National Aeronautics and
Space Admission
Washington DC

Human Research Programme
Houston, Texas

Advanced Design Innovation

Increasing Health-span and Health Related Quality of Life

September 2023 - December 2023

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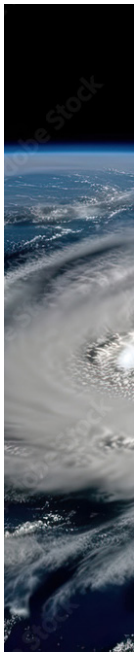
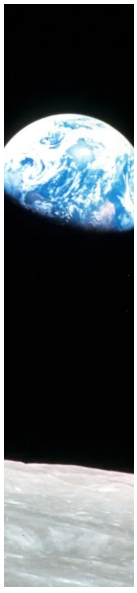
Executive Summary

This report provides a comprehensive overview of the research underpinning NASA’s strategic shift, exploring the rationale behind the decision to venture into the public health domain. It delves into the intricate considerations that led to this repositioning, shedding light on the potential intersections between NASA’s technological capabilities and the pressing challenges in public health. Additionally, the report outlines crucial product design guidelines that will serve as a blueprint for forthcoming developments. These guidelines encompass the integration of NASA’s cutting-edge technologies into healthcare solutions, ensuring that the products not only meet the demands of the public health sector but also leverage the agency’s expertise to address emerging health challenges. By delineating the research foundation, strategic decisions, and design principles, this report lays the groundwork for a seamless and impactful transition into the realm of public health for NASA.

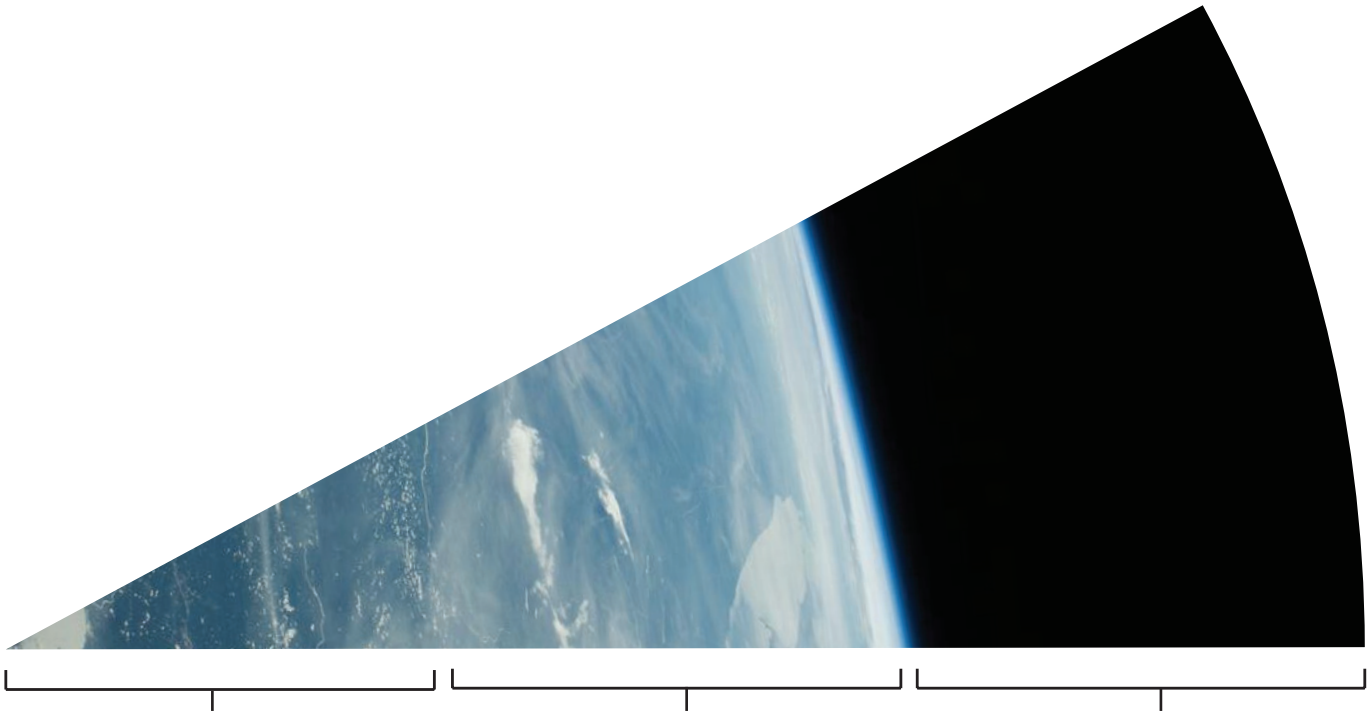
Contents





The Future Landscape

PESTLE Analysis



5 years

Over the next 5 years robotics, virtual and augmented reality will likely become more intergrated into the daily lives of billions of people. With an estimated population of 8.5 billion, Earth will have a whole set of new challenges that will need to be adressed in both strategic and innovative ways.

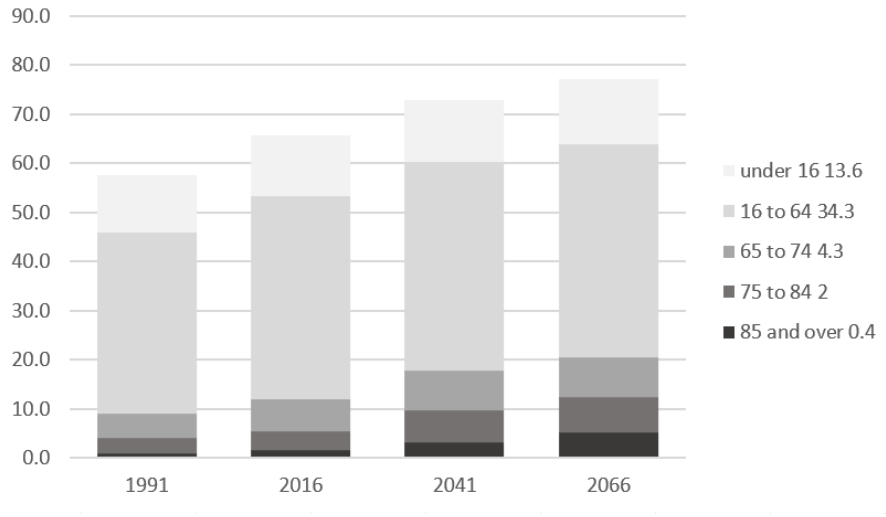
10 years

10 years into the future the average human life expectancy will likely be well over 90. Healthcare in 2030 will be “fully digitalised” and patients will most likely be monitored through smart home devices.

15 years

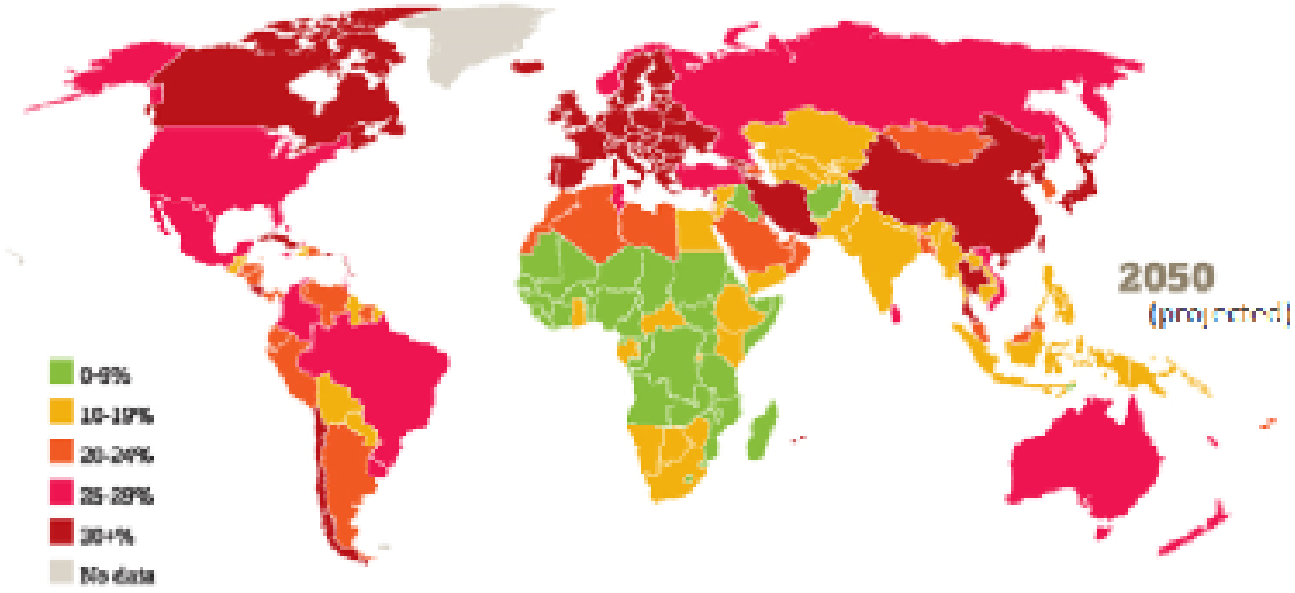
15 years in to the future is a long time, predicitng the future of NASA depends of political priotities, technological advancements and global events. In 15 years we believe AI will have fully intergrated into our daily lives and will be leading the way in terms of research and development.

