/04/22
4	04/04/22	10/04/22
5	11/04/22	13/04/22
Easter break	14/04/22	18/04/22
6	19/04/22	24/04/22
7	25/04/22	01/05/22
Student week	02/05/22	08/05/22
8	09/05/22	15/05/22
9	16/05/22	22/05/22
10	23/05/22	29/05/22
11	30/05/22	05/06/22

Sprint	Start	Finish
12	06/06/22	12/06/22
13	13/06/22	19/06/22
14	20/06/22	26/06/22
15	27/06/22	03/07/22

Into these periods the content of the Project Backlog must be poured. As the Scrum methodology defined several meetings to be held in a sprint, every Monday the Team held a sprint planning meeting. To wrap up a sprint week and have a meeting that is dedicated to SCRUM two other SCRUM ceremonies, the sprint retro perspective and sprint review were held at the same time as the sprint planning. Combining the Project Backlog and the Global Sprint Plan resolves in the Sprint Plan **Table 13**

Table 13: Sprint Plan

Task	PBI	Duration (d)	Responsible	Status	Notes
Sprint 6 (19.04.2022 – 22.04.2022)					
Interim Presentation	I	3	Everyone	done	
Electrotechnical Schematics	ES	2	Julian	in Progress	
Sprint Velocity = 3 d					
Sprint 7 (25.04.2022 – 01.05.2022)					
3D Models	Q	3	Julian + Júlia	done	
Digital Drawing	DD	1	Júlia	done	Done but has to be refined without screen
3D Video	W	1	Jacobine	done	Done but has to be refined with components inside
Refining List of material	J	4	Julian + Gema	done	
Sprint Velocity = 9 d					
Sprint 9 (09.05.2022 – 13.05.2022)					
3D Models	Q	2	Julian	in Progress	
Refined Report	RR	4	Everyone	In Progress	
Sprint Velocity = 0					
Sprint 10 (16.05.2022 – 22.05.2022)					
Poster + Leaflet refined	T + P	3	Jacobine	In Progress	
Refined Report	RR	4	Everyone	In Progress	
3D Models	Q	2	Julian	In Progress	Change of Components keep influencing the size of the Models
Digital Drawing	DD	1	Júlia	done	
Packaging	R	2	Júlia	done	
Paper	S	3	Gema	In Progress	Program Environment and LATEX Coding is being learned
Sprint Velocity = 3 d					

Task	PBI	Duration (d)	Responsible	Status	Notes
Sprint 6 (19.04.2022 – 22.04.2022)					
Sprint 11 (30.05.2022 – 05.06.2022)					
Poster	T	2	Jacobine	In Progress	
Refined Leaflet	P	1	Júlia	done	
Presentation at the Biomedical Engineering Congress	PB	3	Everyone	done	Good Feedback!
3D Models	Q	2	Julian	In Progress	
App Developement	AD	3	Gema	In Progress	
3D Printing	PP	2	Julian	In Progress	Trail and Error process
Paper	S	1	Everyone	In Progress	
Sprint Velocity = 4 d					
Sprint 12 (06.06.2022 – 12.06.2022)					
Building Prototype (Assembly + 3D Printing Parts)	PP	6	Julian	In Progress	Reveiving Help from INESTEC personnel, Trail and Error Process
Stress Test (Simulation)	ST	3	Julian	done	
3D Models	Q	2	Julian	In Progress	trail and error process
3D Model Video refinement	W	3	Julian + Jacobine	done	
Paper	S	1	Everyone	In Progress	
Sprint Velocity = 6 d					
Sprint 13 (13.06.2022 – 19.06.2022)					
Functional Tests	FT	1	Julian + Gema	done	
Final Report Completion	L	6	Everyone	done	
3D Models	Q	4	Julian	done	trail and error process
App Developement	AD	3	Julian + Gema	done	
Paper	S	5	Everyone	done	
Sprint Velocity = 19 d					

3.11 Sprint Evaluations

Table 14: Sprint Retrospectives

Sprint	Positive	Negative	Start Doing	Keep Doing	Stop Doing
6	Preparing our interim presentation as one team together. We organized our work very well in the team.	Not enough time compared to the time needed for the classes.	More correction reading when deliverables are turned in. Fix typos. Include all team members in each task.	Work hard on the tasks. Organizing work in teamwork before leaving each other in free time.	Paying less attention to writing mistakes.

Sprint	Positive	Negative	Start Doing	Keep Doing	Stop Doing
7	We received good feedback at the weekly coaches' meeting. The accomplished work of this sprint looked good.	Writing in the wiki must be improved. The bibliography does not have enough sources.	Considering each other's work inside each chapter while writing in the wiki. Corrections according to the feedback received. Working on the report.	/	
9	The teamwork consists of good support and a good mood.	Due to necessary travels the group didn't meet all together in person and only online. Some team members were not able to attend due to sickness.	More team meetings are necessary after this Sprint.	/	/
10	The free time activities organized by the supervisors were a good chance.	Good communication was hindered by time shortages in individual schedules.	Work on the project development chapter.	The group spirit was improved again by the trip.	Work has shifted more to as much as necessary.
11	The team's focus on the unplanned presentation was great. It was good teamwork. Starting to receive and work with the 3D printing was a good motivator. The working spirit was improved by preparing the presentation.	Planning work ahead failed. We predicted the amount of work wrongly.	Preparation for the presentation should affect the rest of the teamwork in the future.	Good communication and teamwork.	Distributing work over the capabilities of the team members.
12	Receiving help from outer facilities makes the work more enjoyable. Making lots of progress in the topic's theoretical parts is highly motivating.	Focussing on one task at a time is hard as the amount of work raises during the weeks.	Every member should try to be partly involved in every task now as the need for better reviewing is becoming greater. Working on amount of correction before turning in work	Keep up the focus and the optimism.	/

Sprint	Positive	Negative	Start Doing	Keep Doing	Stop Doing
13	The tasks are being done efficiently, without too many meetings and organizational work.	The stress of the deadline lets the focus on the end be hard. Set up meetings in a more frequent manner for reviewing and taking some time to talk about our mood in the project.	Optimism inside of each task. Focus on the deadline is inevitable.	Being afraid of tasks not being completed to the highest standard, as there is always a trial and error process possible.	

3.12 Conclusion

As we practiced our work in an agile way, we were able to see where our strengths and weaknesses were. The sprints were revied after each week and the velocity of each sprint was calculated. In this way, we saw that in some weeks were doing better than in others. The methodology of stakeholder management and for example, cost management gave a good preview for projects that could await a junior employee in the labor market. As the work in project teams becomes a great part of engineering and design work the knowledge of project management is also becoming inevitable in this field. While working in these kinds of teams there should be a fair amount of ability to carry out meetings in the way of the Agile framework and SCRUM methodology. Also, the content of more commercial project management like the content of PMBOK is a good part of today's abilities in the work market. One could go even that far and say that the knowledge of good project management is an ability to use in private and leisure activities. Therefore, basic knowledge should help any person working in this environment and even working in different areas are practicing common type activities.

4. Marketing Plan

4.1 Introduction

In this chapter, we explain how DSTRS will try to bring its first product, Mild onto the market. As a start-up company working in mental health, it's important to look into how we will advertise the product, and how it would be positioned in the market,...

To start we made a Canvas Business Model, to have a broad overview of our company, and our product Mild to be specific. You can read this business model canvas in the appendix.

Afterward, we started building out our marketing strategy and took a look at the following topics: - the market analysis, whom we are building our product for

- our SWOT analysis; what are the strengths, weaknesses, threats, and opportunities

- our strategic objectives, the big picture goals for the company

- the segmentation, how we can divide our users for promotion and reach them

- our strategy and positioning in the market, where we will compare our product to existing products in our fields

- the adapted marketing mix, the 4 p's in marketing adapted to our project

- the budget

- the strategy control

After we discuss all these sections we know where we are on the market, where we want to be, and hopefully how we will try to become there.

4.2 Market Analysis

The Mild customers are people who struggle with anxiety in daily life. This may not seem like a big audience, but it is; 1/10 people struggle with anxious feelings in daily life, **[C Antaviana, 2018]** according to our survey it may be even more. In this survey, we developed for our project, on march 21 of 2022 we did a 10-question survey to get to know more about our audience and the problem itself. We got 119 responses from all over the world. You can find the answers to the survey in the appendix. According to this survey, the need for a product like Mild is increasing a lot. As we all know the previous years were consumed by a pandemic called COVID-19. This pandemic triggers a 25% increase in the prevalence of anxiety and depression worldwide **[Alison Brunier, 2022]**. Our market is growing.

By anxiety, we mean big anxiety attacks, but we certainly also mean the normal anxious feeling that a lot of people deal with daily: too busy metro, stress for a presentation, car drives, airplane anxiety,... All these types of people struggling with anxiety can use Mild to calm themselves down. We narrowed our target audience down by creating Mild for the age group between 18 and 30. Mild is consisting of headphones, a case for the headphones, a tracking bracelet, and an app to control all its functions. These technological gadgets fit perfectly into the life of this target audience. We would reach out to them through their ‘mental illnesses’, although our product could also be used by people who don’t struggle every day. We want our customers to be able to use our product in both states, anxious-period, or normal period. The tracker should be worn on anxious days/periods, if you don’t struggle for a while you can only use the earphones and case, without the tracking function.

The market DSTRS will try to conquer is very big, but small at the same time. There are a lot of anxiety tools on the market, as well as a lot of headphones. The combination is what makes our product, Mild, innovative. There’s been focussed on de-stressing by the use of headphones before, but it usually comes down to having a good sound blocking system as well as a well-working transparency mode. We will try to combine all these needs and extras in Mild.

Our own findings from our survey in the following figures:

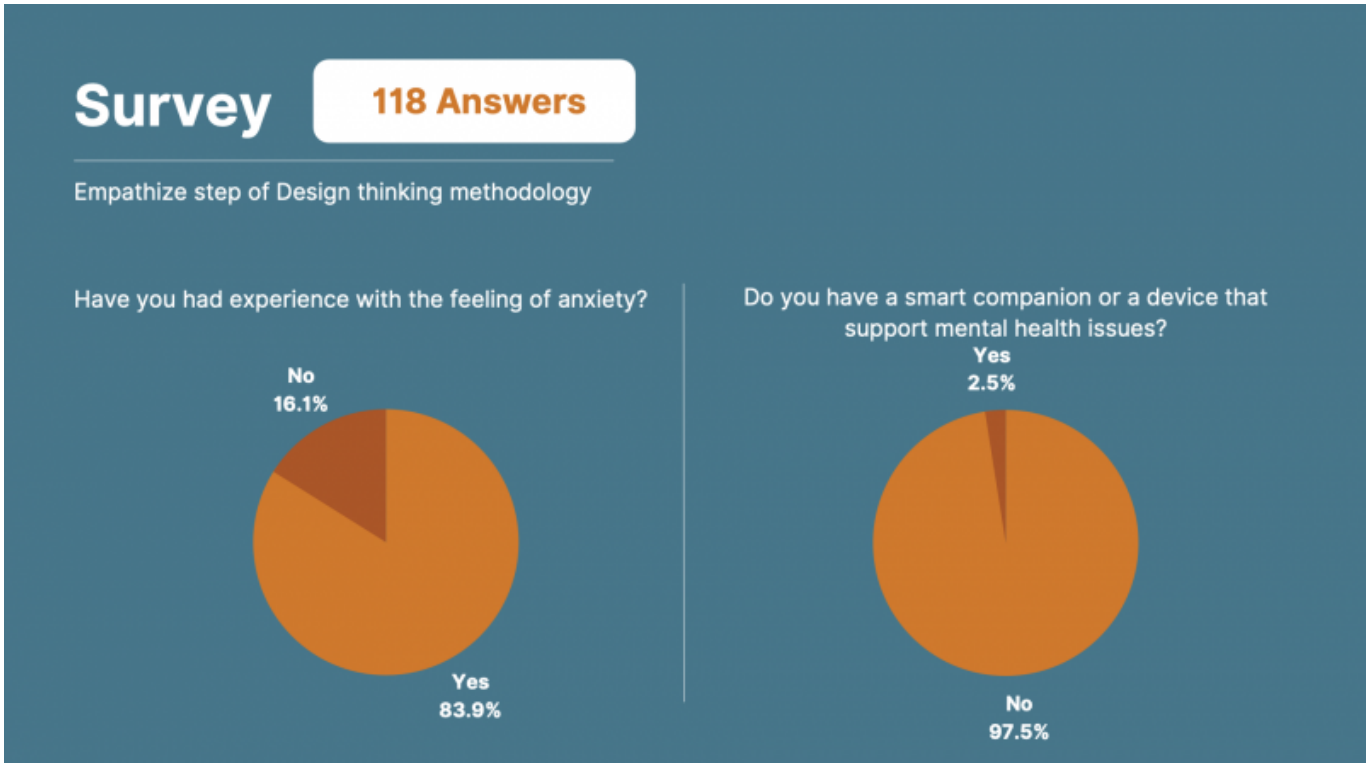

Figure 16: Findings of our own survey

Figure 17: Findings of our own survey

Our survey also contained extra questions, for example, we asked for age, gender, nationality, and financial situation to start with, so we had a better overview of who the people who answered our questions and how for example a country could affect anxiety or if a financial situation had a big impact. The following questions were about anxiety and mental health, how the people who answered the survey were answering here was the part we were interested in of course. Then we asked them finally about a smart companion as a tool to help with mental health and also asked for ideas concerning the smart companion, as you can read above.

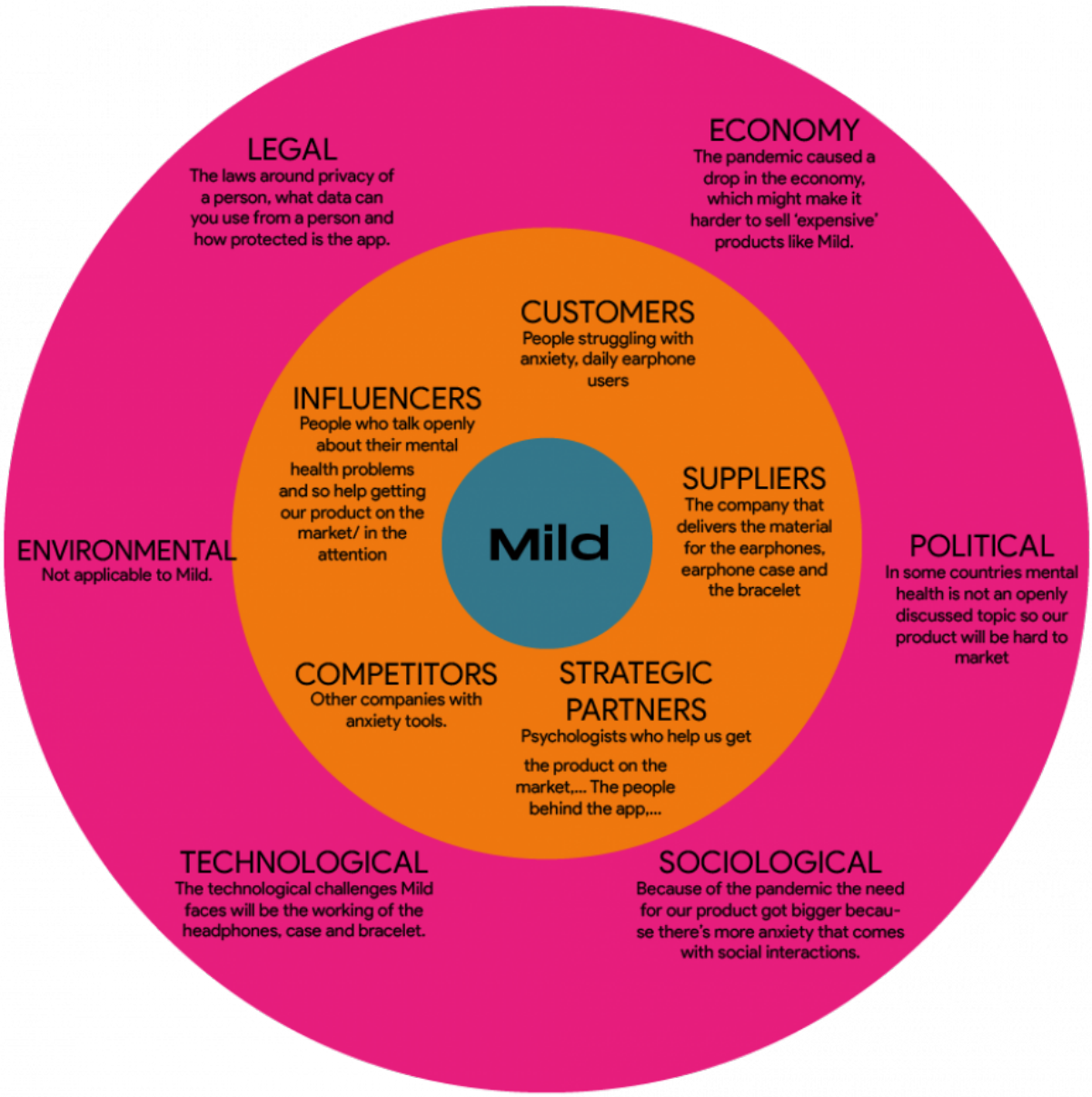

Figure 18: Deeper market analysis

A deeper analysis of our marketing around our product can see in the figure above. On the orange circle, you can see an analysis of the micro-environment, and the pink one is the macro environment, build up with PESTEL.

We can also go a little deeper into the competitor's part. We made a competitive matrix with other, similar, anxiety tools. The **Table 15** shows the differences between Mild and other similar products, also discussed in the positioning chapter.