Aging Population



Population by age group, selected years. (Office for National Statistics, 2018)

Projected population aged 60 and over - 2050



(Office for National Statistics, 2018)

The rising challenge of an increasing aging population is a global phenomenon with implications for societies and healthcare systems. As people live longer, there is a growing need to address the unique health and social care requirements of seniors. This demographic shift poses challenges in providing adequate healthcare, long-term care, and social services. The strain on pension systems, healthcare infrastructure, and the demand for specialized geriatric care are all areas that require strategic planning and innovation. Moreover, the aging population trend underscores the importance of promoting healthy aging, preventive healthcare measures, and creating inclusive environments to support the well-being and active participation of older individuals in society. Effectively navigating the complexities of an aging population requires comprehensive policies, investment in healthcare infrastructure, and the development of innovative solutions to ensure a dignified and fulfilling quality of life for seniors.

The Problem

"How can product design enhance Health Related Quality of Life by increasing the human health span. Improving individuals ability to partake in activities of daily living into old age"

Health Related Quality of Life (HRQoL)

A multidimensional concept that encompasses an individual's overall well-being in various aspects of life that are influenced by their health. It goes beyond just the absence of disease or illness and takes into account physical, mental, emotional, and social factors. HRQoL reflects an individual's perception of their health status and how it impacts their daily life, functional abilities, and overall satisfaction.

Health Span

Health span refers to the number of years in a person's life during which they can enjoy good health, active engagement in life, and freedom from serious illness or significant declines in physical and mental function. It is a concept that focuses on the quality of life rather than simply the length of life.

Activities of Daily Living (ADLs)

These are basic self-care tasks that individuals typically perform every day to maintain their personal well-being and independence. ADLs are often used as a measure of an individual's functional status, especially in the context of healthcare, rehabilitation, or caregiving. The ability to independently perform ADLs is crucial for assessing a person's level of independence and identifying any potential challenges they may be facing.

Health Related Quality of Life

Physcial Functioning

Role Limitation

Social Functioning

Pain

Mental Health

Vitality

Health Related Quality of Life (HRQoL) is the study of how health factors influence quality of life (Karimi & Brazier, 2016). HRQoL can be defined as how well a person functions in their life and his or her perceived wellbeing in physical, mental, and social domains of health. HRQoL can be measured across the following domains: Physical Functioning, Role Limitation, Social Functioning, Pain, Mental Health and Vitality. These domains make up the SF-6D a measure for valuing health and assessing cost effectiveness of health care interventions.

This graph shows responses to the SF-6D questionaire across different age groups highlighting the decline of HRQoL as an individual ages. The authors have identified the ideal intervention age from this graph, aiming to intervine before serious HRQoL issues arise.

System Health

The BBC suggests mental peak in your 40s and 50s and peak happiness in your 60s, tied to improved cognitive skills, better emotional control, and fewer stressors impacting mental health.

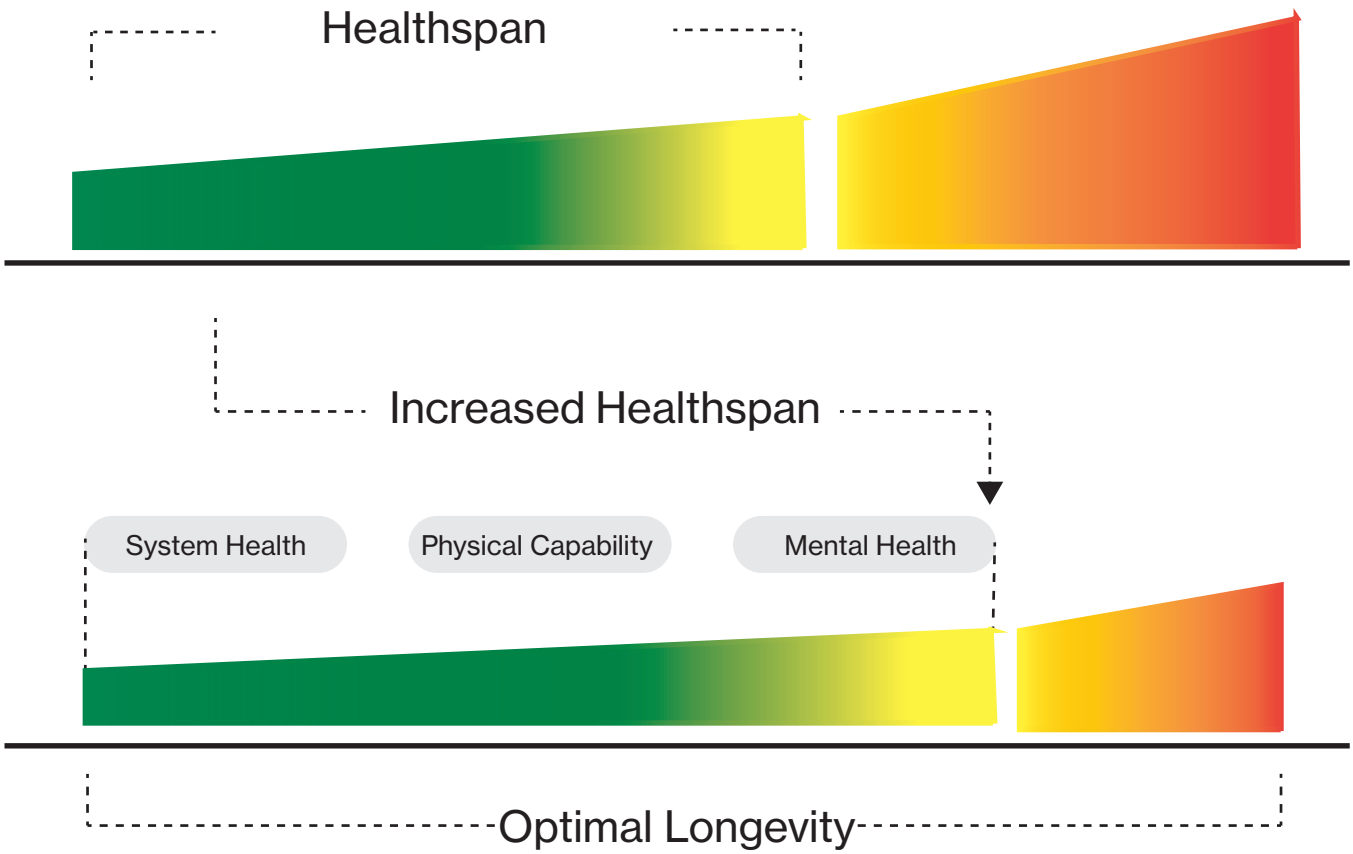
Physcial Capability

From 30 to 59, there's a gradual decline in physical capability due to life changes, and around 65, age related issues, such as reduced bone density and muscle mass, lead to a substantial impact on daily tasks and abilities.

Mental Health

However, between 45 and 60, a gradual decline in system health occurs due to lifestyle factors, impacting the body's resilience and contributing to age-related changes that affect overall health and well-being.

Healthspan

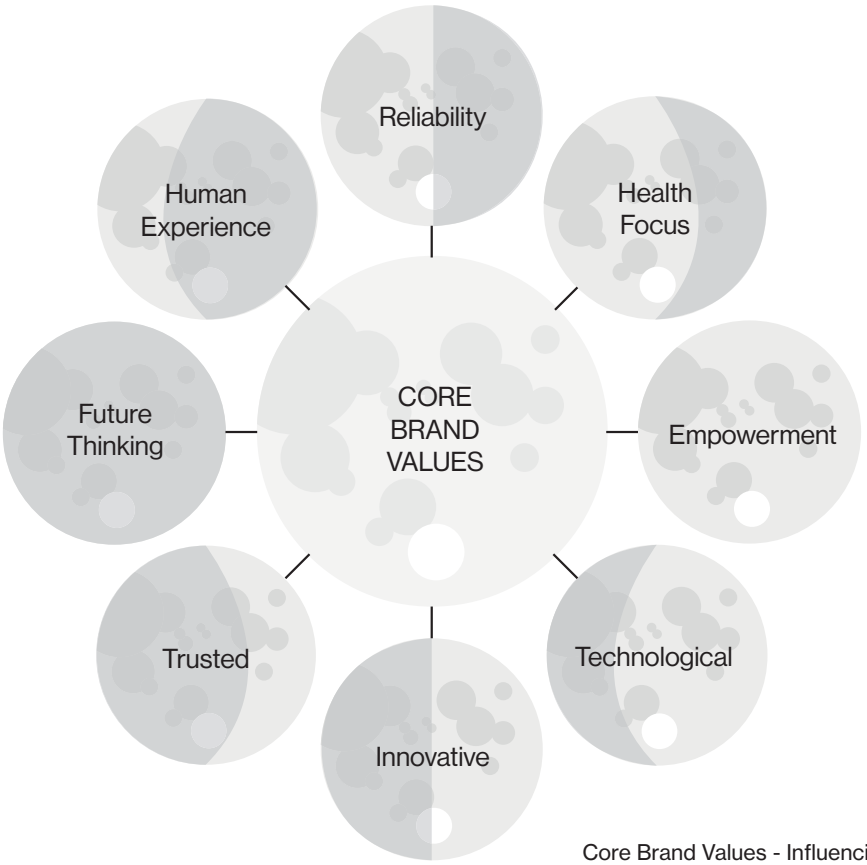


"Healthspan is a period of healthy ageing with a modestly increasing chronic disease burden, followed by a period of age related clinical disease. To achieve optimal longevity (living long, but primarily in wellness) in the future, healthspan must be significantly extended."
(J Physioll, 2016)

Over the next 15 years most nations of the world will undergo rapid and dramatic population ageing, which presents great socio-economoic challenges, as well as opportunities, for large organisation like NASA.