Table 15: Mild competitors matrix

	Gravity Weighted Blanket Strengths (+) and Weaknesses (-)	**Adult Coloring Book Strengths (+) and Weaknesses (-)**	**Anxiety rings/Jewelry Strengths (+) and Weaknesses (-)**	**Mild Strengths (+) and Weaknesses (-)**

	Gravity Weighted Blanket Strengths (+) and Weaknesses (-)	**Adult Coloring Book Strengths (+) and Weaknesses (-)**	**Anxiety rings/Jewelry Strengths (+) and Weaknesses (-)**	**Mild Strengths (+) and Weaknesses (-)**
Target market(s)	Single bed users who are usually cold during the night (-), not broad, not usable during the day	Adults who have time (-), not usable every second of the day	Everyone who can wear jewelry during the day (+), wearable all the time	Young people who use earphones daily (+), useable everyday
Product	* brings a lot of comfort(+) * big and huggable (+) * not useful in everyday life (-) * Least functionalities (-)	* Brings your mind to rest a lot (+) * everyone can use it (+) * very time consuming (-) * Not everyone's interest (-)	* wearable all the time (+) * doesn't seem like an anxiety tool (+) * easy to use (+) * doesn't have a lot of functions (-)	* wearable all the time (+) * Bluetooth connection with an app and sensor bracelet (+) * Sensor, so it tracks your mood for you (+) * multiple options as a solution for anxiety (+) * case as an anxiety tool in case you can't use earphones (+) * high-tec product (-)
Price	Average retail price (+/-)	Low retail price(+)	Very low retail price (+)	High retail price (-)
Place	A lot of online retailers, also in normal shops it's advertised and placed (+)	Online shop: less advertising (-)	You see it everywhere, has nothing to do with anxiety anymore when you look at the advertising (+)	Advertised by psychologists, sold online and in stores (+)
(Potential) Competitive barriers	medium product (-)	inferior product (-)	superior product (+), everyday use is a big plus for our target audience (+)	superior product(+), combines multiple functions in one product (+), everyday use (+)

The **Table 15** can help us understand where we are on the market with our product Mild and how we stand compared to other anxiety tools. We can see that Mild is a more expensive product but it's worth it because of all the extra functions and advantages it has.

4.3 SWOT Analysis

SWOT analyse Mild: Here you can see our strengths, weaknesses, opportunities and threats in our

business DSTRS, more specific in our product: Mild. We concluded them in a clear table down below.

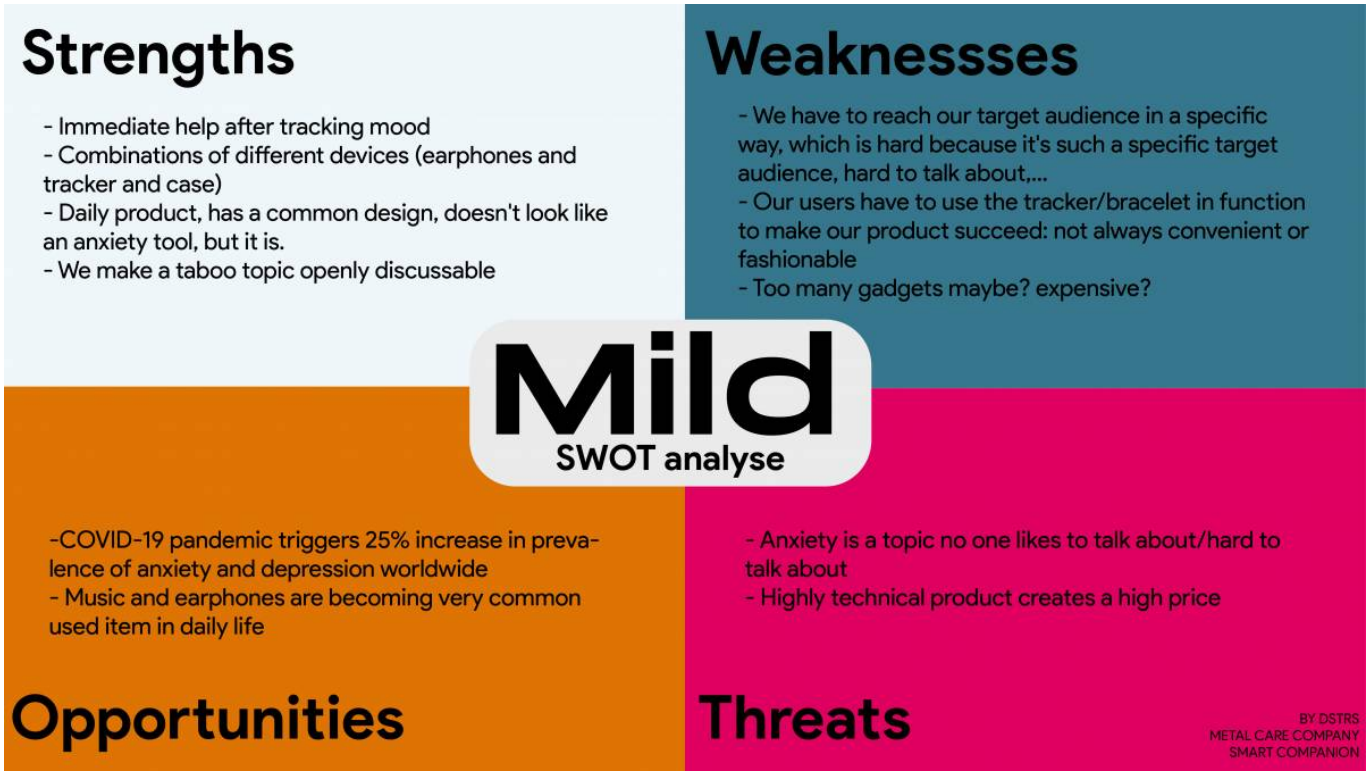

Figure 19: SWOT analysis Mild, HQ: t5_dstrs_swot_analysis.pdf

4.4 Strategic Objectives

DSTRS is a start-up company that created Mild as its first product. The big picture goal for our company, for now, is to successfully launch our new product Mild, get a good position on the market, and help our target audience. For now, DSTRS is focusing on researching the needs of the customers, to find their place in the market. We want to approach our target audience through their illnesses, which makes our strategy different than other technological gadgets like ours. We will try to get through to some customers by recommendations from their psychologists,... Where DSTRS wants to be in the future would be to have a place in the market, be well known in our target audience and maybe collaborate with other companies who would see us as an addition to their company.

Our more specific objectives are specified in the strategy control section.

4.5 Strategy/Targeting/Positioning/Brand

STRATEGY and TARGETING

To position ourself into the market we need to know what our product is, we tried to make this more clear with an elevator pitch:

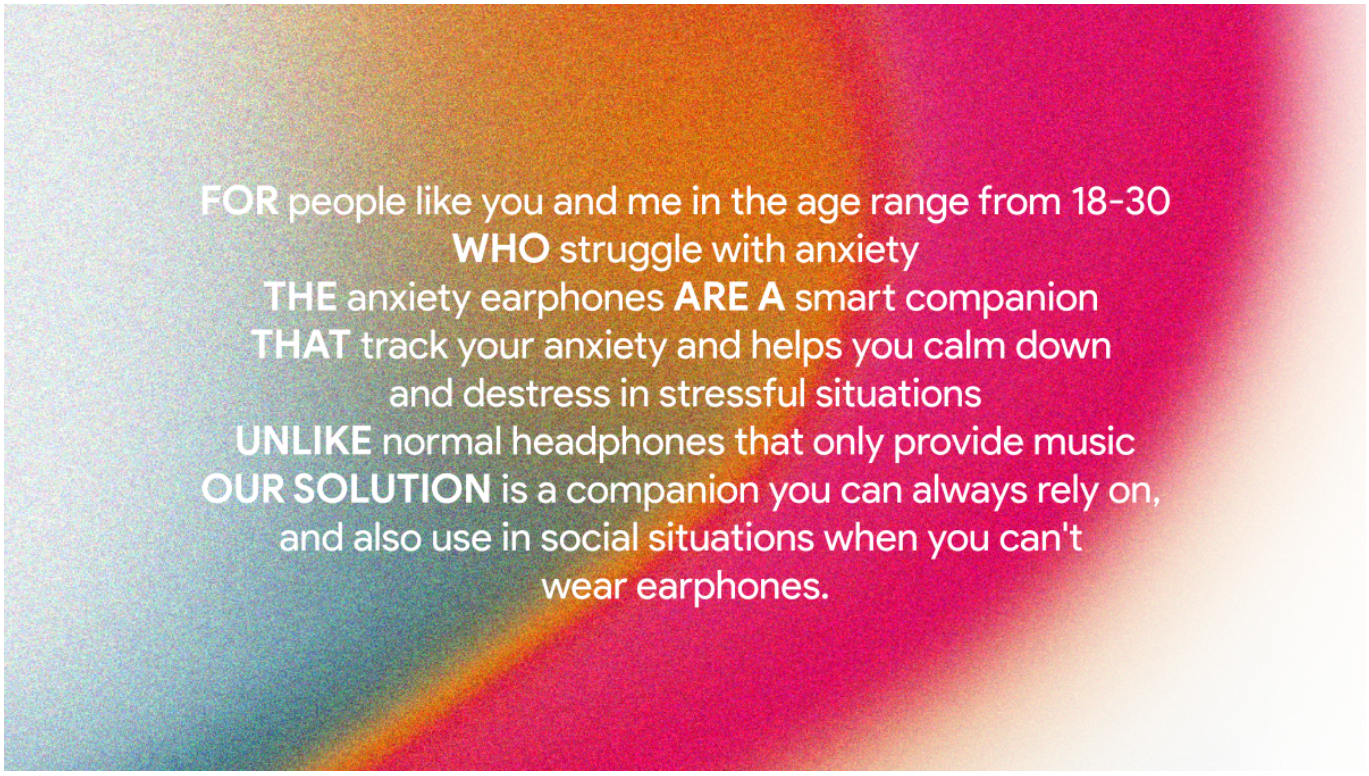

Figure 20: Elevator Pitch Mild

The elevator pitch gives us a clear view of our product and for whom our product is meant. The 'for who' we tried to make more clear by creating a persona: or an ideal Customer Profile (ICP):

Figure 21: Persona Mild

Because of these two things we have a better strategy on how to approach our target audience and know whom we're selling to. Our persona is only an example of a user, our target audience itself is way broader.

Target audience summerized:

Figure 22: Target audience

POSITIONING

The positioning of Mild can be seen in two categories: - anxiety tools - earphones

Our purpose is to help people struggling with anxiety, so of course, Mild is way more than just earphones. We still want to include a positioning in the earphone market because We think it's useful to see how the product is placed as price,.. our customers will only buy our product if they are also interested and on the look for earphones, so this is still an important step. Our main focus is of course still the fact that we want to help anxiety, Mild is an anxiety tool in the form of a smart companion, so this is the most important positioning.

This could be our position for the most well-known anxiety tools that are used nowadays:

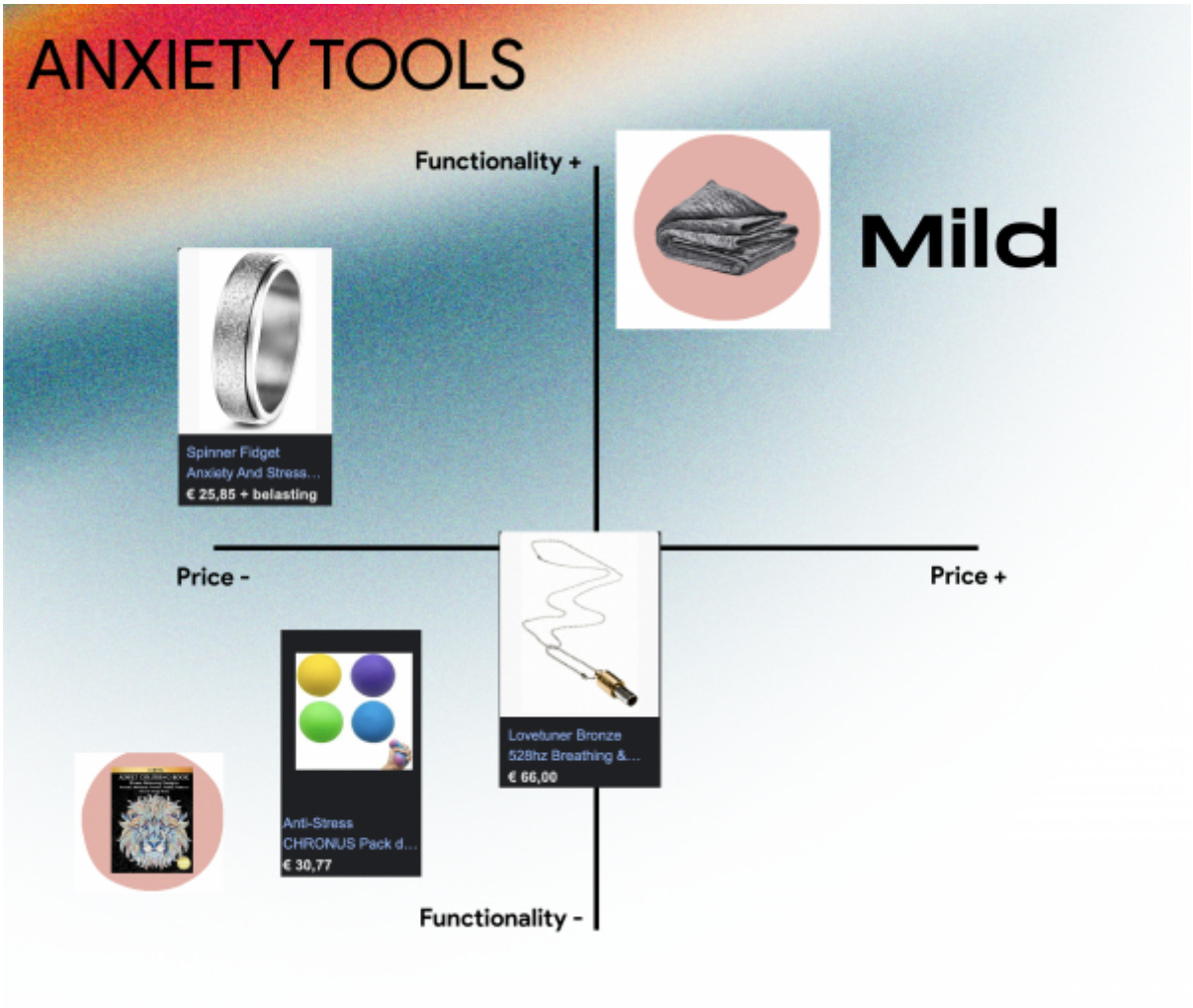

Figure 23: Positioning Mild in anxiety tool market

This could be a goal of the positioning of Mild in the market of the earphones if this is important for our customers:

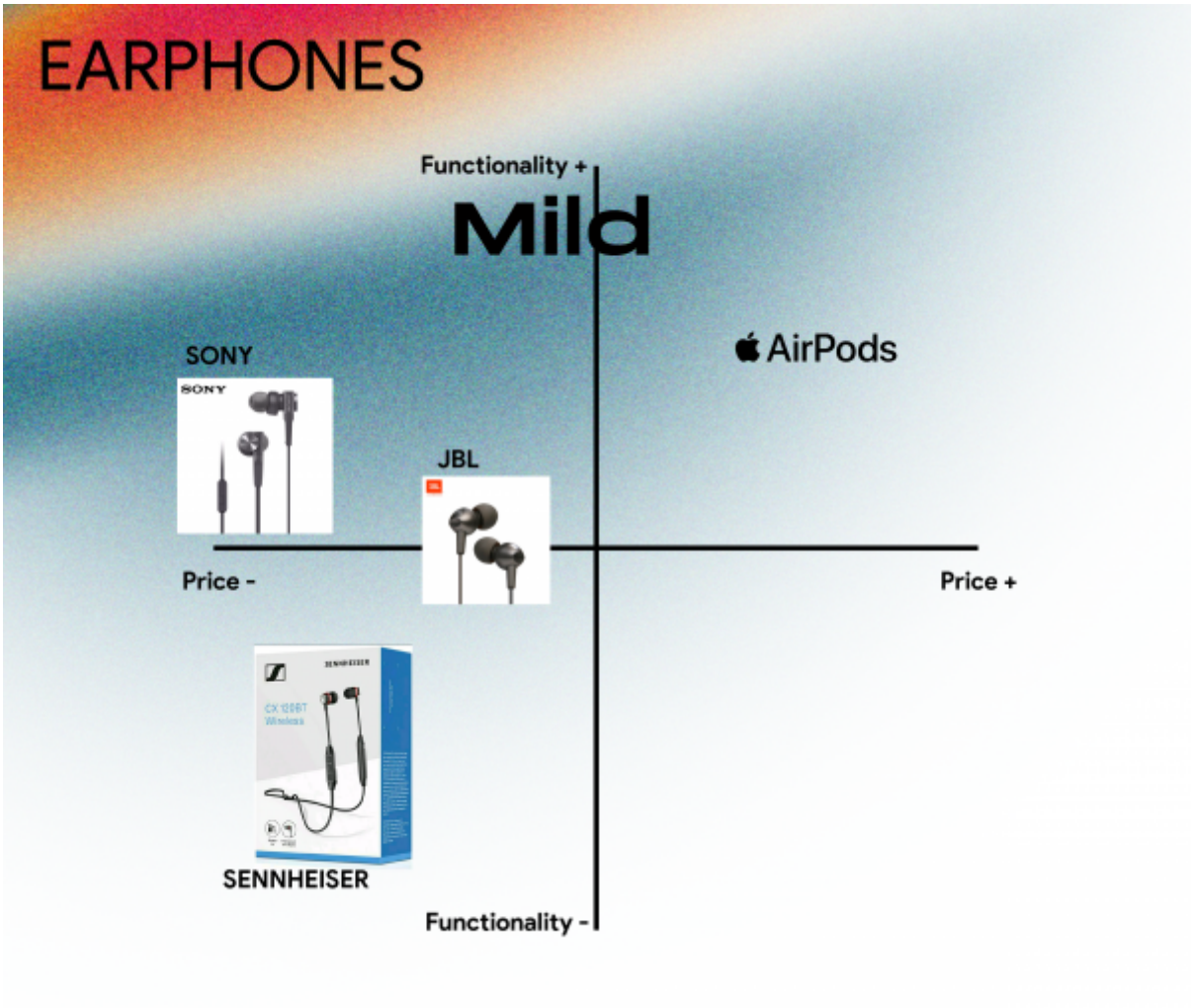

Figure 24: Positioning Mild in earphones-market

SEGMENTATION (TARGETING): With DSTRS's market segmentation the target market got divided into smaller, more defined categories. DSTRS can make a difference in

- Psychographic segmentation

- Demographic segmentation

- Behavioral segmentation

The geographic segmentation does not apply to our product Mild. If our product is on the market it would first of course start in Porto, Portugal, but it wouldn't be designed only for them or specific to this geographic area. Earphones are something very generalized in most western countries.