The graph above depicts how we aim to extend the human healthspan and provide optimal longevity for our identified target users to in turn improve health related quality of life.

Project Values



Core Brand Values - Influencing Brand Selection

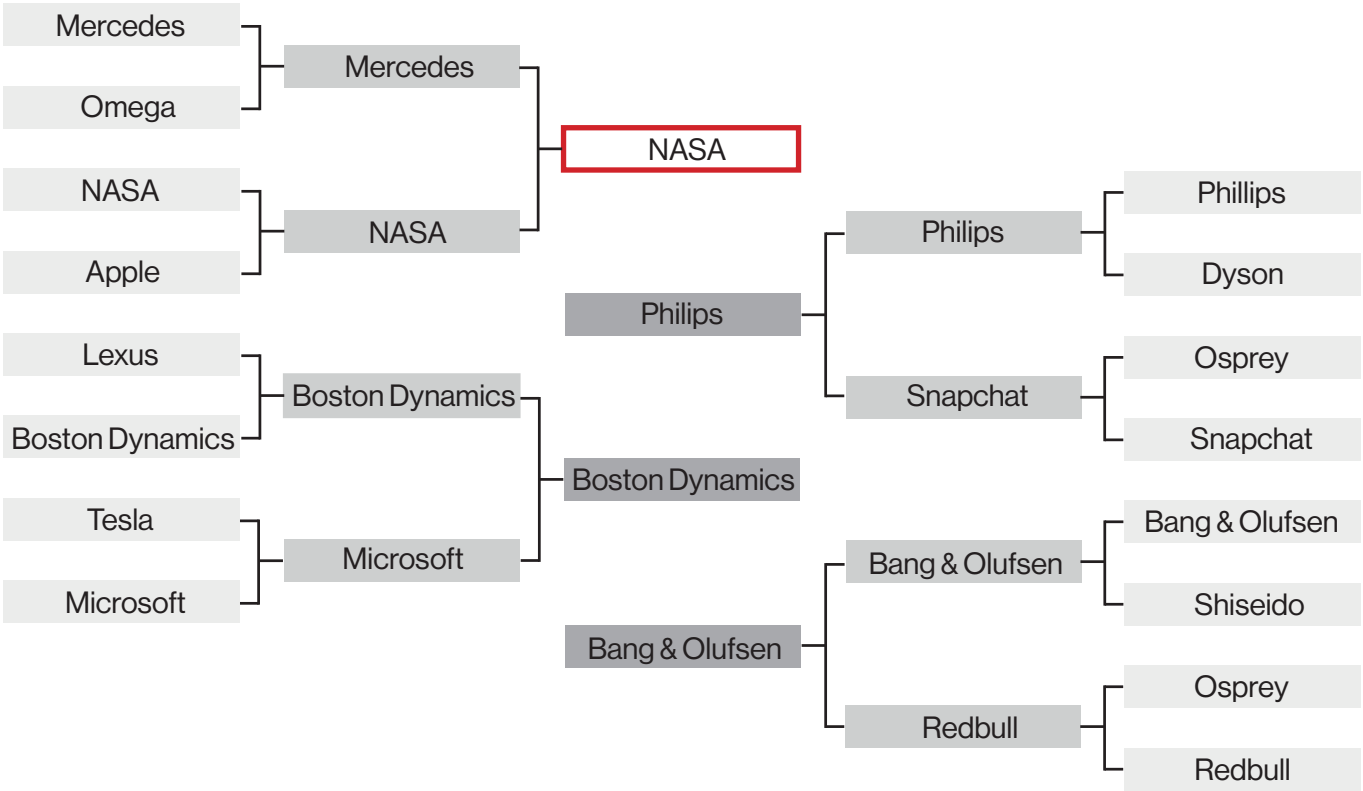
Our project focuses on reliable, health-centered technology that empowers individuals to manage their well-being. By leveraging innovative, trusted solutions at the forefront of healthcare, we aim to anticipate needs and create future-oriented, user-centric experiences for improved health outcomes

It is important to align the chosen company's brand identity and values with the product's values. These similarities ensures a consistent and trustworthy message, which builds customer trust and improves brand perception. It encourages stronger emotional connections, which leads to increased engagement and loyalty while also distinguishing the brand in the market.

Brand Selection

As a group, the authors underwent a meticulous and strategic process to select the most suitable brand for their chosen project. Initially, they created a range of brands across multiple industries, briefly examining their core values and brand identity.

From this extensive list, the authors narrowed down their focus to four different brands, each with unique positive and negative challenges for repositioning. Their decision-making process involved a deeper analysis of each brand's core values, market presence, brand identity, and potential for repositioning.



Why NASA?

Through discussion and evaluation, the authors settled on NASA as their chosen brand for repsitioning. NASA held a long legacy for pursuing humanity's progression, presenting a complex but promising opportunity to explore a repositioning into commercial healthcare. The decision was driven by NASA's potential for dramatic transformation, aligning with their project's objective of positively affecting the human health-span through innovation.

NASA History

1990-Present
Use of the Hubble Telescope to see our galaxy

1973-1979
America's first space station for

1981
The orbiter:
First reusable ship

1958
Nasa was founded

1961-1975
Apollo mission took humans to the moon and created advancements to humans:

- Suits to alleviate dangers from high-heat
- A machine to aids physical therapy
- Water purificationtechnology
- Sensors detect hazardous gasses.

1959-1963
6 missions put the first Americans in orbit.

2004
Vision for Space Exploration

Plan to finish space station, return to the moon and even mars exploration

NASA continues to innovate the technology markets and produces a product range to improve health span on earth

2035
Collaborative efforts between NASA and private space companies lead to increased space tourism

1998-Present
Mars Exploration Rovers

2012
Voyager 1 enters interstellar space, becoming the first human-made object to do so.

2008
NASA's 50th Anniversary

2012
Voyager 1 enters interstellar space, becoming the first human-made object to do so.

(Adobe Stock, 2023)

User Personas

This section outlines the exploration of user personas aimed at identifying the target user group and guiding the design direction. The focus has been on three distinct user types falling within the specified age range of 40 to 50. The first persona represents individuals with limited knowledge about health and fitness, followed by a persona embodying users with intermediate knowledge. The third persona encapsulates individuals with extensive knowledge in this domain.

For each persona, a comprehensive investigation has been conducted, examining their contextual background, overarching goals, as well as motivational and inhibiting factors. This research serves as the foundation for shaping the design strategy, ensuring a tailored and nuanced approach that addresses the diverse needs and perspectives of the target audience.

User Persona 1 - Newcomer

User Story

Persona 1 is a 35 year old architect from London. Is often busy with work and has trouble finding time to exercise. As a relative newcomer to the world of health and fitness he is open to take on new methods and exercises to. His current understanding of this area is that you must have a balanced approach to improving health and incorporating a variety of methods to achieve this. His current goal is to improve his overall health, specifically extending his health span and overarching quality of life.

Goals

“I want to enhance my overall health and well being, specifically extending my healthspan”

Motivational Factor

has recognised the importance of well being and wants to extend his success beyond his career

Inhibiting Factors

Time constraints. Michael often has a busy schedule and struggles fitting in time for his health
Lack of knowledge. As a newcomer, he often finds himself lost in the complex world of health.

Dedicated | Curious | Lack of Time | Guidance

User Persona 2 - Intermediate

User Story

Persona 2 is a 45 year old Marketing consultant, currently residing in the city of Manchester with her 3 children. As a mother with a full time job. She often lacks the time to fit in health and wellbeing in her life. She is often stressed and aims to improve her overall mental health in order to extend her health span. She has already incorporated some mental health techniques and methods to manage her stress. She knows the importance of maintaining a healthy balanced lifestyle in order to improve her health span, given her busy schedule.

Goals

"I want to extend my health span and overall wellbeing for my kids, managing a full time career can be exhausting, I want a better capacity to spend more time with them. "

Motivational Factor

Has children that she wants to spend more active time and energy with.

Inhibiting Factors

Time constraints. Emily has a busy lifestyle, fitting in health in her already busy life is difficult.
Mental wellbeing. having a stressful life carries a burden on her health and wellbeing

Busy Life | Mental Health | Time | Balance

User Persona 3 - Experienced

User Story

Persona 3 is a medicine practitioner, with over 15 years of experience in this field. He has extensive knowledge about the topic of health span and wellbeing. He resides in London with his wife and 2 children. As an advocate for wellbeing and extending the human health span, he has both incorporated recent methods into his professional practise but also his everyday life, though it has been challenging due to time constraints. This use of a holistic approach to health and wellbeing has successfully helped him in extending his health span for the future.

Goals

"I want to refine and advance my knowledge on health span extension solutions and put them into practise within a short time frame!