Psychographic segmentation:

This would mean for Mild that we can focus on different lifestyles and opinions in our target group.

- We can focus on the busy, busy lifestyle. People who are always doing something, taking a busy metro in the morning, getting to work, presentations, and meetings all day, and busy family life afterward,... We could target these people by the trait of Mild being able to calm them down in their busy lifestyle, on busy moments having a distractor/something to quickly react to their anxiety level.

- We could also focus on people living a more normal life, but get stressed over little things. Students living with their parents, and studying in their room. They get stressed from school work or conflicts

with their parents, and they might need Mild to calm themselves down.

- …

Demographic Segmentation: The things that could make a difference in this part:

- Gender:

We could target our product Mild for all genders, but we can advertise it more specifically, which makes that we can make use of demographic segmentation.

- Age

Our age group is 18-30, which is still far away from each other. We could advertise more for students (18-24) in some way, for example talking about studying and the stress that comes with that. And on the other hand, we could be advertising for the young adults (25-30) that just start working and have to figure out how to live an adult life. That comes with a lot of stress and anxiety as well. In all these age categories there are a lot of trigger points we can work on.

- Family size

Family size could even be a segmentation, we could advertise from the point of view that you’re in a big family, never alone, can never find rest and peace, which gives you anxiety and stress. Or we could advertise on having a small family, for example just moving into an apartment by yourself, which comes with loneliness and stress.

- Income

Lastly, income can also play a part in the way we would advertise Mild. Because it is an electrical gadget it doesn’t have a low price, but we will still try to advertise for both. We want our price to be reasonable also for less rich people.

Behavioral segmentation:

We can focus on earphone users in the behavioral segmentation, some people always have their earphones with them, every second of the day, and really enjoy living their life with music in their ears. Others only use earphones when they need to, or when they are all alone, for example on a bus or working for school.

We could advertise our product for both these behaviors.

BRAND:

For our brand Mild, we chose to keep it very simple and calm. We want to focus on the fact we're an anxiety tool, in a cool, modern, timeless way.

Figure 25: logo

We chose to use three bright colors for our branding as well. Although this might for some people not resemble the rest, it does in our branding. The blue we used is according to color research one of the most calming colors. The blue makes you feel peaceful, tranquil, secure, and orderly. That is what Mild stands for in the first place. We also added a bright orange and a bright pink. Orange resembles us happy and spiritual, which also goes with our product. The color grabs the attention of the customer and makes them happy. Which is long-term the purpose of our product either way. It's often linked to spirituality too, which if you look at our product's functions can also be associated with that. The calming sounds, breathing paste,... The pink resembles kindness, calmness, and creativity. Creativity in our product can resemble the music being used, the sounds, and the whole new, creative idea of combining all these functions in a product. Kindness and calmness are more obvious meanings behind the color pink. They are directly in line with what the obvious purpose of our product is.

4.6 Adapted Marketing-Mix

Marketing mix – the 4 p’s of marketing: - Product: Mild. Earphones- case- tracker To calm you down when you need it. For people like you and me, struggling with anxiety. Mild tracks your mood and anxiety level constantly so you get help before you even need it. Mild tracks anxiety all day long by the use of a tracker on your wrist. Mild plays music, calming sounds or breathing pastes to your need. Mild includes a case that can be used to calm you down by vibrations, a distraction tool smell, and a soft feel. Mild has perfect noise-canceling and transparency mode. All to be controlled easily by an app on your phone.

- Price: The price for our product is on the higher side. Mild consists of a tracker bracelet, app, earphone case, and earphones, with all their different functions. This makes it a high-tech product, which automatically asks for a higher price range. The product Mild stays a smart companion so our customers will expect a higher price for the product. It's more than just normal earphones, so the price can be higher too, it's also so much more than the usual anxiety tools. The combination of the both with the Unique Selling Proposition of the tracking your mood, and so helping you before you know you even need it, makes Mild worth the higher price.

- Promotion: We will promote our tools as well on a website and social media, which is a cheap form of

getting our product on the market. But we will also try to get our product on the market by psychologists that could sell/ recommend our product to their patients. We will have to put effort into this, by proving our concept works to these psychologists. Because people with a severe form of anxiety are not our only target audience is it important to also focus on the first two channels because those people are not all going to a psychologist.

- Place: Our product starts in Porto, Portugal, the goal is to expand this quite early in our marketing process. We want to reach people around Europe.

4.7 Budget

Mild's budget for marketing is not that high, because of the high costs of the production. The marketing will mostly take place online: social media advertising and a focus on our website. Our website should represent the product and all its functions in the best way possible as well as explain anxiety, the solutions to it and so much more. Our advertisement will mostly be there for people who struggle with anxiety, so we will have to have a budget for analyzing that target audience on the internet and reaching them in the right way. Also, we would use psychologists and psychiatrists to recommend our product to their patients when they think they would be better off with Mild.

The budget for the social media advertising could be approximately 1-2 posts a day on as well Facebook and Instagram, so that would come down to around 15-22 euros a day. For the psychologists and psychiatrists, we probably need a bigger budget… We could say per recommendation they do we could pay them 10-14 euros… which on a good day could go up to 60-80 euros.

This advertising should be more at the beginning of our market plan, we can slow it down when we have more people that know about us.

Table 16: Marketing budget

Expenses	**Price per month (€)**
Facebook	250
Instagram	500
LinkedIn	200
Google Ads	900
Leaflets and posters	400
Website hosting	15
Psychologists	1500
Total	**3765**

Of course, there are extra costs that come with our product, we would need for example a website that would be a one time cost of approximately 1500-2000, and the updating and improving this website, social media,… would also be an extra cost that is not implemented in the table.

4.8 Strategy Control

For our strategy control we have to make up objectives, measurable and time-managing, and then choose actions to value these objectives and monitor the plan when it's implemented.

The measurable and time-managing objectives we want to achieve with Mild are to have at least 500 sold Mild products in the first 3 months of having our product on the market. After this we want the sales to increase by 5% every month. We will measure this by simply counting the sold products. We also want for 10% of the devices we sell feedback from the customer, so we can adjust our product and advertising to their needs. We will measure this feedback range by keeping track of the sold items and the feedback on several social media platforms. We will implement the need for feedback in our marketing, for example in our packaging or our manual.

How will we get to this point?

We will put a lot of effort into the storytelling around our product. I think it's very important for our customers to know why and how we want Mild to be used by them. What our unique selling point is and how that will impact their life's a lot. We will get these messages into the world by advertising our product online and through psychologists. This way the product will be automatically focused on the target audience we want to reach: people like you and me, struggling with anxiety.

This plan will be controlled and monitored by us, as the founders of Mild, we will make sure our first product gets the place on the market it deserves.

The plan we will follow to monitor this all, to help the efficiency of the company is the Deming cycle or the plan, do check, act (PDCA): this way we keep improving our process and product.

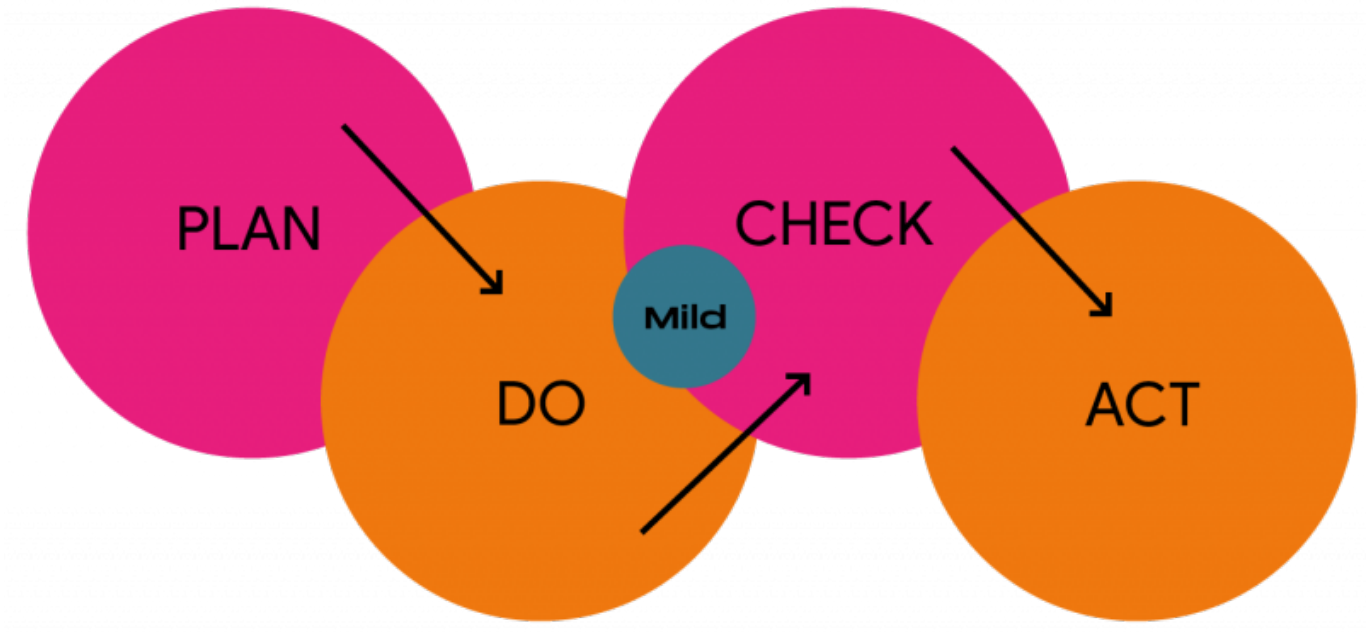

Figure 26: PDCA

These four phases are:

Plan: assessing current situations, adjusting to the trends, predicting issues, and planning things to avoid them in the future. Do - this is a phase of doing what we planned previously. Check-In this phase, we have to check if our plan worked and if the results are how we want them to be. Act - If the plan worked, implement it, otherwise adapt it and start the circle again.

4.9 Conclusion

The market analysis we did in this chapter brought us a lot of information and insights on how we have to reach our customers most effectively. We now know what our customer wants, what already exists, where the need for our product is, and how we can fill this hole.

We can conclude that Mild is a very unique product that will find its place on the market when it's advertised right.

Based on this market/economic analysis, the team decided to create Mild: a unique, smart companion in the form of earphones, an earphone case, a mood tracking bracelet, and a monitoring app intended for young adults, like you and me, struggling with anxiety. As well as severe anxiety as daily life struggles, because Mild wants to help people calm themselves down before they even know they need it. The tracker will give you early, and enough information to be able to help you immediately. Consequently, the team decided to create a product with the function to track your mood all day long, and have multiple options as a solution: Mild can play music according to your mood, play calming sounds or give you breathing exercises in two possible ways: it can give you these through the earphones or the earphone case. Both are controlled by our app.

In the next chapter, we will see the importance of sustainability in our company DSTRS and our product Mild.

5. Eco-efficiency Measures for Sustainability

5.1 Introduction

According to the United Nations World Commission on Environment and Development, sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The idea of sustainability is often broken down into three pillars: economic, environmental, and social (also known informally as profits, planet, and people). In practice, if there is no awareness and recognition of the importance of sustainable development and the interrelationship of its pillars with the various environmental issues, the present generation will leave behind various environmental consequences. Since it has the main focus on helping people, a Smart companion is direct enforcement of these three principles. In this context, DSTRS will target all three pillars of sustainable development for its brand and product building. Therefore, in the following sections, the team will present its impact on the environment first, and on the economic aspect. Then we explain the social value of our product before ending with a life-cycle analysis.

5.2 Environmental

Refers to the impacts that the company's activities generate on the environment and what measures are taken to avoid or mitigate the risks of this interference. There are countless ways to adapt the production chain by incorporating new manufacturing measures, other materials, or equipment that

does not pollute. Technology has contributed immensely with innovative solutions to make industries less harmful to the ecosystem.

Today, global warming, like other environmental problems, is a widely discussed issue. Despite this, many companies compromise the environment daily with unsustainable and polluting practices.

In this sense, in the environmental field, it is possible to create actions to minimize the negative impacts caused by the activities, using raw materials, recycling, and renewable energy sources efficiently.

In addition, the reduction of the carbon footprint is also encouraged, such as the correct disposal of the product's packaging waste.

5.3 Economical

In the economic context, the focus is on profitability, but one must profit while the company sustains the use of natural resources and makes possible the quality of life of its employees.

In other words, the mistake many companies make is to have profit at all costs as their main goal. Adopting measures in favor of employees and the planet result in positive numbers at the end of the month. When the brand invests in the team and incorporates sustainable actions, it consequently improves productivity, competitiveness, and results.

Another fundamental point is the long-term vision, the “sweet spot”, in which customers perceive the brand's sustainable responsibility and see added value in its service, establishing a lasting partnership and identification between the interests of stakeholders and the corporation.

Therefore, the team's main goal is to focus above all on improving the quality of life of the product's users, viewing the brand and the product as adding value from sustainable responsibility.

5.4 Social

In the social field, its function is to provide quality of life for people directly or indirectly connected to the company, inside or outside the company.

Employees are a company's most important asset, and this is further proof of how essential it is to take care of the organizational culture. The treatment that employees receive and the working conditions are the main aspects that must be prioritized by sustainable organizations, from respect and compliance with labor standards.

Therefore, based on this, the company responsible for the product will aim to create a responsible and sustainable work environment, respecting human rights and privacy issues.

5.5 Life Cycle Analysis

Life Cycle analysis is a technique developed to measure the potential environmental impacts caused as a result of the manufacture and use of a given product or service.

The life cycle of a product refers to all stages of production and use. In other words, the extraction of raw materials, through production, distribution to consumption, and final disposal, also contemplating recycling and reuse when appropriate.

The ISO 14040 series of standards determine the structure, principles, requirements, and guidelines that should be included in a life cycle assessment study. Steps of a life cycle assessment study according to the standards:

1. **Definition of Objectives and Scope**
2. **Inventory Analysis**
3. **Impacts Evaluation**
4. **Interpretation**

Regarding our product, we will implement the following measures:

1. Raw materials - to be bought from local suppliers and to use recycled or renewable materials.
2. Manufacturing of the product – is to be done locally and uses renewable energy.
3. Packaging of the product - to use less recycled material and make the packaging reusable (unbleached cotton bag).
4. Product distribution - to outsource distribution to logistics companies with a zero-emission guarantee.
5. Product use - product will be made as long-lasting and durable as possible. Also, easily repairable and components can be easily exchanged.
6. Product Disposal - product to be easy to disassemble. Most components should be easily recyclable or reusable. In addition, the company should ensure proper disposal points for all components.

Besides that, DSTRS will care about applying eco-efficiency measures inside of the factory and offices, such as educate not only the consumers of Mild but all employees as well :

- Install low-flow faucets and water-efficient toilets;
- Use energy-efficient light bulbs and automatic light shut-off;
- Whenever possible, use large windows that allow the penetration of a big amount of natural light;
- Invest in renewable energy and its proper use;
- Reduce scrap material during production;
- Designate colored recycling bins for different wastes and make them accessible to all employees;
- Reduce excess processing and product defects;
- Educate peers about corporate sustainability;
- Offers easy and proper disposal of the product;
- Educate consumers about responsible consumption and the proper disposal;
- Whenever needed, upgrade to new equipment;
- Stop using single-use products, such as coffee cups, plates, and utensils.

5.6 Conclusion

Sustainability is a theme discussed from various points of view in industrial environments. Full of challenges and benefits, sustainability appears in the modern world as a possible solution to environmental problems and aggravating the damage caused by the production process.

Its materialization happens when the factory agent can simultaneously live with government regulations, external performance pressures, demanding consumers, and competitive markets, without compromising the future of the next generations. The electronics industry, the focus of this work, demands-resources, emits pollutants, and generates an expressive amount of waste in the world.

Based on the sustainability analysis and the project theme, good management must ensure that the company's strategy and sustainability efforts are aligned. Therefore, in addition to the internal measures already mentioned above, the company believes that good transparency through communication is essential to ensure the company's sustainable development. The next chapter has a close connection with sustainability because the latter shares its main values with ethics.

6. Ethical and Deontological Concerns

6.1 Introduction

Deontology is an ethical theory that says actions are good or bad according to a set of rules. Its name comes from the Greek word deon, which means duty. Actions that comply with these rules are ethical, others are not. This is associated with the German philosopher Immanuel Kant, who believed that the ability to use reason was what defined a person.

Kant's ethics is not the only example of deontology. Any system that involves a clear set of rules is a form of deontology, which is why some people call it a “rule-based ethics”.Most deontologists say that there are two different types of ethical duties, perfect duties, and imperfect duties. A perfect duty is inflexible. Imperfect duties allow for some middle ground. We must do our duty just because that is the right thing to do.