Motivational Factor

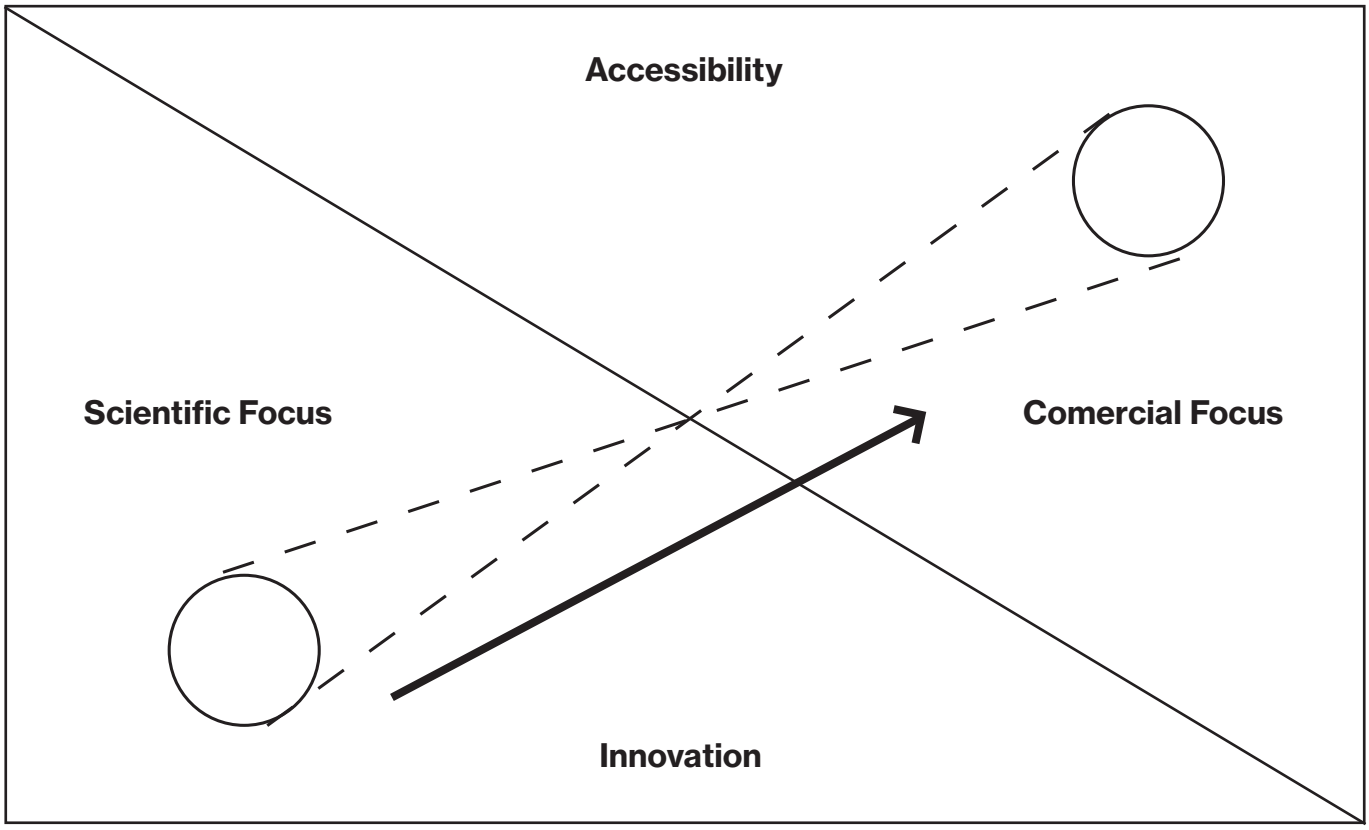
Wants to be a positive role model of health for his children

Inhibiting Factors

Time constraints. Adam works long hours and often without breaks, he wants to fit his health plans within a short time frame, but making sure they are still effective.

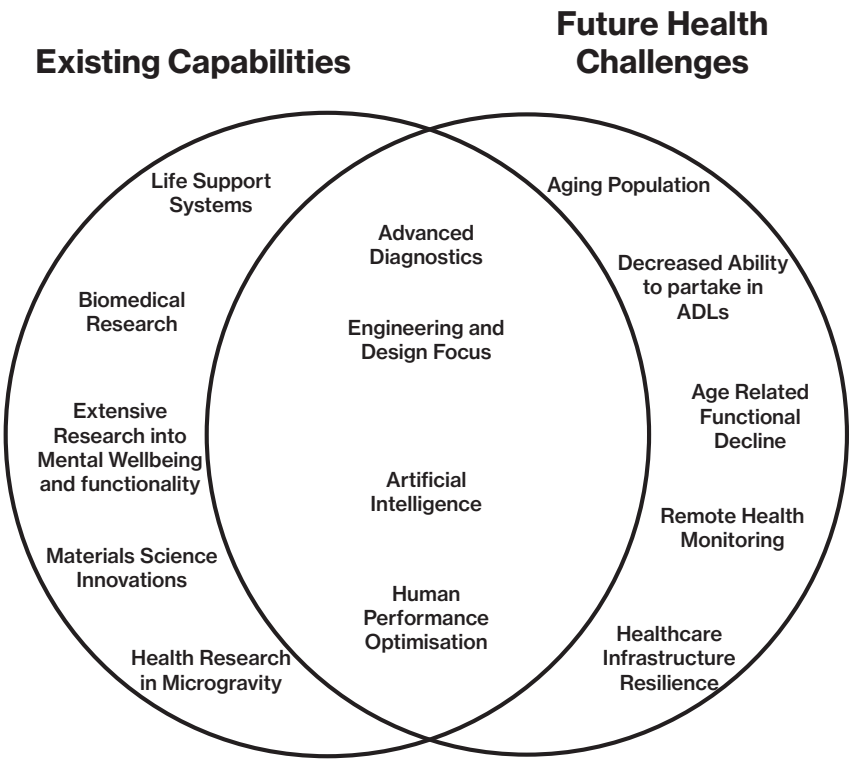
Busy | Role Model | Refine | Time

Repositioning Strategy



The core of the repositioning strategy entails a transition from a strictly research-focused innovation model to a more commercially-oriented approach. This transformation involves the development of designs that prioritize accessibility, encompassing not only physical aspects but also user-friendly interfaces and inclusive features to appeal to a diverse consumer base.

By utilising NASA's expertise in areas like remote sensing and advanced imaging, the goal is to apply these innovations to improve healthcare. This involves adapting space technologies for medical use, creating cutting-edge medical devices, and collaborating with healthcare institutions. The aim is to combine NASA's technological development with healthcare needs, helping to address important health challenges and push forward medical innovation.



National Institute of Health
Bethesda, Maryland

National Aeronautics and Space Admission
Washington DC

Human Research Programme
Houston, Texas

Advanced Design Innovation

The repositioning strategy resulting in the proposed Advanced Design Innovations involves a strategic collaboration between the National Institute of Health and NASA's Human Research Programme. This partnership aims to leverage the unique strengths of both organizations to address emerging health challenges and propel advancements in healthcare design and innovation.

The collaboration utilises National Institute of Health's extensive biomedical research, indepth understanding of human health and disease as well as leveraging the vast databases of health related information to develop informed product and accompanying service directions.

Style Guide

Consistency with the public perception of NASA as a brand and a reputable organization should be a guiding principle throughout all facets of the repositioning initiative, extending to the visual design of the products. Preserving and reinforcing the positive associations the public holds with NASA is crucial for building trust and credibility in the new venture into public health.

Visual Elements

NASA BLUE	
RGB	0 50 160
HEX	#0032A0
CMYK	100/80/0/12
PMS	286

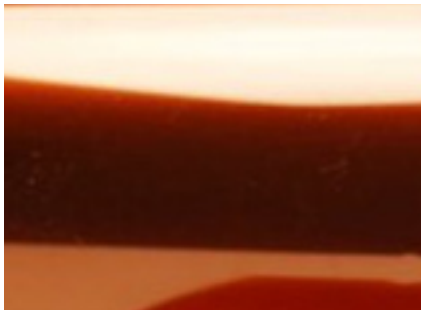
NASA RED	
RGB	228 0 43
HEX	#E4002B
CMYK	0/100/100/0
PMS	185

Ortho-Fabric

Ortho-fabric is unique material designed for orthopedic applications, commonly used in braces and supports due to its supportive, breathable, and durable characteristics.

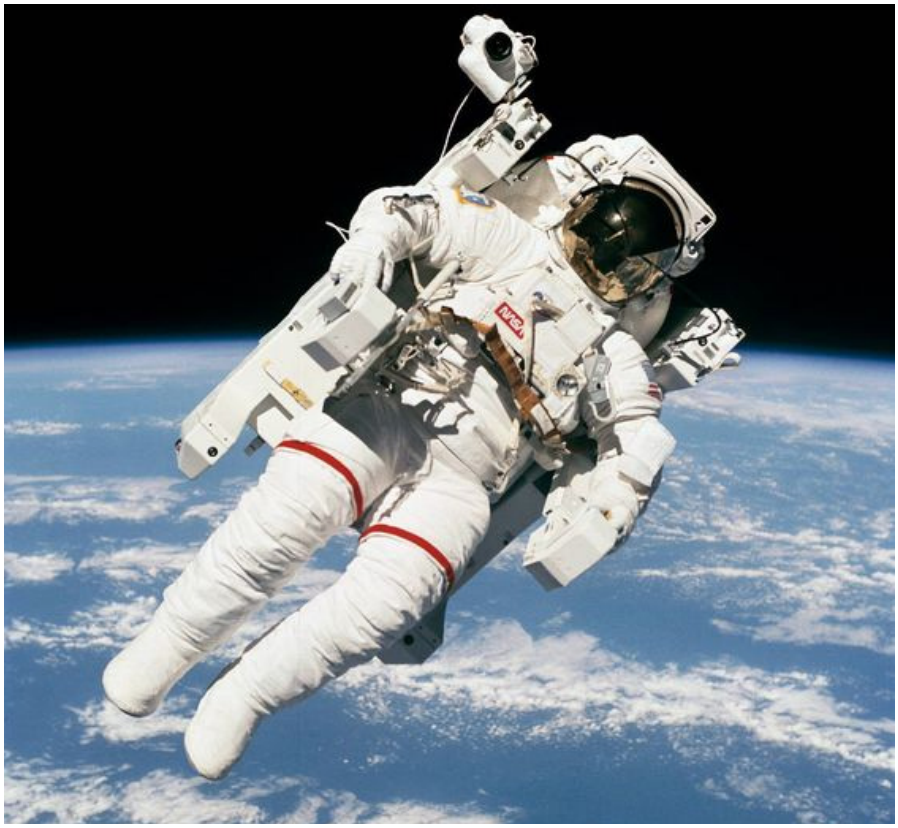
Stainless Steel

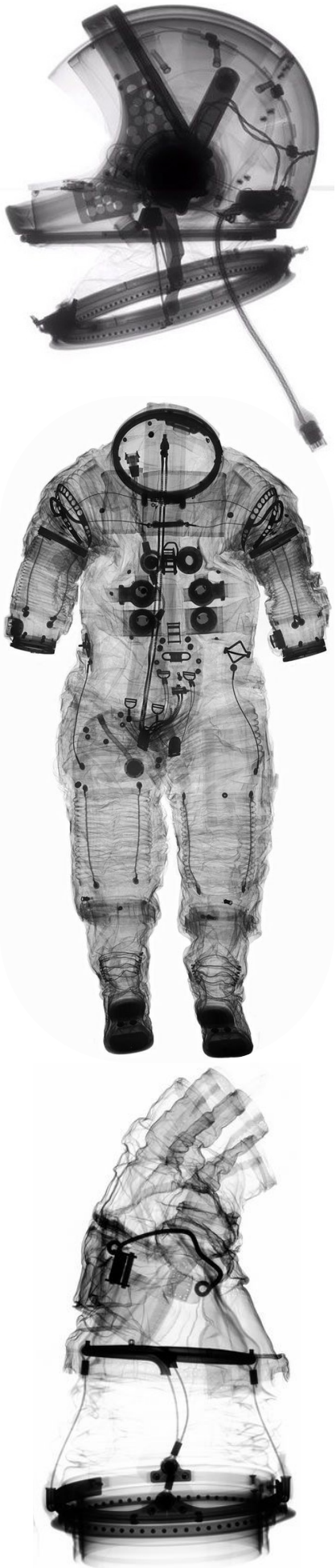
NASA utilises stainless steel in spacecraft construction for its exceptional strength, corrosion resistance, and ability to withstand extreme temperatures encountered in space exploration.



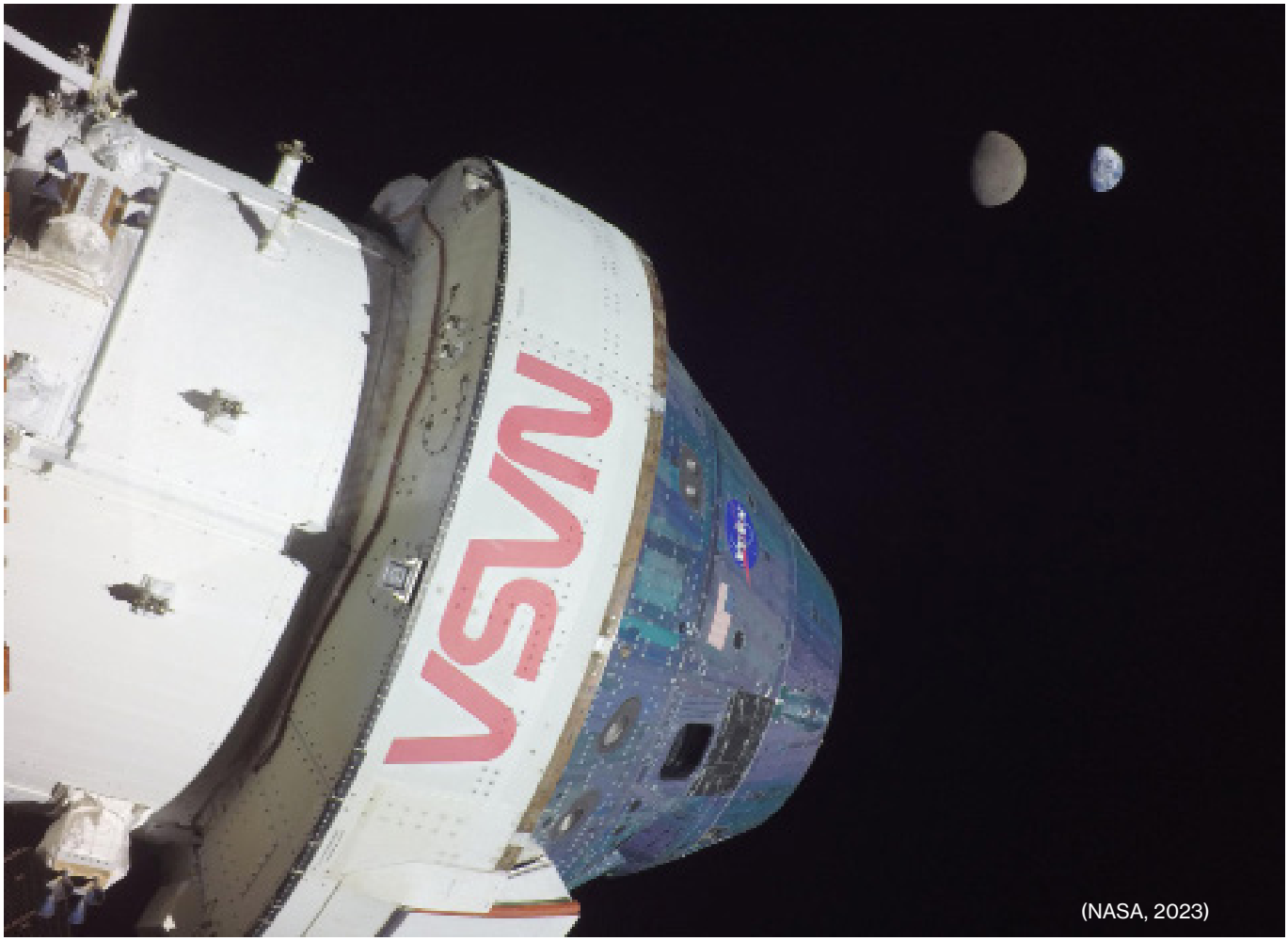
Kapton Tape

Kapton tape is a heat-resistant film tape often used in electronics and aerospace industries for its ability to withstand high temperatures, provide electrical insulation, and resist chemicals.





Left: (NASA, No Date)
Right: (Avino & Cunningham, 2021)



(NASA, 2023)

Product Family Requirements

06-12-2023

Product Requirements for the overall cohesive nature of the product family

To ensure consistency across the family of health products a Product Requirement Specification has been devised. Consistency is important in making the products identifiable as a collective of interlinking solutions. It is also important to allow smooth transitioning from one device to another, maintaining a consistent interaction design language.

1.1 Performance

1.1 Design solutions must contribute to the improvement of users health related quality of life.

1.2 The means of communicating interaction should be consistent across products

2.1 Human Factors

2.1 Designs must be simple to understand.

2.2 Wide accessibility should be considered in the design of the products.

3.1 Enviroment

3.1 Ensure the product family functions optimally across various environmental conditions, both indoors and outdoors

3.2 Strive for reduced energy consumption during manufacturing and operation

4.1 sustainability

4.1 Concepts should be created with repair and recyclability central to design

4.2 Utilize sustainable and environmentally responsible materials in manufacturing, aligning with NASA's commitment to sustainability.

5.1 Maintenance

5.1 Design products with easily serviceable components, ensuring straightforward maintenance and repair procedures

6.1 Materials

6.1 Materials should be selected for durability, ease of cleaning and longevity of construction.

6.2 Ensure materials are biocompatible and safe for prolonged human contact, meeting stringent health and safety standards.

7.1 Visual Language

7.1 The visual design of the products should reflect NASAs history.

7.2 Visual elements should be consistent across the range of new concepts.

7.3 The means of communicating interaction should be consistent across the designs

8.1 Standards

8.1 Maintain consistent quality standards across the product family to ensure reliability and user safety.

8.2 Adhere to established health and safety regulations and standards in the development of health-related devices.

Individual Research

06-12-2023

Louis DeCleyn - Product Concept for Bone Density and Muscle Mass

Reduced Bone Density

1 in 3 women over the age of 50 years and 1 in 5 men will experience osteoporotic fractures in their lifetime. (Sozen et al., 2017)

Reduced Muscle Mass

50% of people over 80 have low muscle mass. (Colón et al., 2018)

Having identified a growing issue with reduced bone density and muscle mass causing reduced ability to participate in activities of daily living, the focus of the following three concepts will be on combining techniques that improve muscle mass and bone density.

Vibration therapy was initially developed by scientists involved in space travel. The studies revealed that astronauts who spent months in space stations lost 1 to 2% of bone each month. It was found that such bone loss can be regained by standing on a lightly vibrating plate for 10 to 20 minutes each day (Royal Osteoporosis Society, 2017)

In a study involving elderly men with different types of training approaches, it was shown that strength training maintained muscle mass and performance more efficiently than other types of exercise.