Ethics is based on well-founded standards of right and wrong that prescribe what humans ought to do, usually in terms of rights, obligations, benefits to society, fairness, or specific virtues. Deontological ethics “in philosophy, ethical theories that place special emphasis on the relationship between duty and the morality of human actions. In deontological ethics, an action is considered morally good, not because the product of the action is good, but because of the characteristic of the action. Deontological ethics also raises awareness of the consequences of each individual's action.

Now we are going to talk about engineering ethics, naming the main principles, rules of practices, and professional duties. We will continue talking about sales and marketing ethics explaining what is our project aim related to this topic. Environmental ethics has been also taken into account at the time of deciding which materials we need and how are we going to produce our product. Finally, we will make a list of the liability EU directives our team is going to follow in this project.

6.2 Engineering Ethics

Engineering ethics is the branch of applied ethics that brings together the set of moral principles established for the practice of engineering. It examines and establishes the obligations of engineers to society, clients, and the profession. It is linked to the ethics of technology and related to the philosophy of science and the philosophy of engineering. **Canon sets out the following principles:**

- Engineers regard safety, health, and public welfare as of paramount importance and shall strive to comply with the principles of sustainable development in the exercise of their professional functions.
- Engineers shall provide services only in areas of their competence.
- Engineers should make public statements only in an objective and truthful manner.
- Engineers should act in professional matters for each employer or client as faithful agents or representatives and should avoid conflicts of interest.
- Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
- Engineers shall act in such a manner as to maintain and enhance the honor, integrity, and dignity of the engineering profession and shall act with zero-tolerance for bribery, fraud, and corruption.
- Engineers shall continue their professional development throughout their career, and shall provide opportunities for the professional development of engineers under their supervision.
- Engineers shall, in all matters relating to their profession, treat all persons fairly and encourage equal participation without regard to gender or gender identity, race, national origin, ethnicity, religion, age, sexual orientation, disability, political or family affiliation, marital or economic status.

Rules of practice

- Engineers shall consider the safety, health, and welfare of the public to be of paramount importance.
- Engineers shall provide services only in the areas of their competence.
- Engineers shall make public statements only in an objective and truthful manner.
- Engineers shall act for each employer or client as loyal agents or fiduciaries.
- Engineers shall avoid misrepresentation.

Professional duties

- Engineers shall be guided in all their dealings by the highest standards of honesty and integrity.
- Engineers shall always strive to serve the public interest.
- Engineers shall avoid any conduct or practice that misleads the public.
- Engineers shall not disclose, without consent, confidential information relating to business matters or technical processes of any current or former client or employer, or of any public body in which they serve.
- Engineers shall not be influenced in their professional duties by conflicting interests.
- Engineers shall not attempt to obtain employment, promotion, or professional commitments by mendacious criticism of other engineers, or by other improper or questionable methods.
- Engineers shall not seek to damage, by malice or misrepresentation, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe that others are guilty of an illegal or unethical practice shall bring this information to the attention of the appropriate authority for appropriate action.
- Engineers shall accept personal responsibility for their professional activities, provided that they

can seek compensation for services arising from their practice, except in situations of obvious negligence, in which case the engineer's interests cannot be protected.
- Engineers shall give credit for engineering work to those to whom credit should be given, and shall recognize the copyright interests of others.

Now we will continue talking about ethics but now focused on sales and marketing.

6.3 Sales and Marketing Ethics

Ethical marketing is not a marketing strategy, but a philosophy that must reach all levels of the company. It consists of making morally correct marketing decisions. You have to make every marketing decision taking into account not only the business return or profit but also the moral perspective: whether or not a decision is ethically correct.

This behavior is in line with new consumer demands.

The effort a company makes to make its communications and marketing more ethical will have a positive impact on all areas of the business.

Applying ethical marketing to a company's strategy will bring about the following benefits:

- It gives prestige to the company and enhances its reputation.
- It adds value to your product.
- It favors business and improves sales.
- It avoids bad practices.
- It establishes long-term relationships with stakeholders and customers.
- Improves staff quality, team cohesion, and commitment.
- Improves competitiveness.
- It facilitates the connection between consumers and the brand.

Unethical marketing is evolving and new forms are emerging, as with all forms of marketing. And most of them are not only unethical but also illegal.

The “Institute for Advertising Ethics” published a list of 8 basic principles of ethical marketing:

1. All marketing communications shall share the standard of truth.

2. Marketers will abide by the highest standards of personal ethics.

3. Advertising should be differentiated from news and entertainment editorial content.

4. Marketers should clearly state whom they pay to promote their products.

5. Consumers should be treated with their nature and characteristics in mind (e.g. marketing to children).

6. Consumer privacy will never be compromised.

7. Marketers will comply with laws and standards set by governmental or professional organizations.

8. Ethical issues will be discussed openly and honestly during marketing decision-making.

In our team we will do an appropriate design of labels, we will respect the laws and standards, we will sell efficient and beneficial products, and we will try to be as clear and accurate as possible to have good communication with customers and with all members of the project, we will establish transparency. We also will promote responsibility, fairness, and honesty.

Nowadays environmental ethics has reached huge importance, that is why we are going to focus on them in the next chapter.

6.4 Environmental Ethics

Environmental ethics is the branch of philosophy that considers in particular the relationship between people and the environment in which they live and is especially concerned with regulating the actions of human beings so that they do not threaten the development and evolution of the natural environment.

As human beings, we perceive and are aware, to varying degrees, of existence and its conditions. And we respond to this fact, either through actions or omissions. Thus, if we are aware of the deterioration of the planet, this demands a personal and collective response, for example, by reducing our ecological footprint by not buying products that we know damage the environment, or perhaps by not driving a car on certain days of the week. This ethical responsibility arises from our very fact of existing and being aware of the world we live in.

In the middle of the last century, the damage perpetrated on the environment by both industry and people with little awareness of respect for the environment began to be publicly denounced.

This growing situation triggered the need for the creation of a specific space that would ensure the care of our nature and, if not, would punish those who do not act in this sense.

A scale of values that invites responsibility and care for the environment, i.e. environmental ethics proposes a moral standard that demands responsibility on the part of companies and people in terms of caring for our natural environment.

The fundamental proposal of this branch of ethics is to ensure the well-being of society and nature so that human beings can develop in a well-cared-for natural environment.

Environmental ethics, therefore, provides a set of arguments related to the conservation of the planet and directed at people's practices. These are fundamental considerations for environmental decision-making, setting priorities in research and studies, publishing results of environmental impacts, and setting policy.

Regarding our project in terms of environmental ethics, our team will reach the maximum product life possible, we will use environmentally friendly materials to build our products, we will reuse components that are in good condition, and we will try to increase energy efficiency. And last but not least, we will try to reduce waste and packaging.

Furthermore, we have also to take into account liabilities issues, which we will talk about in the next chapter.

6.5 Liability

Concerning the EPS project, our team must comply with the following EU Directives to avoid product liability issues:

- Machinery Directive: guarantees a high level of protection for EU workers and citizens, and ensures the safety of the machinery and its components entering the European market. Following this directive Soaksy must meet the essential health and safety (RESS) requirements:
    1. Built according to certain parameters
    2. Marked and recognizable
    3. Accompanied by a booklet (instruction manual for use and maintenance)
    4. Guaranteed by the manufacturer with the declaration of conformity.
- Electromagnetic Compatibility Directive (EMC): because of the nature of electrical current, different household appliances tend to interfere with each other. This directive aims to ensure such interference is minimal and doesn't pose danger to the user.
- Low Voltage Directive (LVD): ensures that electrical equipment within certain voltage limits provides a high level of protection for European citizens, and benefits fully from the single market.
- Radio Equipment Directive (RED): establishes a regulatory framework for placing radio equipment on the market. Ensures no interference and data security regulation in radio communication with other devices.
- Restriction of Hazardous Substances Directive (ROHS): Restrict the usage of harmful substances in devices, allowing for more efficient recycling.

6.6 Conclusion

After the study of engineering, marketing, sales, and environmental ethics, we also took into account all the directives to avoid liabilities issues, our team decided to work in a specific way. We have produced our product with a technique that takes into consideration the benefits of the workers and also the people who use the product.

Finally, we are going to talk about project development. During this semester we have been working on the ideation of the product, studying the black box diagram, structural sketches, and cardboard model. We are also presenting our product concept with our logo, concerns, and regulations.

7. Project Development

7.1 Introduction

Taking all the previous chapters and analyzing all the characteristics and strategies proposed for the product development, in this chapter, the team will show the creative process and the evolution of the product and its design starting with the first sketch and finalizing with the final product. Besides

the creative process, in this chapter, the team will also show some challenges that were faced in developing the product.

First, the team decided on the main idea of the product and how it should work and analyzed not only different opportunities with structural drafts of the concept but also the relationship between devices and how they work with system architecture analyses. The main goal is to create the best user experience possible since mental health can be a delicate subject and the product has to take into account many considerations to ensure it.

7.2 Ideation

Figures 27 shows the black box diagram.This diagram shows the inputs and outputs that the Mild system has and also how they are linked to the system. Therefore, it's important to remember that the internal structure is irrelevant in the black box diagram and only the external behavior of the system is considered.

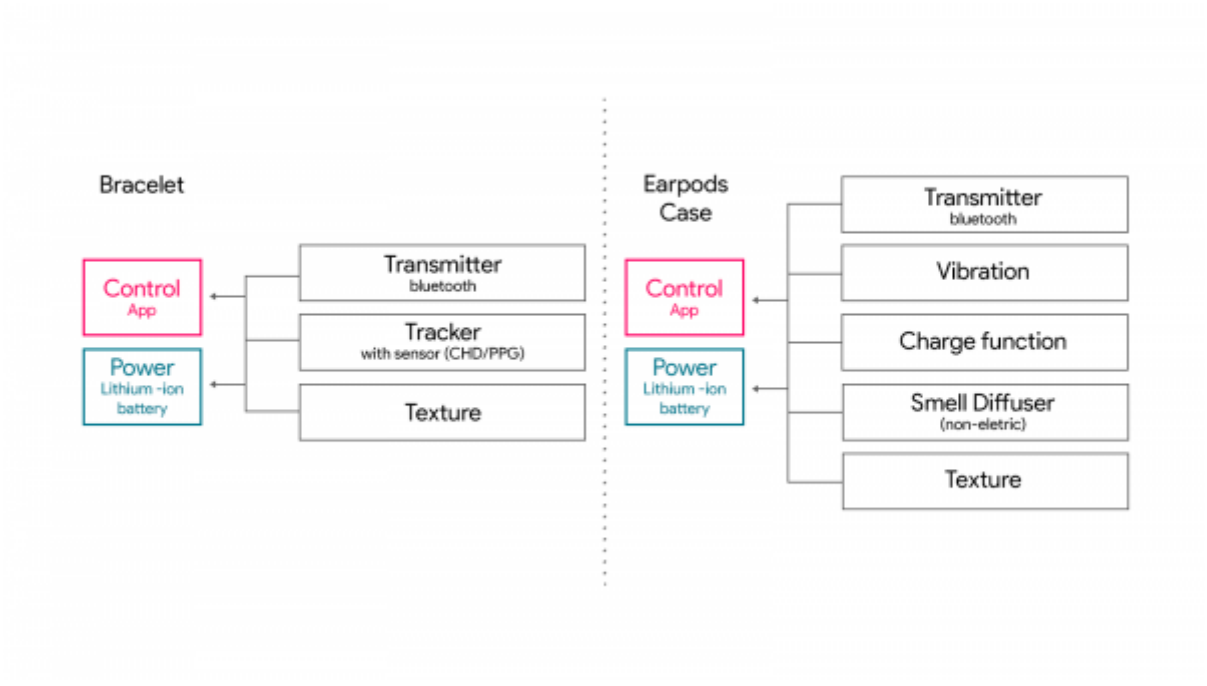

Figure 27: Blackbox

Figure 28 represents the concept of the product. The team considered several possibilities to come up with the best solution to our problem. Initially, we established that the product would be the combination of the headset with its respective case. Then the team came up with different ideas and analyzed the different positioning variants of the wearable until we came to the final decision. In the ideation phase, it was also established what kind of connection the devices would have to interact with each other and with the user.

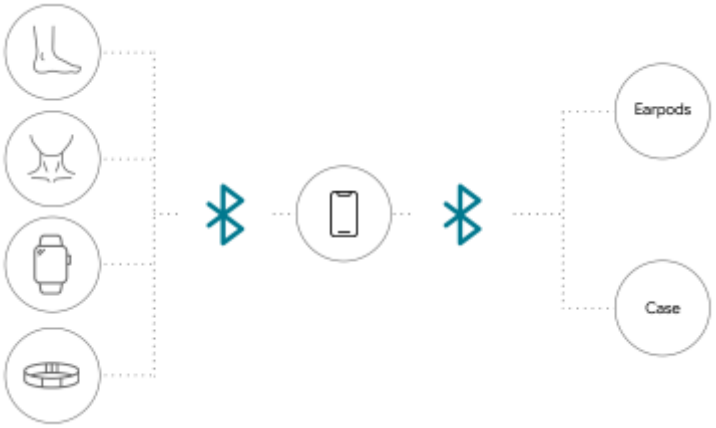

Figure 28: Structural Draft of the concept

Regarding the wearable, which will take data from the user's body, the options would be positioned on the ankle, having a necklace, a watch, or a bracelet. Before getting to the final decision, the team analyzed and noted the advantages and disadvantages of the different positioning options of the wearable shown in the previous figure. All in all, the positioning of the wearable has been decided to be in the form of a bracelet. The team analyzed criteria like Space available, the possibility of pulse measurement, conspicuousness, and the possibility of interaction with the app. Also, in general, people are used to wearing bracelets or watches on their hands, an additional advantage to argue this choice. To better understand the relationship between devices and how they work, Figure **29** reveals the system architecture. In addition, figure **30** reveals the user journey with the device. The information recorded by the bracelet regarding the user's heart rate variability will be transmitted via Bluetooth to the app, then the user receives a notification when the bracelet detects anxiety levels through the heart rate variability data. From the app, the Mild user can choose among 3 options: Vibration, Music, and Sounds. The app will command via Bluetooth the Earpods and their Case, depending on each feature the user chooses.

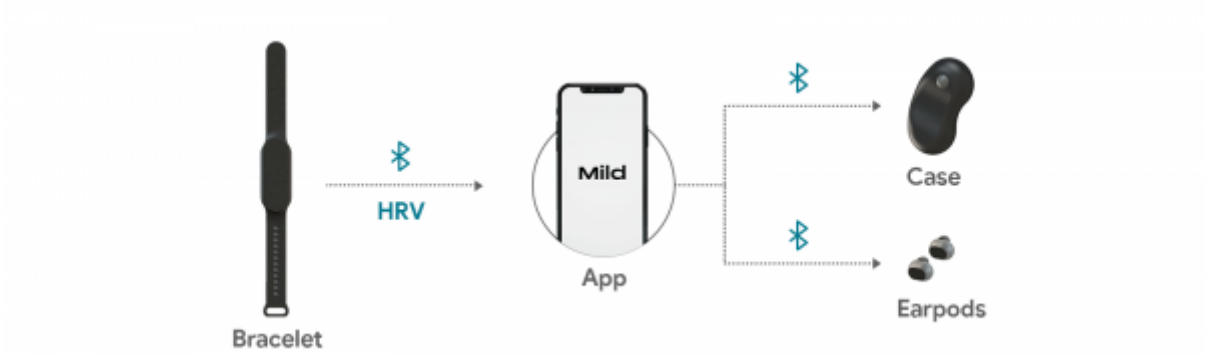

Figure 29: System Architecture

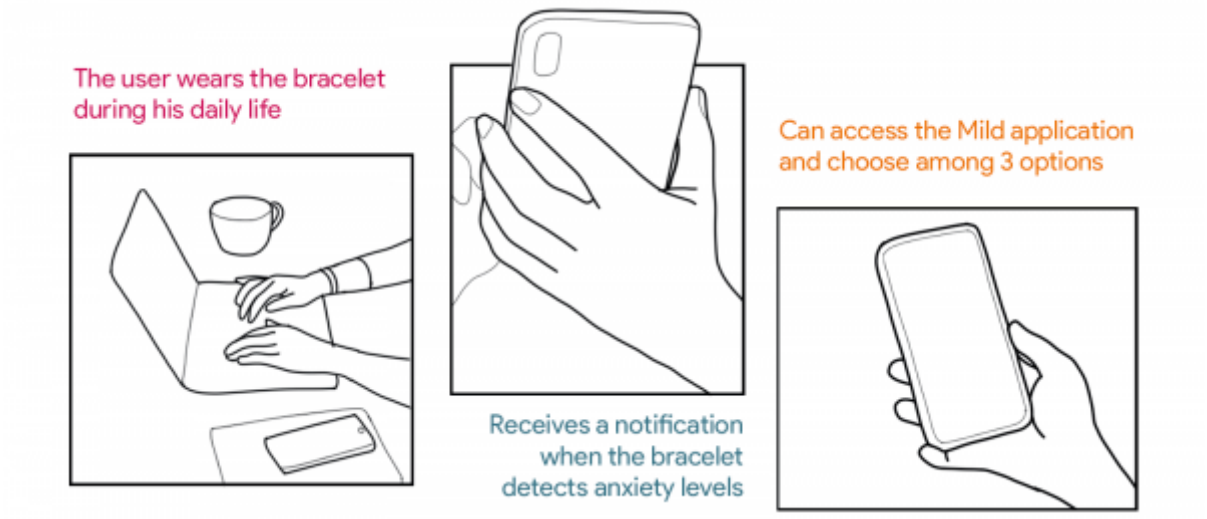

Figure 30: Storyboard

Figures 31 and 32 illustrate the Electrotechnical Circuit Schematics for the case and the bracelet.

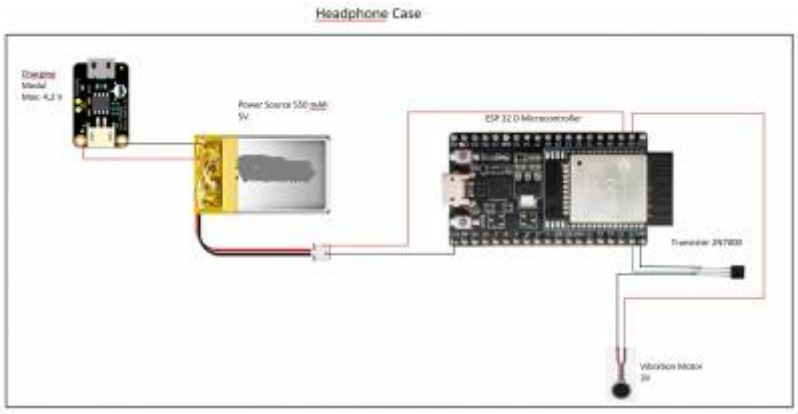

Figure 31: Headphone Circuit

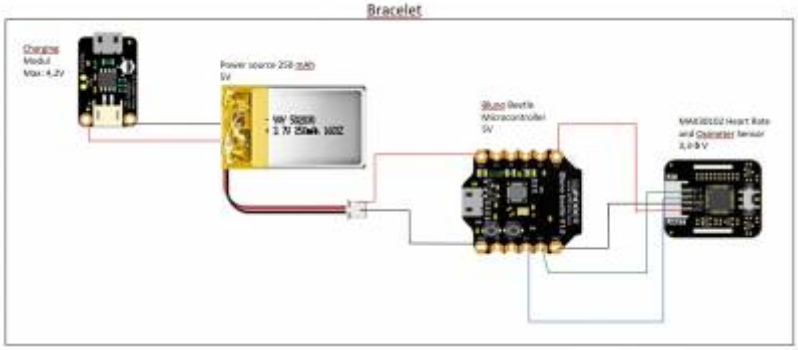

Figure 32: Bracelet Circuit

Regarding the shape of the product, sketches have been done in order to explore different concepts and possibilities. This stage of ideation included brainstorming ideas, breaking conversations, building a fresh product from the ground up, and making free and abstract forms and shapes. From the first sketches, shapes were defined for the final product design concept. To create a soft and mild concept, the team decided to adopt squishy shapes as the main concept.

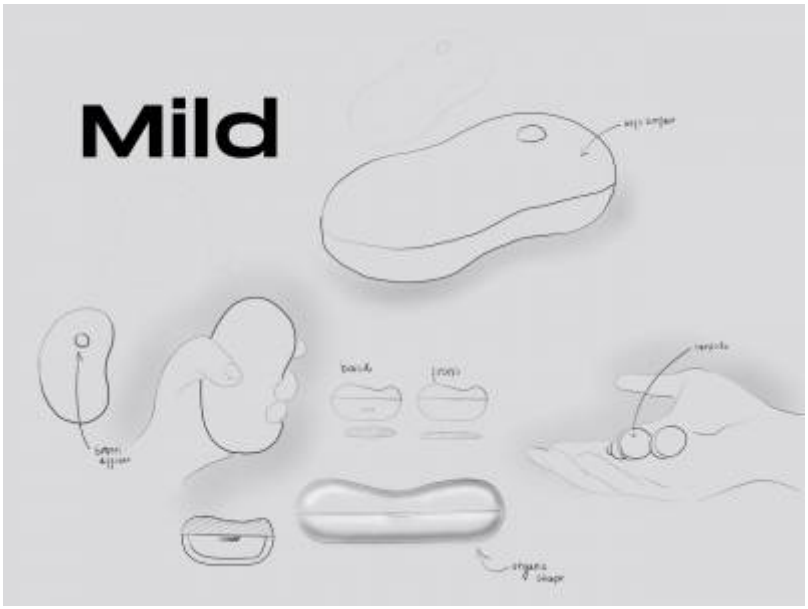

Figure 33: Structural sketches

Still regarding the shape of the product, a clay model was made for initial ideation to understand not only the proportion of the case, but also its ergonomic aspects. In addition, this ideation step also helped in deciding on the measurements and building the 3d model, as is later illustrated in Figure **50**.

Figure 34: Clay model

7.3 Concept

The first step for the creation of our concept was the creation of the visual identity, first the team brand, as illustrated in figure **35**, and then for the product, as illustrated in figure **36**. For this step, the team collected concepts considered important not only from the definition of the target audience but also from the analysis of products already on the market, as observed in the State of Art chapter. First, for the construction of the brand DSTRS, keywords were collected, such as Authenticity, timelessness, modernity, and versatility. Therefore, DSTRS is a young, versatile, and dynamic mental care company, whose main goal is to create a smart companion for people who suffer from anxiety. Furthermore, the creation of the product's visual identity began by defining the very name of the

device, called Mild. Before coming to a final decision, the team thought of several words that were discarded, but that also refers to the concept of something soft, such as Mellow. To choose the final name, the team took into consideration concepts such as innovation, a name different from existing products in the same field; sonority, how the product name will sound when referring to it as an object; and lastly, meaning, what the word itself means. In this case, Mild comes from the Old English word milde for “gentle” and means moderate and soft, such as the product.

Figure 35: Logo DSTRS

Figure 36: Logo Mild

In addition to the logo, to put into practice the marketing concepts and perfect the brand concept, the team also developed graphic elements and media, not only for the product Mild but also for the team's brand: DSTRS. These elements are important to help affirm the proposed brand concepts and collaborate in the development of the product. **Figure 37** illustrates three different concepts for possible posters for the DSTRS brand. For the product brand, Mild, a poster (**Figure 38**), an informative flyer (**Figure 39**) and illustrative cards (**Figure 40**) were developed. For the development of these elements, the team strengthened the brand concept by using graphic elements referring to sound waves, soft gradients with the brand colors, and the representation of a user after the Mild effect.

Figure 37: DSTRS Poster

Figure 38: Mild Poster

Figure 39: Mild Informative flyer

Figure 40: Mild Cards

Regarding the elements of the product:

Smart bracelet: The bracelet tracks the anxiety level of the user all day long and when the anxiety level is too high it communicates with the app that will help with a solution.

Smartphone Application: Gets information from the tracker and notices the user when the anxiety level is too high. When this is the case the user can easily control its preferred solution for the problem. The user can choose to play music according to their mood, play calming sounds, play breathing exercises or use the earphone case to practice breathing exercises.

Earphone case: The Mild Case holds the earplugs and works also as an anxiety tool. It is a case with a soft feel and a distraction smell-diffuser to calm you down when you need it. It includes a vibration function to help set your breathing pace.

Earphones: The Mild Earphones provide the user with either music, calming sounds, or a breathing pace that can be followed.

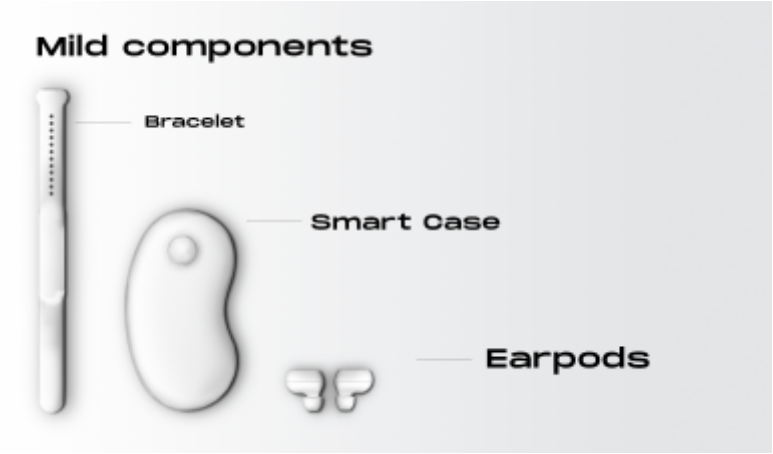

Figure 41: Mild components

Requirements for the user to be able to use our product would be a working smartphone and the will to wear our tracking bracelet all day long.

Our concerns would be the price of our product being too expensive for some people who need it, and as stated above, the will of the user to wear a bracelet every day that tracks your anxiety level.

7.4 Structural Design

In the production and the design of wearables, every aspect that has to do with the material has great importance. These products are under constant stress through contact with clothes, skin, and other irritating substances like sweat or soap. As well as the fact that a wearable is mostly also supposed to be a fashionable design piece makes the requirements for these products even higher. Following the requirement of great durability and a good look is already a difficult task in structural design. On “Mild” the requirements for the design are also combined with the need for an ergonomic shape as well as a soft finish that fits the product's purpose of looking and feeling calming. Here the choice of a good material that fulfills all these needs becomes an important decision not only for the production technique and price but also for the environmental impact of the materials production and the material itself. In product development it is mostly necessary to create a prototype like it is described in Prototype. Here requirements shift again to having a quick-to-produce material that has similarities with the actual design material. The choice for prototyping was a plastic that can be 3D printed and gives the bracelet and case the right features. For the real product concept, another material is needed which can be produced in casting or injection molding. A material that has good material properties and can be molded like this is Polycarbonate. Here it is possible to produce large quantities in a short amount of time and remain a good base of properties like tensile strength, elasticity module, or hardness like it as shown in **Table 17**.

Property	**Value**	**Unit**	
Density	1.2	kg/dm	**3**
Tensile Strength	60	MPa	
Modulus of Elasticity	2.3	GPa	
Brinell Hardness	80	BHN	
Melting Point	576 / 298	K / °C	
Estimated Price	2	$/kg	

Table 17: Material Properties Polycarbonate

For the structural design of the bracelet and the headphone case, the above-mentioned design requirements must be applied. An ergonomic shape and enough space to fit all the electrical components are necessary. Also, room for all functions of “Mild” and the headphones are to be fitted inside of the headphone case. The technical drawing of the headphone case is shown in **Figure 42** .

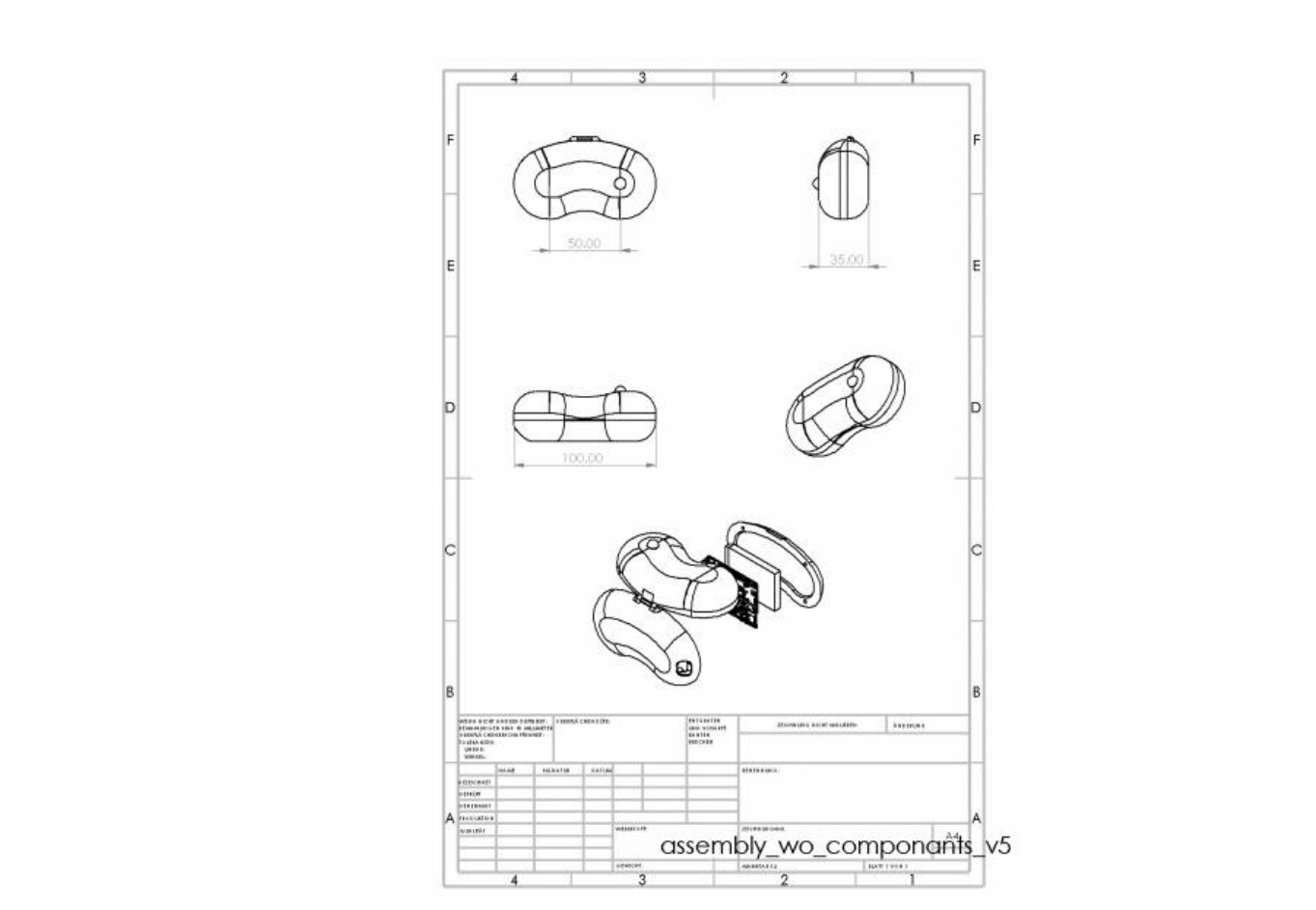

Figure 42: Technical Drawing Headphone Case

Similar requirements go for the bracelet. Here the importance lies in the spacing of the electrical components that are quite large in the state of prototyping as shown in **Figure 43**. For further development, the bracelet will have a slimmer design that is fashionable and not so obvious as it is shown in **Figure 44**. It is important to mention that the inner electrical components of products being made in mass production can be designed on a printed circuit board (PCB) which makes the possibility of having a smaller and less obvious design possible. The material for the bracelet is supposed to have a soft finish that can be bent around a wrist. A good material that has proved itself is silicone which is easy on the skin and good to put in any form or shape. The box part of the bracelet itself is supposed to be made from PC as well.

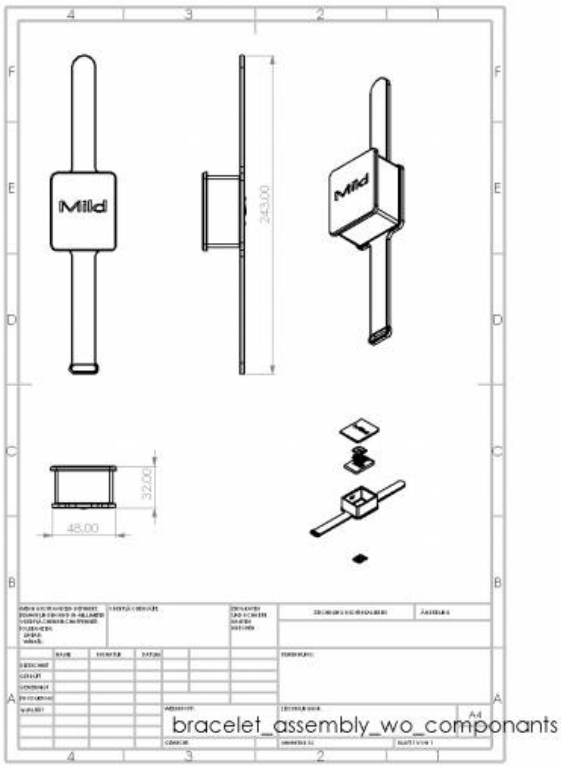

Figure 43: Technical Drawing Bracelet Prototype

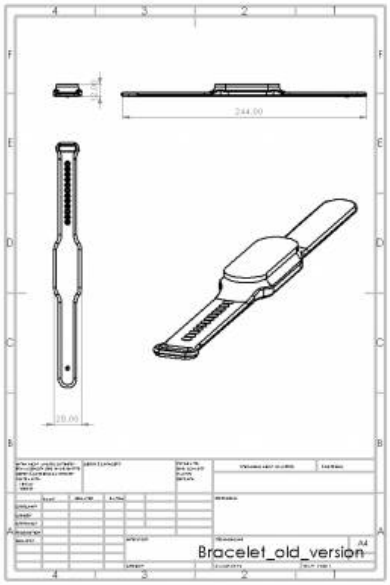

Figure 44: Technical Drawing Bracelet Concept

The strength of the material is supposed to withstand load cases that resemble falls from standard heights or forces that could be easily put on by the user’s hand. Here the headphone case is being focused on since it contains a fragile structure like a hinge. To test the strength of the product and if the structural design is being carried out appropriately finite element methods (FEM) simulations were being done especially on the hinge part of the headphone case. This is a method for numerically solving differential equations arising in structural and mechanical engineering. A model of the stressed structure is divided into a custom mesh that separated the model into a finite number of elements for which different algebraic equations are applied. Here in particular the Von Mieses stress value is calculated for the elements of the constructed models.

Load cases here should resemble the falling of the product and a person accidentally putting too much force on these parts of the case. A simple load case of 50 Newton static force was put on the case in two different y-directions to check the product's deformation result and to check the distribution of stress on the two loaded parts the upper and lower part of the headphone case.