To counteract the detrimental impacts of diminished bone density and muscle mass, scientific research indicates that exposure to impact and vibration is instrumental in preserving bone density and decelerating its decline. Additionally, fostering hypertrophy via strength and resistance training proves effective in promoting the development and maintenance of muscle mass.

Individual Product Requirements

1 Performance

1.1 Develop bone density using vibration therapy.
1.2 Develop muscle mass using resistance training.

2 Human Factors

2.1 Easy and accessible to use.
2.2 Feedback on exercise progress.
2.3 Product should fit comfortably in the hand.

3 Enviroment

3.1 Suitable for home use.
3.2 Suitable for gym use.
3.3 Should be able to withstand a drop of 1 - 1.5m max.

4 Size and Weight

4.1 Product should fit inside gym bag to allow for transport.

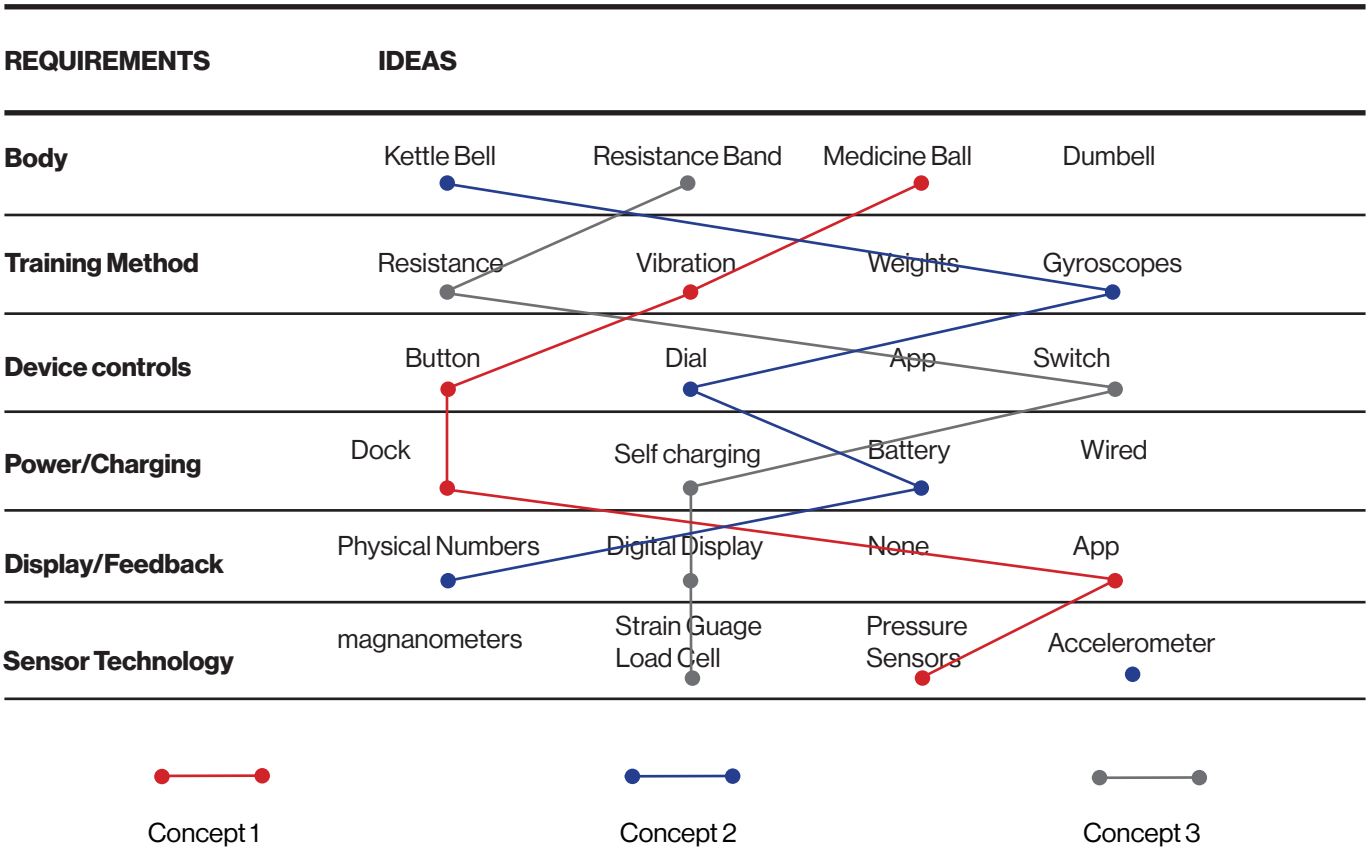
5 Materials

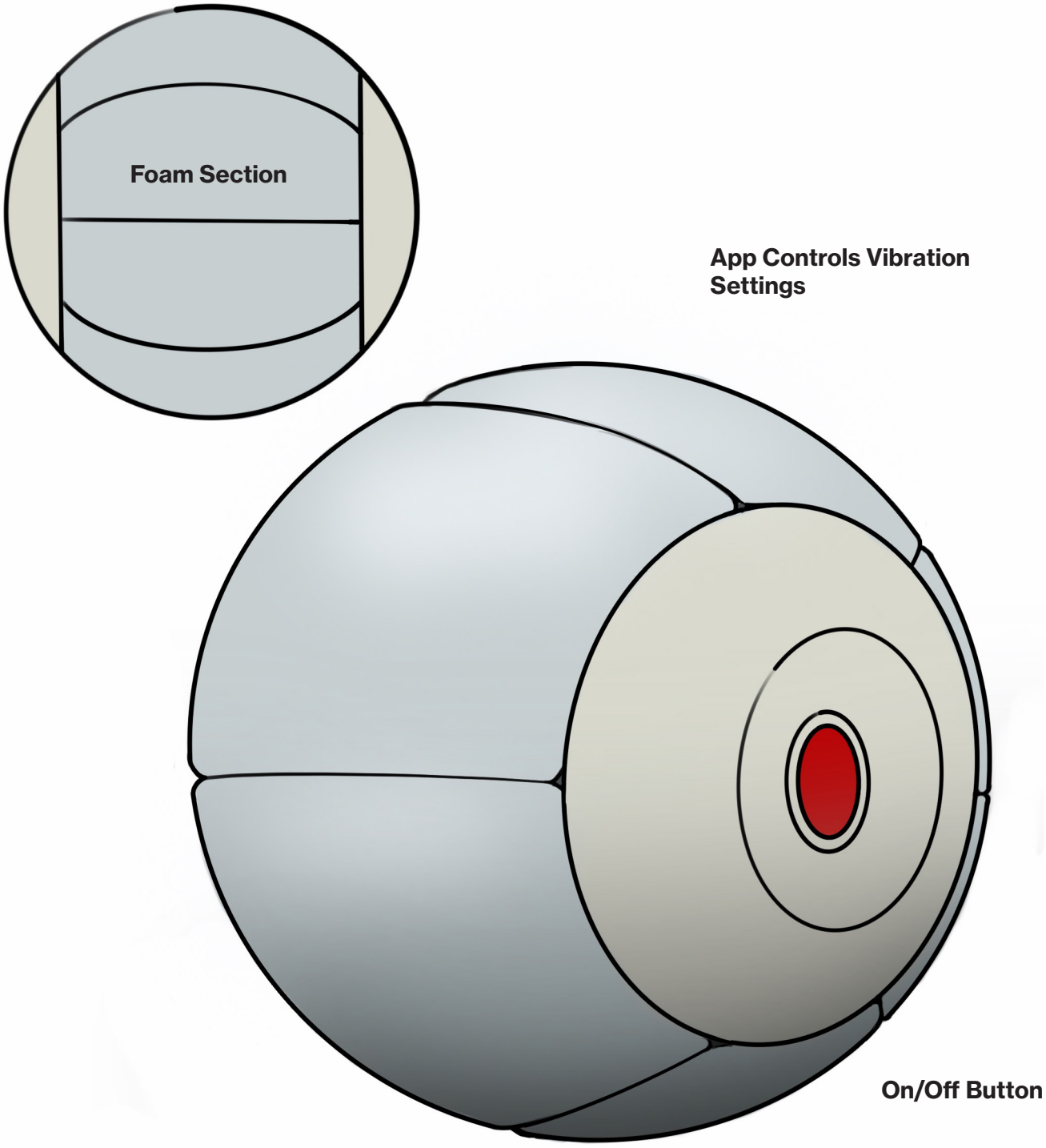
5.1 Lightweight
5.2 Excellent Durability