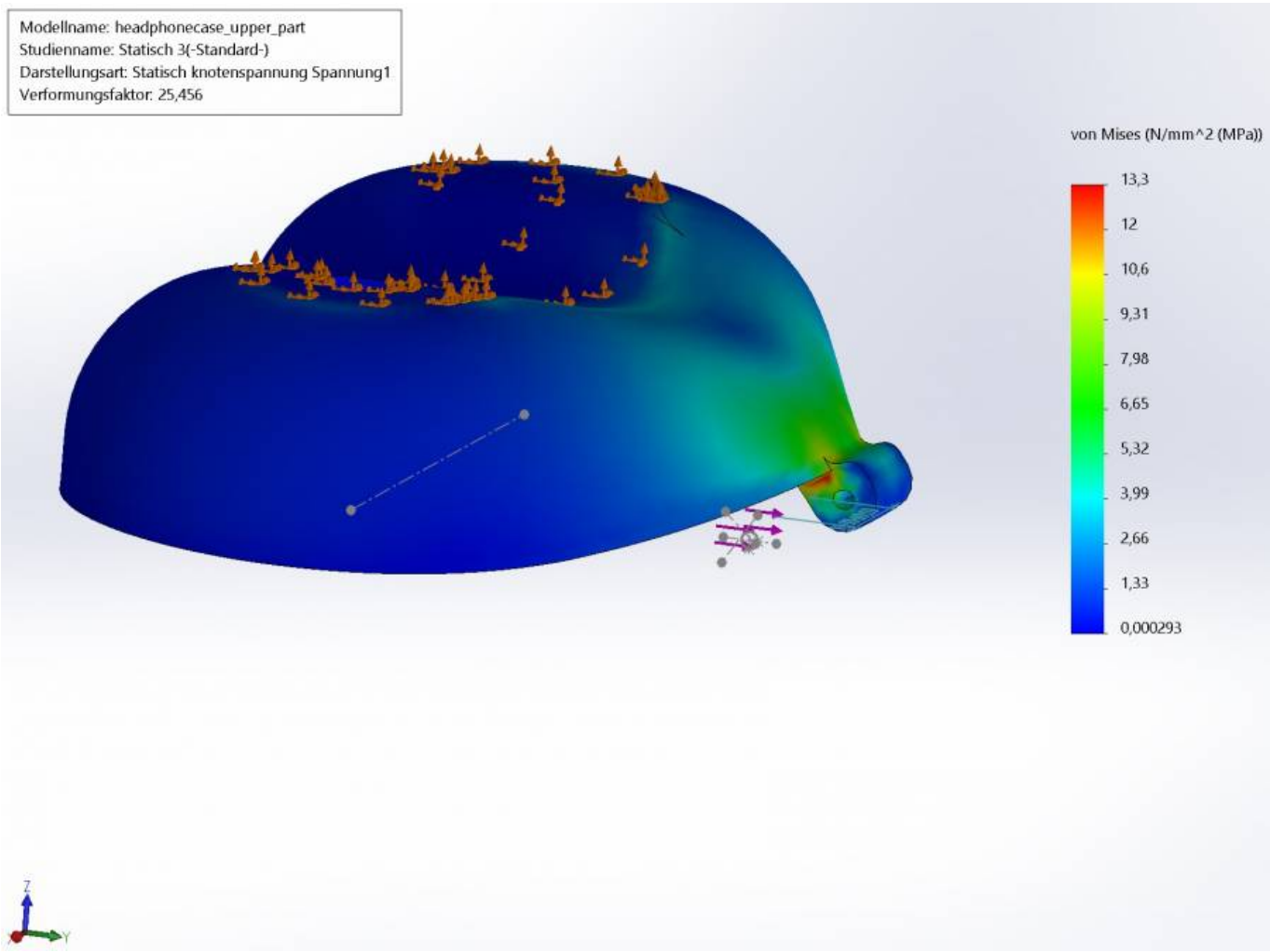

Figure 45: Stresssimulation Headphonecase Upper Part

In **Figure 45** it is visible that the upper part under the mentioned load deforms in the direction of the applied force. The legend explains that the amount of stress is made visible through different colors with red being the part under the most stress. Here it is visible that the most amount of stress does not exceed 14 MPa which is a fair amount not to break the structure. The same conclusion is applicable for the lower part of the headphone case as well where the highest amount of stress does not exceed the materials yield strength of 60 MPa by far. Although a clear amount of deformation is seen the simulation results never give a sign of breaking or ripping of the material. Also in the simulation result of the headphones cases, the lower part as seen in FEMbl **Figure 46** and **Figure 47**

the highest visible stress amount on the hinge in red does not exceed the highest possible amount for PC of 60 MPa.

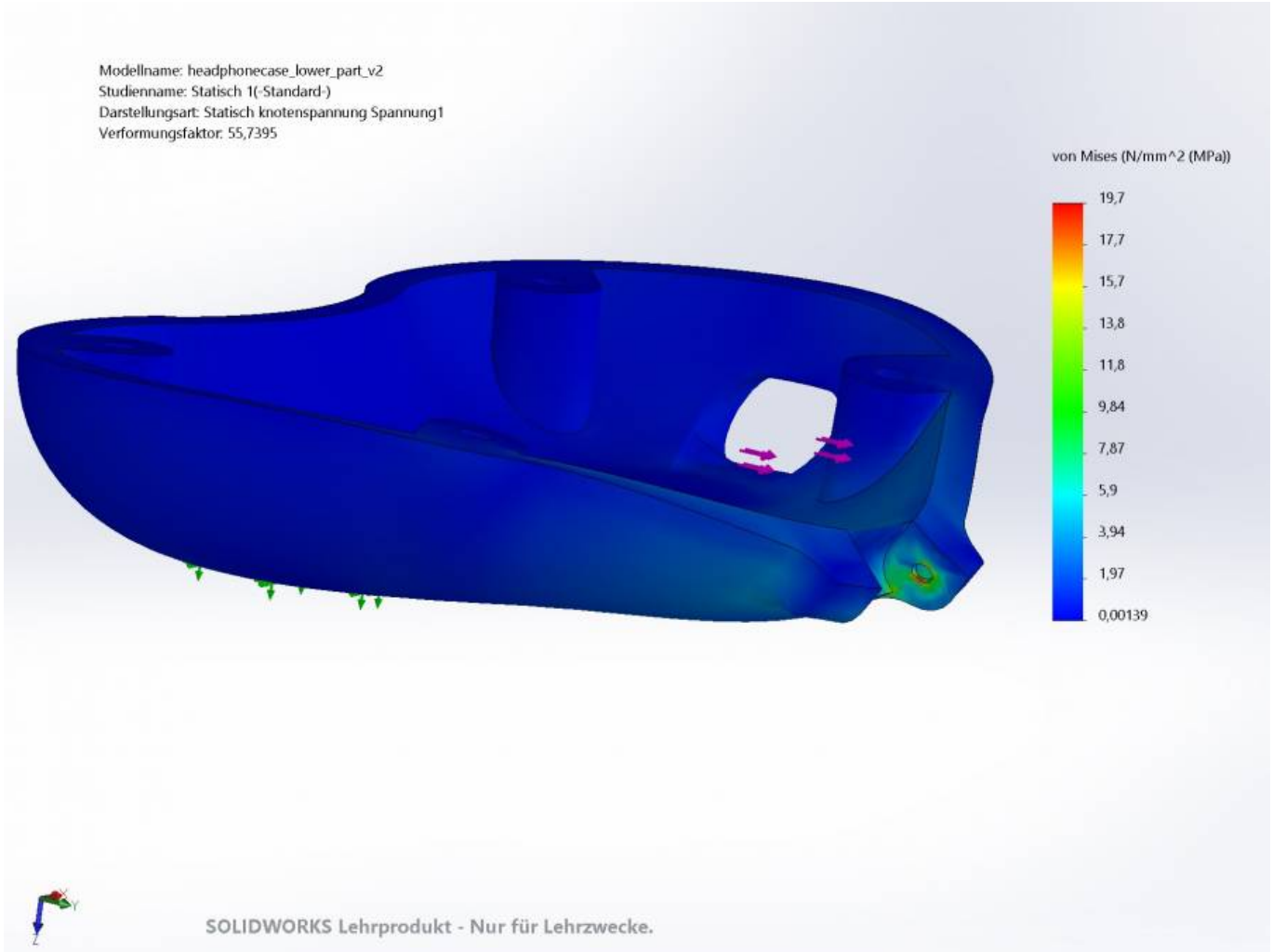

Figure 46: Stresssimulation Headphonecase Lower Part 1

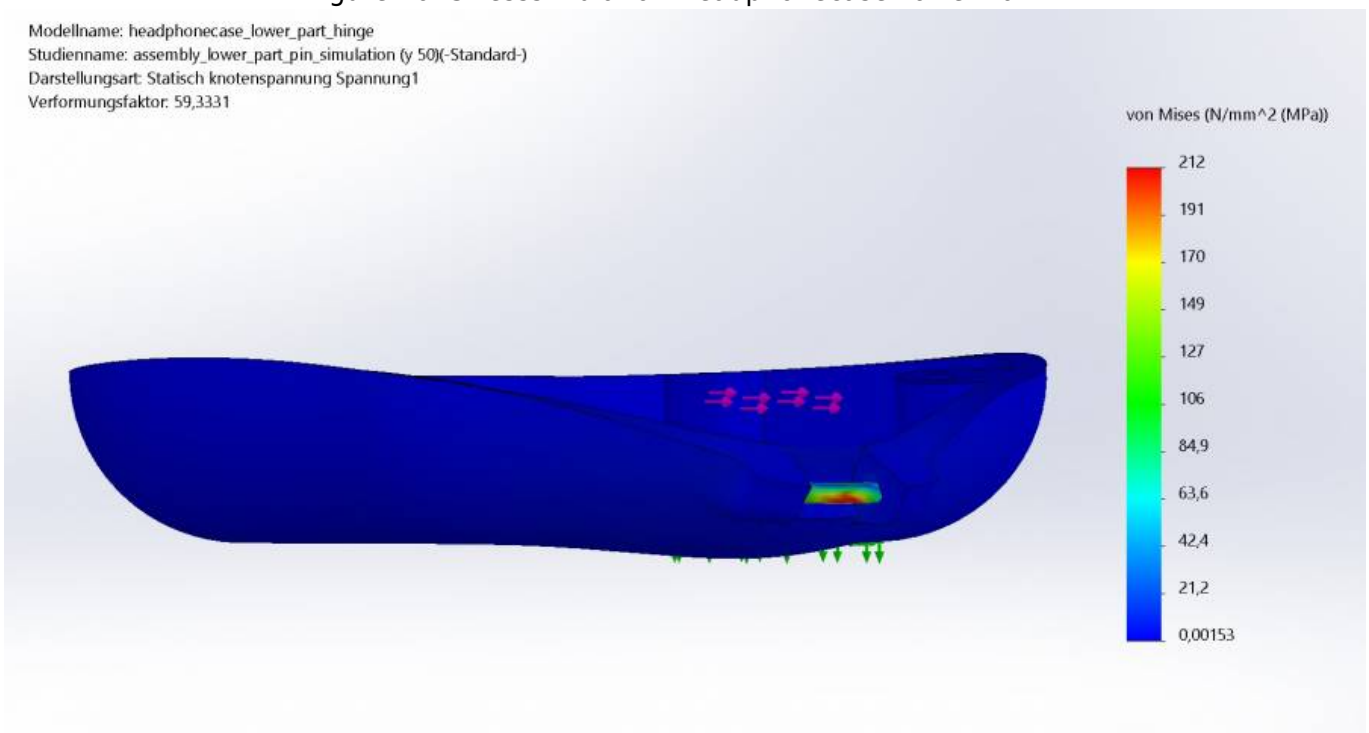

Figure 47: Stresssimulation Headphonecase with hinge

7.5 System Design

The choice of components is a very important topic for product development. For the final product to work as it should, it is necessary a previous analysis of several available options as well as their respective advantages and disadvantages in relation to the final product. From the design of the product concept and its respective functions, the team started the research about the necessary components for the best development and, with the help of the supervisors, arrived at a final electronic components list, as illustrated in **table 18**.

Table 18: List of materials

BRACELET					
Name	**Description**	**Materials needed**	**Size**	**Local providers**	**Power**
Plenthysmography (PPG) iHaospace MAX30102	measures heart rate variability (HRV) and blood pressure (bp)	Sensor chip	0.5 x 8.5mm	https://www.botnroll.com/pt/biometricos/4310-m-dulo-sensor-de-frequ-ncia-card-aca-max30100-pulsa-o.html	1.8 ~ 5V
Rechargable Power Source		Lithium Ion battery	6x17x30mm	https://www.botnroll.com/pt/baterias-e-carregadores/1407-lithium-ion-polymer-battery-37v-250mah.html	250 mAh
Micro controller	BLUNO BEETLE - Atmega328/16MHz e Bluetooth 4.0	Electrotechnical Modul	28.8mm X 33.1mm	https://www.botnroll.com/pt/arduino-controladores/1281-bluno-beetle.html	5V DC
Alimunium Alloy	Al 6061-T6			Leroy Merlin	
Silicone wristband	bracelet to smartwatch				
HEADPHONE CASE					
Name	**Description**	**Materials needed**	**Size**	**Local providers**	**Power**
PETG Filament	Material to insert into a 3D Printer			https://www.ptrobotics.com/filamento-3d/8181-filamento-pla-175mm-1kg-preto.html	
Rechargable Power Source	3,7 V Lipo Akku 1000mah Lithium-Polymer	Lithium Polymer battery	5 x 30 x 40 mm	https://www.botnroll.com/pt/baterias/1409-lithium-ion-polymer-battery-37v-550mah.html	battery 3.7V 550mAh
Charging Module (USB-C port included)	Charging Module in order to charge up the battery cell of the headphones. Charging protection functions included. USB-C	Electrotechnical Modul	26.3 mm x 17.1 mm x 5.6 mm	https://www.botnroll.com/pt/carregadores/3074-carregador-micro-usb-5v-1a-para-baterias-litio.html	Input: 8V Output to the batterycell: 4,2 V (+ security margin)
Vibration motor	Micro Vibration Motor 10mm Diameter 3.4mm Thickness NFP-C1034	Electrotechnical Modul	2.7 mm	https://www.botnroll.com/pt/motores-dc/3255-mini-motor-de-vibra-o-2-7mm.html	3V
Transistor	The 2N7000 N-Type MOSFET	Modul in order to drive the Vibration Motor correctly. Modul has to be placed between micro controller and vibration motor.	5.2 x 5.3 x 4.2mm	https://mauser.pt/catalog/product_info.php?cPath=324_247&products_id=002-1349	
Micro controller + bluetooth modul	Espressif ESP32 WLAN/BLUETOOTH Dev Kit Board	Modul in order to receive data from the smartphone via bluetooth and control the multiple funtions of the headphone case	54.4 × 48.2 × 27.9 mm	https://www.botnroll.com/en/ethernet-wi-fi/2452-esp32-devkitc-development-kit-espressif.html	
Aroma diffusor/ Distraction Tool		ceramic stone ball that is placed in a certain spot on the outside of the case, this can be used as distraction tool	about 8.5mm in diameter, hole: 1.5~2mm	not found localy, shipping: €3.16	

Sensor choice

For the choice of sensor, the team conducted prior research into different methods that could be chosen to detect anxiety levels in the user. Currently, as this market grows, heart rate (HR) and heart rate variability (HRV) have received a lot of attention. Both metrics have many pros and cons that should be considered before using either one. To determine when to use these metrics correctly, it

was important to understand the basic science in this field of physiology and behind each sensor technology for the best decision for the end product.

Heart Rate (HR) is measured in beats per minute and it doesn't require exact times. This technique is a simple test that has been in existence for a long time due to the low-tech requirements for measurement. Generally, a low HR indicates rest, while a high HR corresponds with exercise or exertion. Although it is a really easy technique to measure, heart rate is a vague indicator of internal activity at best and inconsistent at worst. After analyzing the product's target audience, as well as the symptoms that anxiety causes, it was noted that simply recording the heart rate is not enough to learn something new about how we feel, but that the most informative metric relies not just on the heart rate, but how much the heart rate varies. Therefore, Heart Rate variability (HRV) measures the specific changes in time (or variability) between successive heart beats. As illustrated in **Figure48** the time between beats is measured in milliseconds (ms) and is called an “R-R interval” or “inter-beat interval (IBI).”

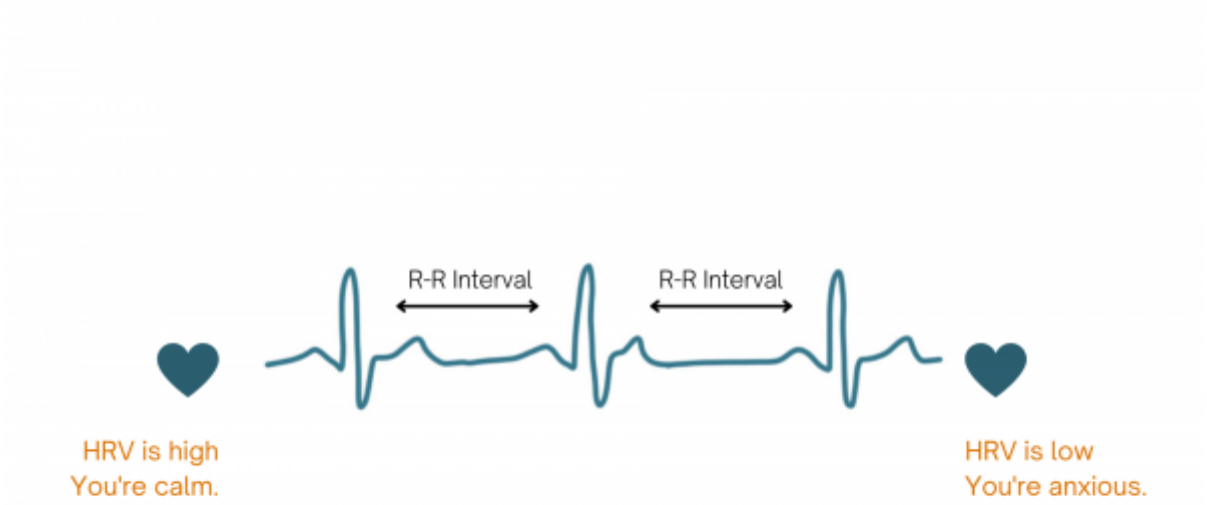

Figure 48: Heart Rate variability (HRV)

HRV in general is an indicator of physiological stress or arousal. Therefore, by analyzing the HRV, we are analyzing how well our body oscillates between stress and recovery, with increased arousal associated with a low HRV, and decreased arousal associated with a high HRV. Generally, a higher heart rate variability (HRV), or greater variability between heartbeats, usually means that the body has a strong ability to tolerate stress or is strongly recovering from prior accumulated stress. The more your heart jumps around (to an extent, of course), the readier you are for action. On the other hand, a low HRV (or less variability in the heartbeats) indicates that the body is under stress from exercise, psychological events, or other internal or external stressors.