6 Sustainability

6.1 Product should be designed for disassembly to allow for repair and recycling.

Morphological Analysis





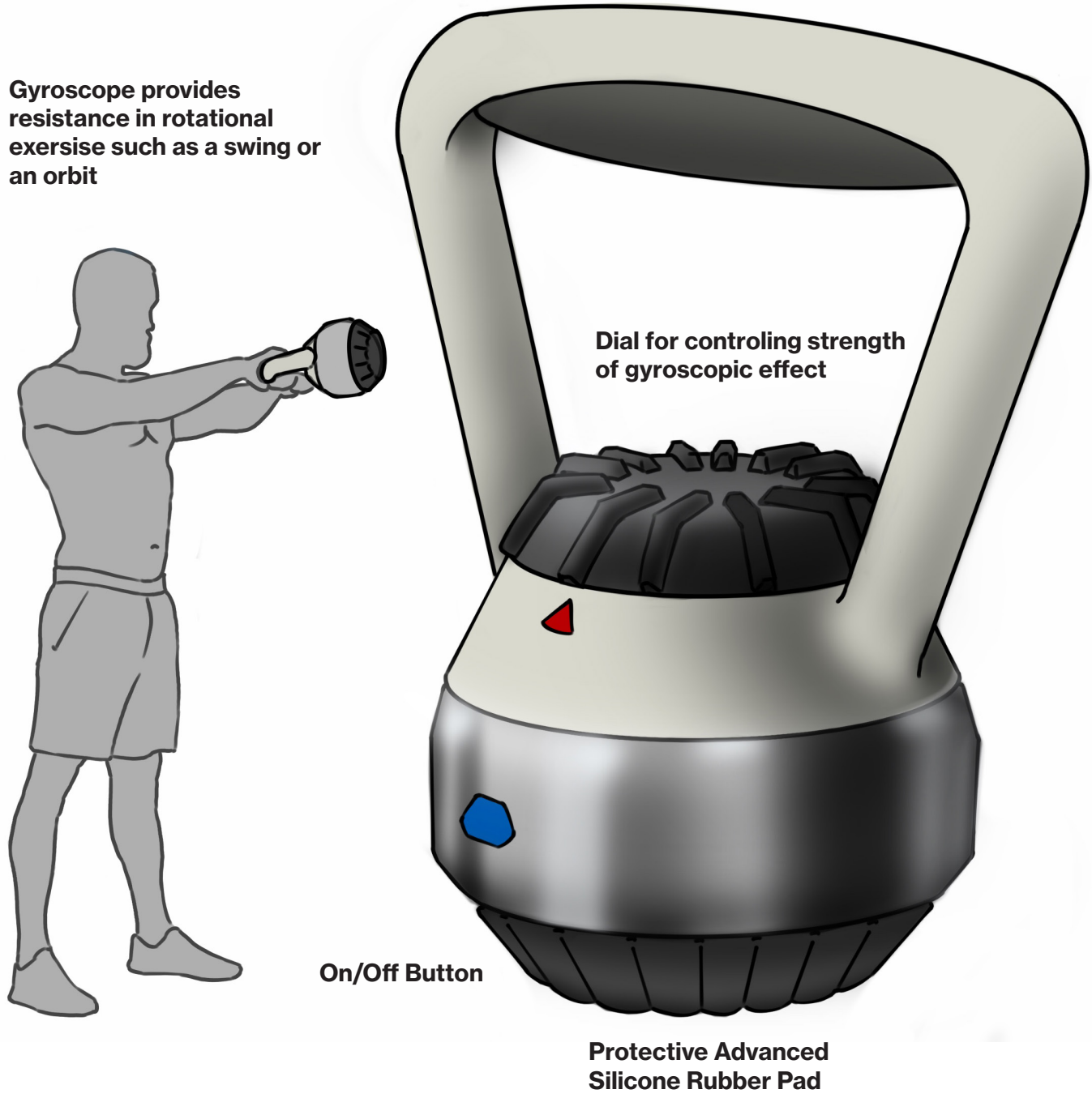
Concept 1

Individual Product Concept

06-12-2023

Louis DeCleyn - Vibrating Medicine Ball

This concept utilises vibration to develop bone density in the form factor of a medicine ball allowing for use on a range of areas on the body including: hands, legs and lower back. The vibration can be controlled from a mobile app to switch between vibration patterns designed for bone development and vibration for muscle soreness recovery.



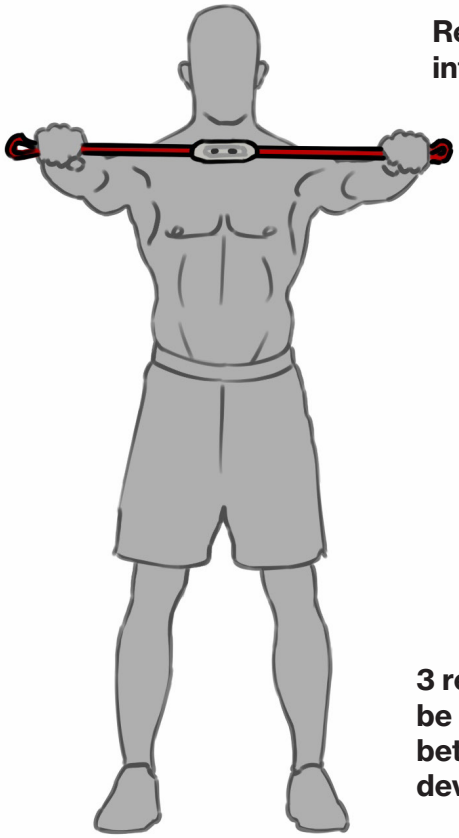
Concept 2

Individual Product Concept

06-12-2023

Louis DeCleyn - Gyroscopic Kettle Bell

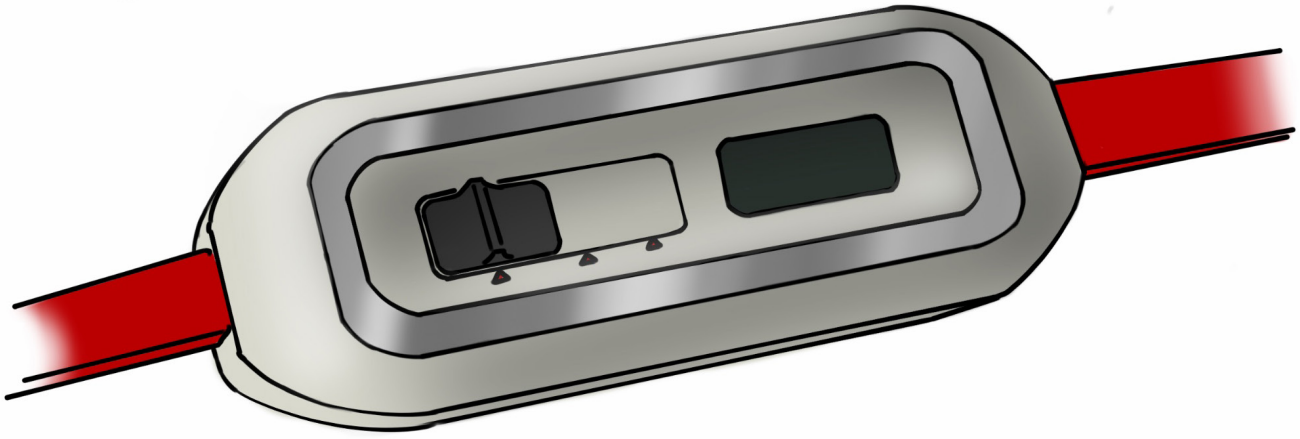
Concept 2 utilises gyroscopes to simulate resistance in rotational directions using the procession of the gyroscope. This develops strength in unconventional directions and allows for a wide variety of uses. the kettle bell can also be lighter than the resistance it causes making it more portable.



Resistance controlled by internal wire coil

3 resistance settings can be immediately alternated between with switch on device face

Digital interface gives precise controls and feedback.



Concept 3

Individual Product Concept

06-12-2023

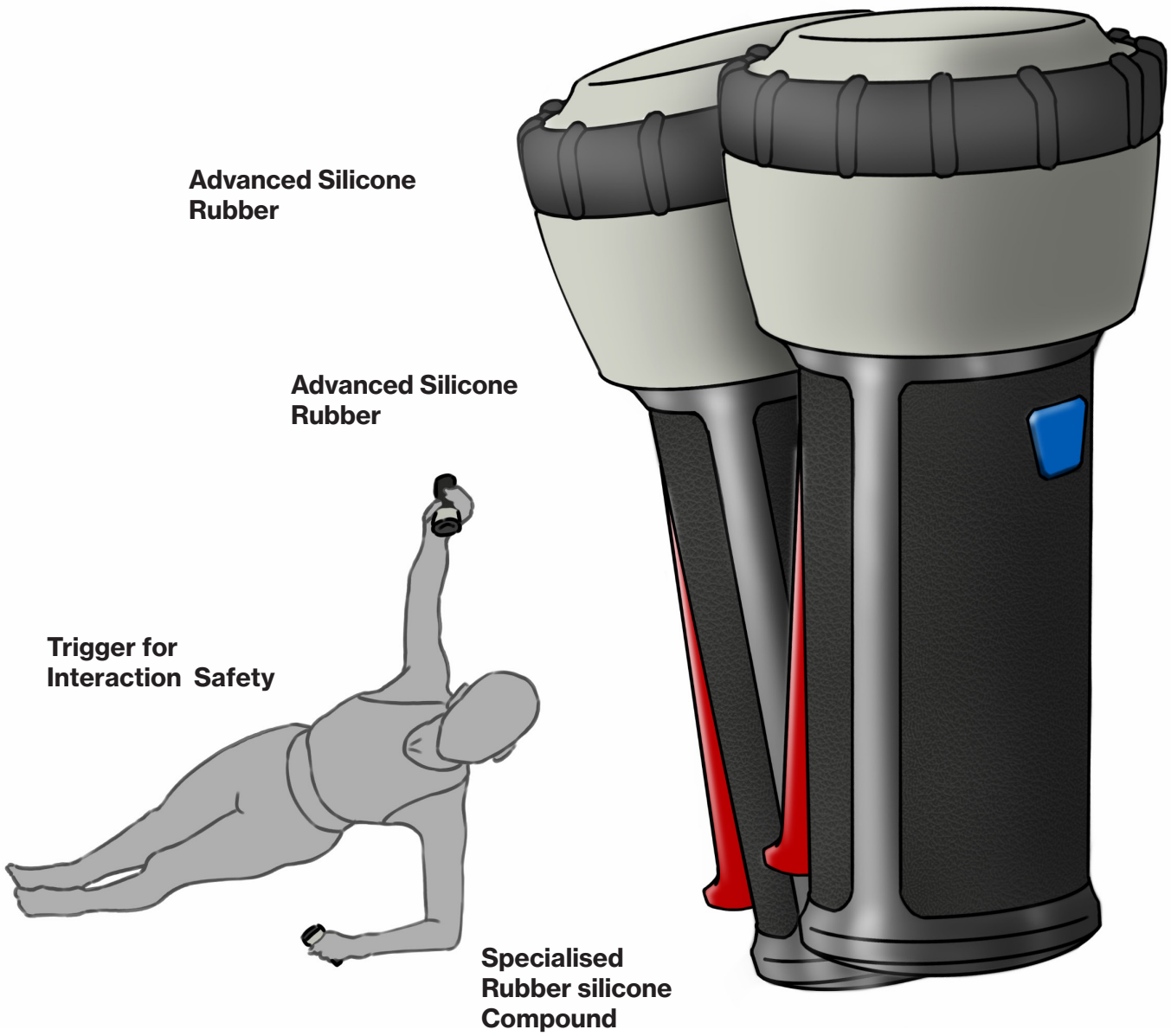
Louis DeCleyn - Electronic Resistance Band