While medical uses of HRV are widely used for other functions, there are also aspects of thoughts, emotions, and behaviors that can be derived from HRV data, resulting in several advantages in using this technique for the project:

- The most precise non-invasive measurement of Autonomic Nervous System activity (responsible for recovery and the body’s response to stress among other things);
- Can be measured by affordable consumer-grade heart rate monitors;
- Able to detect psychological stressors, and integrate the nervous system, cardiovascular

system, and respiratory system;
- Various metrics inside of the HRV like the Standard Deviation of normal to normal R-R Intervals (SDNN) or the Root Mean Square of the successive differences (RMSSD) are used as indicators of physiological stress or arousal, with increased arousal associated with a low HRV, and a decreased arousal associated with high HRV.

Therefore, since HRV focuses on the imperceptible changes between each heartbeat (in milliseconds), it is much more complex and requires higher degrees of accuracy than heart rate, so this technique was chosen for the development of the project. As the team focused on the value of RMSSD as the main metric to be used the calculation of this value is a complex task. RMSSD can be computed using the following equation:

$$\mathrm{RMSSD} = \sqrt{\frac{\sum_{i=1}^{n-1}(RR_i - RR_{i+1})^2}{n-1}}$$

Figure 49: Formula RMSSD Value

It was implemented in the code for the microcontroller of the bracelet as the main value that detects anxiety or stress. This program is supposed to have a baseline RMSSD value for each user. This baseline is used to create a certain value for each user that can be used to detect their mental state. If this threshold is out of a common range which is in the 25 to 34-year-old age group, women had a typical RMSSD of 42.9 ± 22.8 and men had a typical RMSSD of 39.7 ± 19.9 (mean ± standard deviation).

7.6 3D Model

This chapter presents the 3d model of the product. However, first, it is important to consider that two different assemblies were made: the first represents the ideal concept, so the product assembly in the case of production with smaller electronic components; the second model represents our prototype for the proof of the concept, with significantly larger components than the ideal assembly.**Figure 50** illustrates the Mild concept in the case of large-scale production with smaller components. The concept development was made from all the Design thinking stages, especially the ideation stage, which was very important for the team to reach the final product concept, as it is better illustrated in **figure 33**.

Figure 50: Mild Components Concept

Regarding the development of the 3d model for the prototype construction, an exploded view and an external view was made of each of the two products (case and bracelet), considering that for the testing phase, an existing earphone should be used. The exploded view is intended to represent how the parts are arranged inside the case. The models were created with the main objective of not only obtaining a realistic view of the arrangement of the electronic components required in each of the devices but also to later be used for the prototyping phase with 3D printing. The SolidWorks program was used for the development of the models, and the components inside the housings were therefore shown in their actual dimensions.

Bracelet

Figure 51 represents the external view of the bracelet for the proof of concept. The model consists of four different parts. First the bracelet itself, then a box designated for housing the electronic components as well as its lid. In addition, a kind of ring was also modeled, which serves to close the bracelet on the wrist. In this figure, it can also be seen that for the purposes of better finishing the prototype, the team placed the product logo on the bracelet cover.

The **Illustration 52** below shows the exploded view of the portable device. This figure shows how the components are arranged inside the bracelet case. The Plenthysmography sensor is arranged directly at the bottom of the case, where there is an opening to allow contact with the user's skin, forming the first level inside. The second level is the Lithium-Ion battery, which supplies the device with power. Next, a charger module is lined up to charge the device. The last level is formed by the Bluno Beetle microcontroller. Among other things, it is responsible for exchanging and processing data from the handheld device.

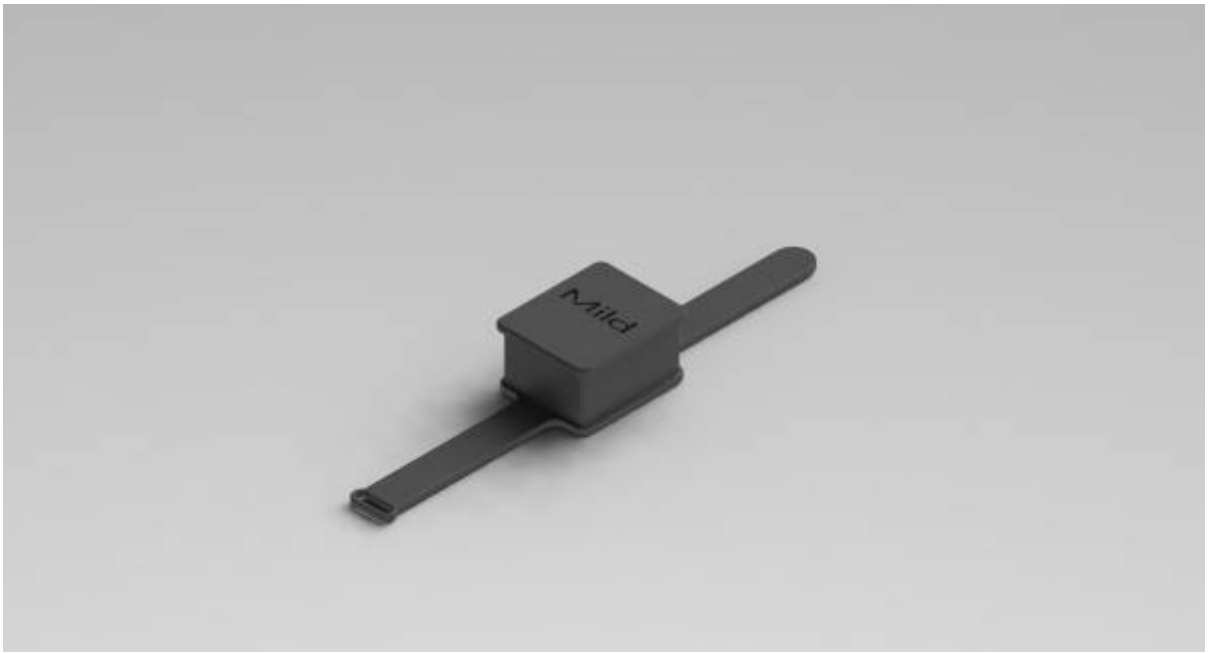

Figure 51: External view of the bracelet

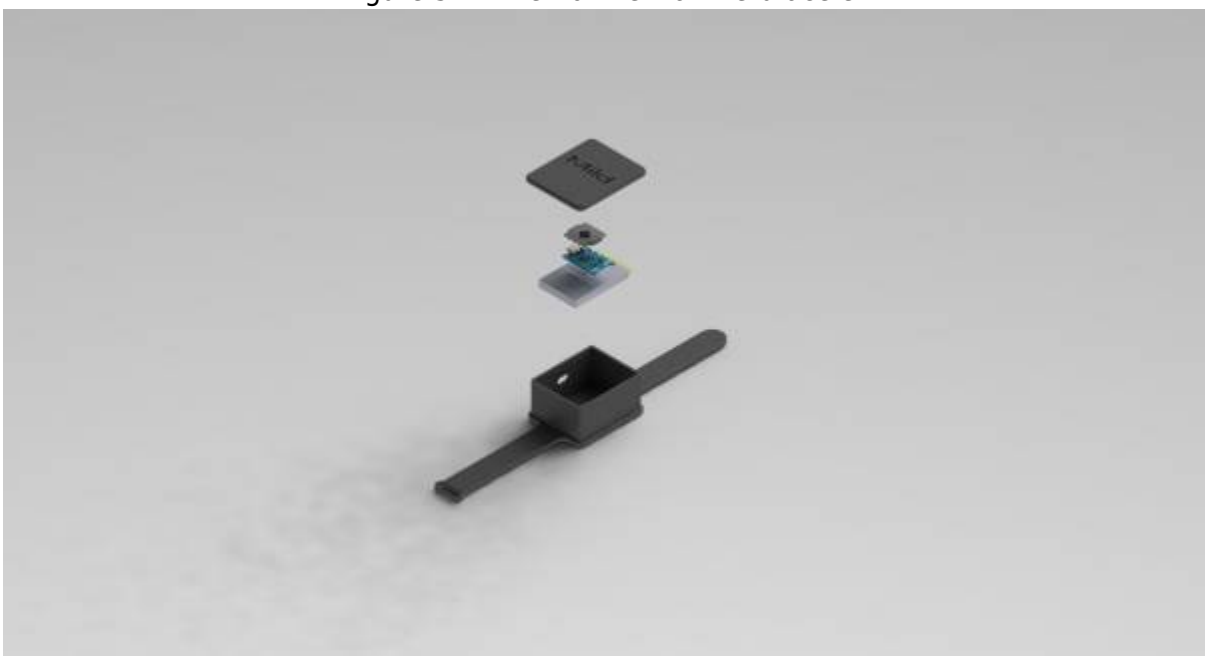

Figure 52: Exploded view of the bracelet

Headphone Case

Figure 53 represents the external view of the Mild smart case for the proof of the concept. The model consists of four different parts. First, the bottom part is designated for housing the electronic components in the prototype stage. Next is the middle part of the case, which serves not only as a cover for the bottom part to protect the electronics, but also to simulate what would be the space for the earphone. Then, the upper part, which is the lid of the smart case. This part is not only designated to protect other components but also to place the smell diffuser ceramic ball, which is the last part of the model and is used as a distraction tool.

The **Illustration 54** below shows the exploded view of the smart case. This figure shows how the components are arranged inside the case. To drive the vibration motor correctly, the transistor is arranged next to it. This component is responsible for the vibration feature of the product. The second level is the microcontroller with a Bluetooth module, to receive data from the smartphone via Bluetooth and control the multiple functions of the earphone case. Next, a charging module is placed

together with the battery, to charge up the battery of the device.

Figure 53: External view of the case

Figure 54: Exploded view of the smart case

Mild Product

Figure 55 shows the exterior view of the smart case and the bracelet. With this view, the dimensions of the two sub-products should be clarified, although this model represents our prototype for the proof of the concept, with significantly larger components than the ideal assembly.

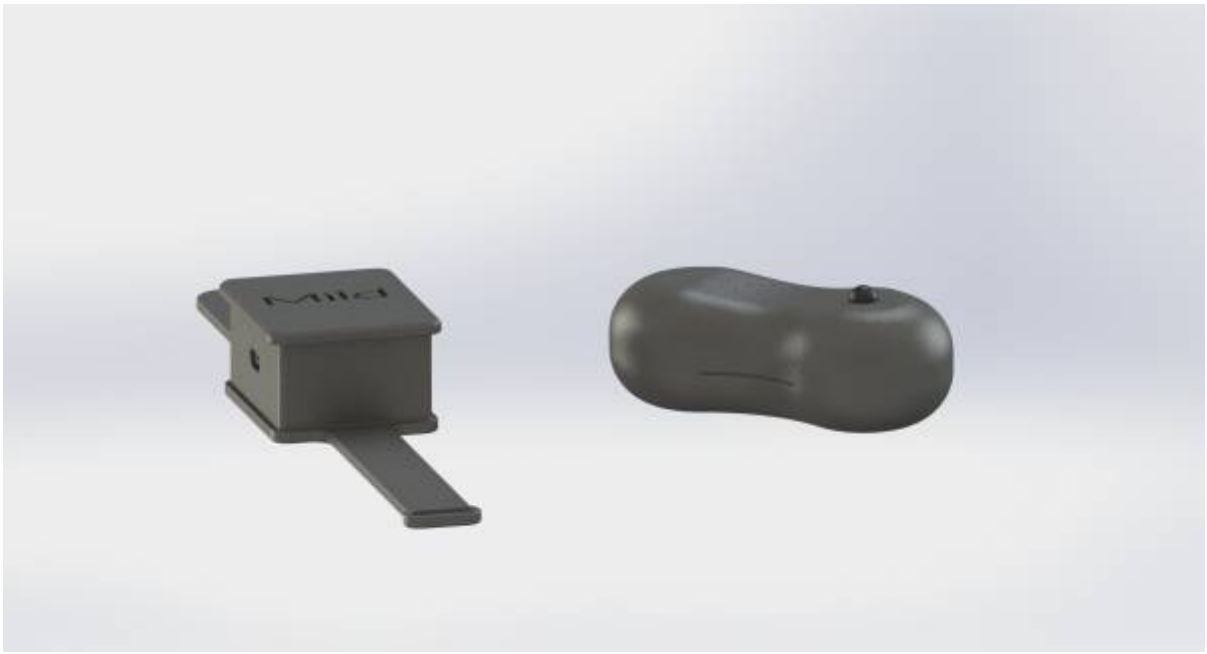

Figure 55: Prototype for the proof of the concept

7.7 Packaging

It is well known that the main functions of packaging are storage and transport of a product. But following the circular economy concepts, the team didn’t want the product packaging life to end the moment that the user gets off the product from the box or just uses recycled raw materials as an argument for sustainability. For these reasons, the Mild packaging is an unbleached cotton bag, using paper to structure the bag and keep the devices in order. In that way, besides creating a user experience and a relationship with the customer, the team is also giving the packaging a new meaning since the cotton bag is an item that can be used in our everyday life as our product does.

Material

The packaging is going to be made of unbleached cotton because it is a sustainable and eco-friendly option to replace plastic bags. Besides being stylish, it is also versatile and can be used on different occasions, as a nécessaire when traveling, when shopping, or even to carry your things during a walk. The unbleached cotton bag stands out among the different alternatives to plastic bags or bags made of other materials that are harmful to nature. This is because the unbleached cotton fabric does not go through any kind of chemical process, reducing the emission of pollutants, energy consumption, and water use.

The main advantages of unbleached cotton are:

- Reduces pesticides and toxic waste: By choosing unbleached cotton bags, you stop contributing to businesses that harm the environment. Raw cotton does not go through chemical processes to be made and, if it is organic, it is grown without pesticides and chemical fertilizers, minimizing damage to the planet.
- Less time to decompose in nature: The raw cotton bags have high durability, the time of use will be years without it tearing or deteriorating. However, in case you need to dispose of it, its decomposition time is much shorter than that of other materials. While plastic is a material that can take up to 400 years to decompose in nature, the unbleached cotton bag takes from three to twelve months, depending on the region's climate and the other components used in its

manufacturing.

- More durability and strength: The unbleached cotton bag has a much longer life cycle than bags made of other materials, especially plastic.
- It's affordable: The unbleached cotton bag is one of the most economical options on the market because it combines low cost, high durability, and versatility. This means that you will have an affordable product that will keep you company for years to come with a variety of possible uses.

Figure 56: Mild Packaging

7.8 Mobile App

After the creation of Mild's visual identity, to start the development of the application research about other mental health applications was done. Aspects like available options, visual identity, and how it works were observed. The app will have as a wire-frame a register function firstly, to maintain a database of users and their roles, a login function for accessing the app, and a set of 4 available features on the home screen:

- Music: Ready-made playlists will be recommended to the user with the main goal of promoting relaxation and de-stress through songs that have been proven to promote this. In addition, the user will also be able to create their own playlist with songs of their general preference.
- Sounds: A library of different sounds with different categories capable of calming and relaxing to be listened to in the background, such as nature sounds: ocean sounds, birds, and forest.
- Vibration: It gives the consumer the option to feel the vibration of the earphone case without wearing the earphones. This option is effective in situations where earphones cannot be worn.
- Breathing: Sounds to guide the breathing pattern to relax and achieve a normal breathing rate.

Regarding the application design, concepts and graphic elements from the Mild product were used. Furthermore, to promote the best user experience possible, not only with the components but also with the application, the interface was created in the most intuitive way possible, facilitating its use during situations of stress and anxiety for the user.

Figure 57: Mobile app design concept

Figure 58: Mobile app mockup

For the development of the app, we have used the MIT app inventor program, where we have programmed all the possible options that can be used by the consumer to calm down after a warning that their stress levels are increasing. We have implemented the options of vibration and breathing, sound and music creating blocks. We have had the setback that in this program it is not possible to maintain Bluetooth connections between screens, that is why the app has a single screen with a series of blocks that are programmed with the different options to be developed, these blocks will be hidden or visible depending on the use of the consumer.

7.9 Prototype

For prototyping the product, a 3D printed model was made. First, it is important to remember that the 3d model of the prototype was built exclusively for the proof of concept, since some changes regarding dimensions were necessary because of the size of the electronic components. The 3d printing process offers the possibility to print 3D models created at low cost with little time. In

addition, this method offers many advantages over simulating a prototype in a development environment. Firstly, it is possible to create a dynamic prototyping cycle where changes can be made in a short period of time. Furthermore, 3d printing allows the evaluation of the true size and shape of the model and the identification of assembly problems, as well as the possibility of mounting electronic components on the model. It is also noted that in CAD development environments, using software, the possibility of zoom settings can often falsify the actual size of the component as it is a product design. Another aspect that can be observed and better understood with 3D printing is the ergonomic aspects of the product, allowing consideration of possible changes. In the case of the making of the MILD prototype, these considerations were also made during the clay model, as illustrated in **Figure 34**. Another advantage of printing is the ability to test the product design in real environments and therefore in a specific application.

For the final prototyping of the product, the team chose to 3D print not only the case but also the bracelet. After building the model in clay, the necessary changes concerning the ergonomics of the case were observed. Regarding the changes needed while building the prototype, adjustments were needed to the size of the model to fit all the electronic components. A 3D model of the case and bracelet was designed to use the smallest possible support structure for 3D printing. Therefore, excessive work was minimized to implement the least amount of waste material and therefore minimize printing costs and production time.

In this case, a 3D printer from Investec robotics lab was used for printing. Therefore, the STL data was then transformed into the G-code data structure using the Ultimaker Cura slice, which could be transformed into shape by the 3D printer. Specifically, the printers used were the Ultimaker S3 and S5. In the material analysis, the team planned to use ABS material for printing. However, PLA was used to print the case and also a part of the bracelet. Firstly, because this material was already available, but also because it has higher strength and stiffness than ABS. Only one type of PLA was used for cost reasons. Regarding the bracelet printing, TPU was used firstly because this material was already available, but mostly because this 3D printing material has been engineered to simulate rubber-like features by combining strength with great elasticity and durability. Therefore, the color of the components could be implemented as planned and they were printed in black. The running time of the 3D printer was about 15 hours for all components counting the reprinting process of some of the parts. In addition, to refine the prototype after printing, the model was sanded for better assembly.

After printing and sanding, the individual components were assembled using the components list. Regarding the quality of the prints, it is very good and corresponds to what the team had in mind when it came to the design. It’s important to remember that the bracelet is relatively large, but would be significantly reduced in the case of production using smaller electronic components. In **Figures 59 and 60** the printing results are shown.

Figure 59: 3D printing results

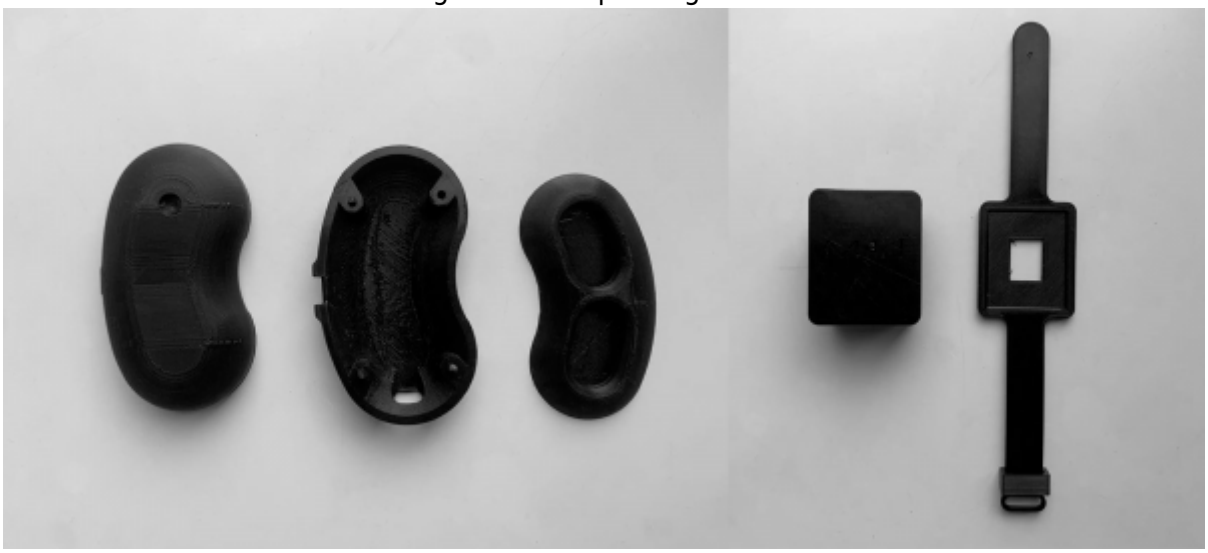

Figure 60: 3D printing results 2

Furthermore, **Figure 61** shows the prototype's everyday use.

Figure 61: Prototype's everyday use

7.10 Tests and Results

The testing of “Mild” was mostly done by setting up and building the prototype. Every function that has a mechanical origin was done through testing and assembling the 3D printed prototype. Here it was included that the hinge of the headphone case was supposed to work smoothly and various kinds of headphones. As the further development of “Mild” had planned to contain our design of headphones this was done with normal-sized Bluetooth in-ear headphones.
The control system of the different devices like the headphone case, the bracelet, and the app was done virtually and physically. For the headphone case, a circuit of the vibration motor and transistor with the LOLIN 32 LITE (ESP 32) micro-controller was set up. A Bluetooth connection to the developed Application was tested and succeeded. The vibration motor was able to be activated in a fade mode to carry out the vibration pattern that lasted 6 seconds of raising vibration intensity and 6 seconds of fading vibration intensity. The programming of the bracelet was the task with the highest difficulty since here the RMSSD value was to be calculated. A test of the heart rate sensor that normally gives out the heart rate value in beats per minute was to be calculated into the RMSSD value in milliseconds. Unfortunately, the heart rate sensor didn’t give out the right value for the RMSSD as it was only giving out 0 value. Here it has to be referred to future development that a new code has to be implemented that sets for representation purposes. A control code that sets a threshold in the heart rate value that cannot exceed 90 bpm would be appropriate here. The testing of the app and its Bluetooth connection worked as well as all four implemented calming functions worked out.

7.11 Conclusion

To develop the project, the team followed the steps of Design Thinking, going through Empathize, Define, Ideate, Prototype, and Test. The development of the project began by defining and structuring the main idea. Next, research was done to define not only concepts for the product design but also how it should work. This research took into consideration not only aspects of the target audience of the device (persona) but also products with the same purpose existing in the market. The main objective that was established for the project was the creation of an intelligent companion that would help people who suffer from anxiety during their everyday lives. From this research, empathizing with the target audience and defining the main goal, the team started the ideation phase, with the goal better defined: to use wearable technology. During the ideation phase, several possibilities of what the product could look like were explored through sketches and diagrams. This stage of ideation included brainstorming ideas, breaking conversations, and building a fresh product from the ground up. As a result, the product concept consists of a bracelet that will take data from the user's body and the information recorded by the bracelet regarding the user's heart rate variability will be transmitted via Bluetooth to the app, then the user receives a notification when the bracelet detects anxiety levels through the heart rate variability data. From the app, the Mild user can choose among 4 options: Breathing, Vibration, Music, and Sounds. The app will command via Bluetooth the Earpods and its Case, which will also be a smart device, depending on each feature the user chooses. Still, regarding the ideation of the product, sketches have been done in order to explore different concepts and possibilities for the shape of it. From the first sketches, shapes were defined for the final product design concept. To create a soft and mild concept, the team decided to adopt squishy shapes as the main concept. To collaborate in the development of the product. The team also developed the concepts of brand, visual identity, graphic elements, and media, not only for the product Mild but also for the team's brand: DSTRS. With the development of the product's design, a physical prototype with all the electrical functions was created, with significantly larger components than the ideal assembly. With these devices a good view and feel of the whole product were visible. Although these prototypes were not the final developed product it gave not only the developer team but also the potential customers of DSTRS the possibility to give feedback on design and function. One could say that the advertisement of mild became only truly possible through the existence of this prototype. Through the building with the method of 3D printing and prototyping style, circuit board development gave the team a large insight into these fields of development. The use of this technique along with 3D modeling after the basic principles of user-friendliness and mechanical requirements had a good impact on improvements of the real product concept. Here an example is the improvement of the initial model of the headphone case that did not contain strong enough mechanics to withstand a user's common load cases.- After preparing the model for the process of 3D printing it had to be partly redone in order to have stronger wall thicknesses and hinge mechanics to be able to be built. These changes were taken into the design of the product's design concept and not only the model of the prototype. During the product development phase, the packaging of the device was another aspect considered. Following the circular economy aspects, the Mild packaging is an unbleached cotton bag. In that way, in addition to creating a better user experience and relationship with the device user, the team is also giving the packaging a new meaning since the cotton bag is an item that can be used in our everyday life as our product does. Furthermore, from the visual identity and concept of Mild, a mobile app was made. Regarding the design of the application, the interface was created in the most intuitive way possible, facilitating its use during situations of stress and anxiety for the user. In addition, a prototype of the mobile application was made. For the development of the app, the team used the MIT app inventor program.

8. Conclusions

8.1 Discussion

The end of our project has arrived, and a successful product has been created. Our product, Mild was a journey to get there, but it all worked out in the end. Our expectations in this project were to create something we would all be proud of, which worked out. It was also important to us to work together as a group, make the decisions together, learn from each other, think as a team and have fun after all. We created a group dynamic where this was all possible.

Mild, our product was created after a lot of research and idea forming. After all our prototype doesn't completely reach our expectations, because, for example, the components don't completely fit in the earphone case. The look of our prototype is also a little different than our expectations, but we are happy with how it turned out.

There are some differences between how we created Mild as a product, and as a prototype: Mild as a product fits all the components perfectly unlike the prototype, it also has a smooth look and feel to it, to help the user calm down. The ceramic ball, to find in as well the product as the prototype, in Mild as a product, has a smell diffuser, and movement is possible as a distraction tool. In our prototype, the ceramic ball is there, but the movement is not possible and the smell isn't there either. This is because the attachment of the ceramic ball wasn't possible in any other way with the 3D-printed model of the case.

The bracelet in our prototype is really thick and big, in Mild as a product the bracelet is way smaller and more fashionable. This happened because the components had to fit in some way. The real bracelet is also made of a different material, so you can always wear it, it feels comfortable and looks okay all day, every day. It also would not contain a 'pile' of components in the concept of Mild, the components would be a lot smaller and fit the small, fashionable bracelet perfectly. The sensor we used in the bracelet is the Plenthysmography (PPG) iHaospace MAX30102, and it measures heart rate variability (HRV) and blood pressure (bp). We used this sensor in our prototype, but in the real concept of Mild, we could also use an electrochemical sensor for cortisol detection from tiny volumes of sweat. This kind of sensor would be more expensive and less available, that's why we did not use it in our prototype.

Mild, as a product, obviously contain its own earphones, while our prototype makes use of existing earphones.

As far as our prototype we are satisfied with how it turned out, although our concept product would look a little different/better.

Regarding the other expectations we had:

The requirements we made up for ourselves in this project:

1. Stay sustainable trough-out the project and the product itself, as well as the packaging: We succeeded here, we sustainably build our whole prototype, we used a lot of 3D printing to build our model,… also our packaging is a very sustainable concept.

2. Our marketing has to comply with the values of gender and racial equality: Succeeded, we included always everyone and every situation possible in the marketing around our product.

3. Don't cross ethical lines: succeeded.

4. Create a good user experience and relationship, because we are a mental health company: We can't say if we succeeded here, because it is not part of the project, more of the aftermath of the product. But how we build up our product, manual, and marketing plan I believe we will succeed here.

5. Comply with the EU Directives: succeeded.

The objectives we made for ourselves:

1. To have a companion that gives a certain amount of relief quickly and whenever possible:

Our smart companion, Mild, gives you relief/help quicker than you even expect. The sensor in the bracelet will sense your high anxiety level before you even notice it yourselves, and so it will give you a possible solution before you even realize you need it. The app will give you a notification right away, and you can act right away. It is also very useful that you can use our product every second of the day, with a small number of exceptions. We chose to create a concept involving earphones: so you can choose the solutions calming music, sounds, or a hearable breathing paste and they will appear through the earphones. Of course, there are always situations when you can not use earphones, for example when you are having a conversation with someone. For this reason, we also made our case the way we did: our case is an anxiety tool too: the soft, gentle feel to it can calm you down, as well as the distraction tool that's in the design. When you turn this distraction tool, the ceramic ball, around, it will also diffuse a calming smell. The case can also vibrate in a breathing paste, to help you keep your breathing normal and calm down after all. You can use your earphones and case at the same time for optimal solutions.

2. The design should be comparable to common devices that are on the market and seen being used in a normal way. It is supposed to be fashionable and not tell the story of the users' needs or problems. It should fit into a modern set of accessories with all devices that are needed to make “Mild” useful:

We tried our best to make the products look as fashionable and normal as possible, I think we succeeded for sure on our case and earphones. The case and earphones look cool, soft and like real, normal earphones in a case. I don't think the anxiety-tool part about it would make people not buy our product, purely on the look of it. The only thing that we didn't completely succeed in is the bracelet. Because it has to contain a sensor, the bracelet is never going to look very fashionable and thin.

3. The production of “Mild” should be able to be carried without high complexity and with the use of integrated electronics when chips go into production. Using all common techniques of production and design organization like quality assurance and testing, the product should be considered as a high standard and working device with a good reputation in the market. To produce a physical display of “Mild” it is objected to producing a prototype with hands-on displaying functionalities.

I think we succeeded here, although our prototype has less functionality than our actual concept of Mild.

After all, I think we can be happy with how our work went, and how Mild turned out as a smart companion.

8.2 Future Development

In the future, saying our product Mild will be on the market this year, we would of course have to work on the making of the actual earphones too, so they could be from the Mild brand as well.

We would also like to make the case in different colors, shapes, and functionalities to be more fulfilling to everyone's needs.

In the further future, we would consider collaborating with earphone companies, who want to have a new, innovative concept in their normal line of earphones. Then our product would not only be marketed as an anxiety tool, but also as earphones.

We would also like to expand our products as a company DSTRS, we would bring more anxiety products or mental health helpers on the market, and put more effort into our marketing as a company, as well as a product, when we can.

The future will also just be implementing what our users tell us need to be better/added/... we want to always keep improving our first product, Mild.

9. Appendix

Business Model Canvas

Designed for:	Designed by:	Date:	Version:
Mild	DSTRS	6-04-22	1

Key Partners
Our partner for bringing our product on the market, as well as for research would be psychologists that believe in our product. We need them to help us get our product on the market. Besides that we need their knowledge on how to deal with anxiety cases the right way.
We also need to get our technology from a large variaty of suppliers. We need a lot of materials and they contribute to the product itselves.
Other partners would be the customers theirselves because they have to track their anxiety all the time to use the product correctly.

Key Activities
Our company provides help for people struggling with anxiety. We want to make their daily life easier and better by puting out technological gadgets in the market. We sell them trough our website and in stores. We build up our customer relationship by always building our products according to the needs of the client.

Key Resources
To get our product on the market we need a good website, a good social media platform, a way to get to people struggling with anxiety for example psychologists.
Practicaly we need to build a tracking bracelet, so we need a tracking device that can be connected to an app, we need the app itselves, we need the case in different forms to the needs of the customer, the headphones, packaging for the whole product and a shipping service.

Value Propositions
We bring out headphones, a case and a tracking bracelet as our newest product. The product is called Mild.
Hereby we try to bring calmth, rest, peace,... in the life of our customers.
We try to help solving their anxiety issues that they struggle with in daily life.
We provide them with Mild, a tool that they have with them all the time. It includes an anxiety-tracking bracelet. So when the bracelet tracks that you're in an anxious mood, it will tell you to use our tool. The tool include earphones and a case for the earphones. You can use the earphones in situation where it is okay to listen to music/separate yourself from the world, and the case in other situations. Mild provides you with calming sounds, music adapted to your mood, breathing exersises, a distraction tool on the case, a calming smell and feel to it, vibrations to help you breath and a companion in every situation.

Customer Relationships
We want to create deep and good customer relations because it's important in our target audience. The people using our brand should know we try to adapt the products exactly to their needs. For example we will change the cases, so the customer can chose what he/she thinks is helpful for them (smell, feel, vibration,...)

Channels
We will promote our tools as well on a website and social media, which is a cheap form of getting our product on the market. But we will also try to get our product on the market by psychologists that could sell/ recommend our product to their patients.
We will have to put efford into this, by proving our concept works to these psychologists.

Customer Segments
Our customers are people who struggle with anxiety in daily life. This may not seem like a big audience, but it is. 1/10 people struggle with anxious feelings in daily life, and according to our own tests it may be even more.
By anxiety we mean big anxiety attacks, but we certainly also mean the normal anxious feeling that a lot of people deal with on daily base: too busy metro's, stress for a presentation, car drives, air plane anxiety,...
We would reach out to them trough their 'mental illness', altough our product could also be used by people who don't struggle everyday. We want our customers to be able to use our product in both states, anxious-period, or normal period.
The tracker should be worn on the anxious days/periods, if you don't struggle for a while you can only use the earphones and case, without the tracking function.

Cost Structure
The main goal of the product Mild is to help our customers with their problem in a convenient, easy and cheap way.
Headphones, especially with a tracking system is of course still a product that we can't sell on a very low price, but we try to keep the costs as low as possible so we can sell the product to a 'low' price as well.
Costs we make for the product:
- Materials
- Shipping of materials
- Shipping of product to customer
- Packaging
- Advertising
- Website

Revenue Streams
The value we want to highlight, what makes us different than other people, is the fact we track your anxiety level, so you don't have to feel yourself when to use our tool, because if we would do that, it's usually too late.
That's what makes our product a better product than other anxiety tools. It of course makes it more expensive, because it is combined with earphones. Earphones are on the market a lot these days, but not with the same calming, suiting results as ours. There's so much more that comes with our product then normal earphones.
We think that people who struggle with anxiety would like Mild a lot, and are going to be willing to pay for it, because it helps their problem in a more flexible way than all of other fast calming methods.

Figure 62: Canvas business model

t5_dstrs_business-model-canvas.pdf

Our own survey with answers:

smart_companion_survey.xlsx

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Will be added automatically by citing, in the body of the report, entries specified in BibTeX format and stored in the http://www.epswiki.dee.isep.ipp.pt/doku.php?id=refnotes:bib file

PS - *If you have doubts on how to make citations, create captions, insert formulas, etc. visit this page with examples and select "Show page source" to see the source code.*

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