Concept 3 innovates on the traditional resistance band using a coiled wire attached to a motor to increase and decrease resistance allowing for one device to be suitable for any experience level and for better tailored workouts.

Matrix Evaluation

PRS	Concept 1	Concept 2	Concept 3	Final Concept
Resistance Training	DATUM	+	+	+
Vibration for Bone Mass		-	-	=
Mobile Intergration		-	-	=
Digital Interface		=	+	=
Wide array of training methods		+	=	+
Easily Portable		+	=	+
		+1	0	+3

Taking optimal features from all three concepets the final converged concept combines resistance training and vibration therapy. Using high power electric gyroscopes to create torque the resistance is generated from the user moving in the oposing direction.
The handheld devices can also be switched to vibration mode sending congruent vibrations down the users hands and forearms. Targeting a common later issue of arthritis in the fingers and hands, which leads to reduced ability to partake in the activities of daily living.
The final concept also uses motion sensors to track the users movements offering personalised exercise reccomendations.



Final Concept

Individual Product Concept

06-12-2023

Louis DeCleyn - Product Concept for Bone Density and Muscle Mass

The final converged concept combines the use of gyroscopes to create resistance with vibration capabilities required to reduce bone density loss. The individual hand pieces allow for a wider range of available integrations into dynamic work out routines.

Individual Research

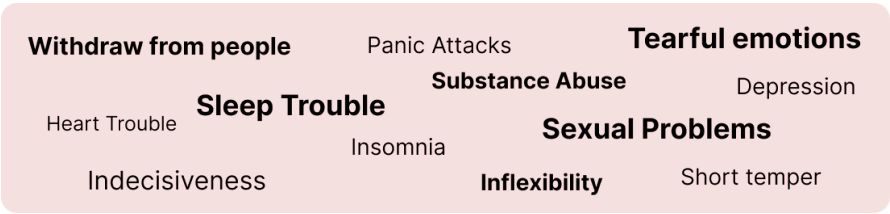
06-12-2023

Nathan Hall - Stress Management

What is stress?

There is a ever growing need for stress management across our population. The World Health Organisation defines stress as a state of worry or mental tension caused by a difficult situation (World Health Organization, 2023) Also according to WHO, stress has been classified as the health epidemic of the 21st century (Arora et al., 2019). This problem has major negative physical and mental consequences that need to be addressed for our demographic of 40 - 50 year olds including: Workplace stress, Parenting issues, Financial responsibilities, relationship strain and physical health problems (Scott et al., 2013). In response to this I will be designing a solution to help manage stress in our target demographic of 40 - 50 year olds with hypothetical implementation of near future technologies.

How might you react?



*"This past year **74%** of people have felt so stressed they have been overwhelmed and unable to cope"*

What is the Future?

With more recent advancements in Artificial Intelligence and Machine Learning how can we :

Use NASAs Artificial Intelligence and Machine Learning data collection methods such as Earth Data (Earth Science Data Systems, n.d.) to personalise stress management for Users.

Use Artificial Intelligence's knowledge to craft physical environments through : Sound, Sight and Touch to improve stress management.

Individual Product Requirements

1 Performance

1.1 Implement and use of AI and ML algorithms to create personalised and tailored stress management
1.2 To improve the efficiency of stress management solutions
resistance training.
1.3 To utilise human senses to create calming and stress

3 Size and Weight

3.1 Maximum Size should not exceed 200x200mm per product
3.2 Maximum Weight should not exceed 3kg per product.

5 Material

5.1 High Quality matte finished or anodised metals
5.2 Lightweight
5.3 Excellent Durability

2 Environment

2.1 This product will be designed to be placed on countertops/tables around the home.
2.2 Should be able to withstand a drop of 1 - 1.5m max.

4 Visual Language

4.1 Include NASA's signature Blue and Red colour theme
4,2 Angular geometric, futuristic shape
4,3 narrow bevelled edges
4.4 Curved corners, narrow radius
4.5 80-90% light matte space grey
4.6 Flat surfaces

6 Price Range

6.1 £230 - £270

Brand PRS

Longevity - Durability

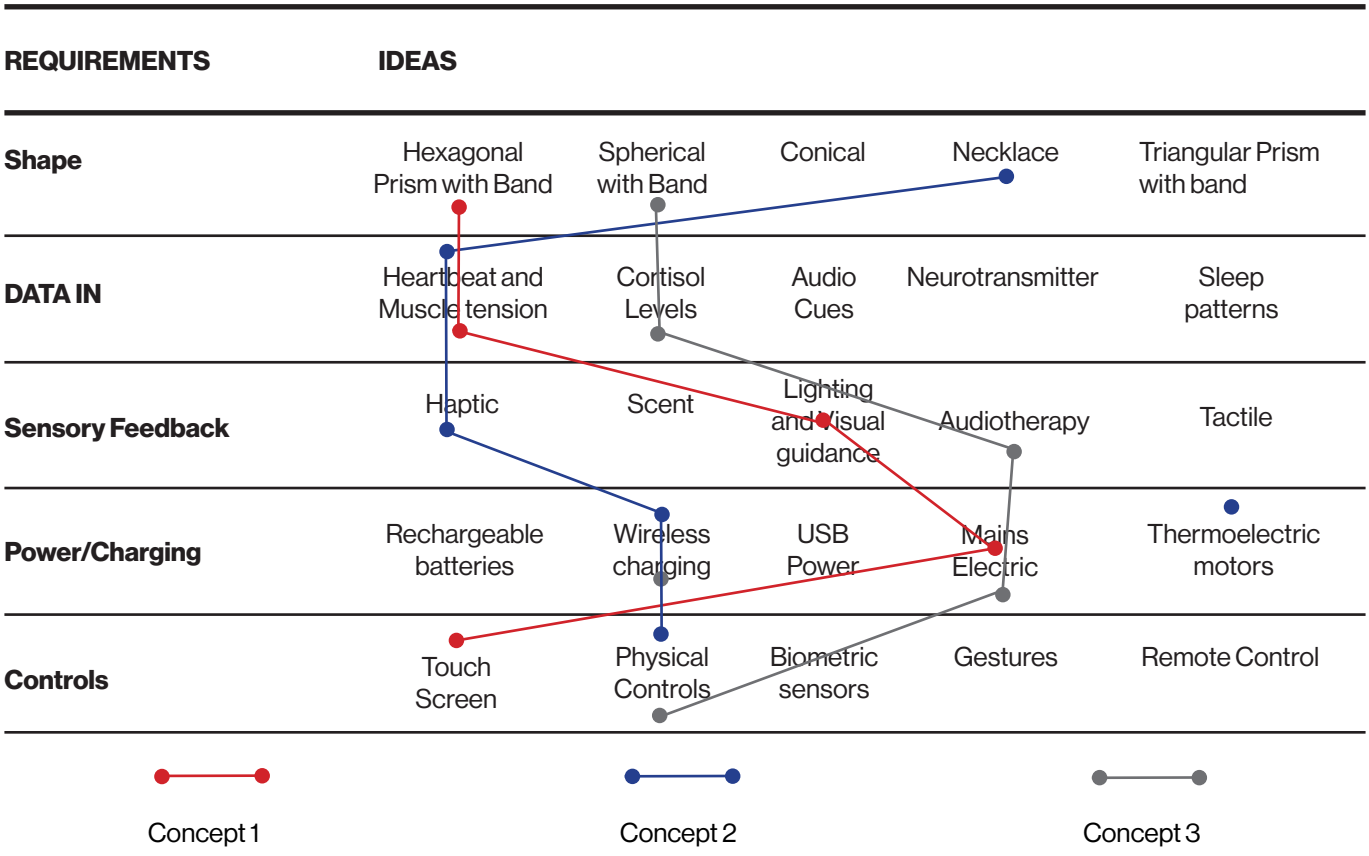
Innovation - Cutting edge technology, Excellent performance

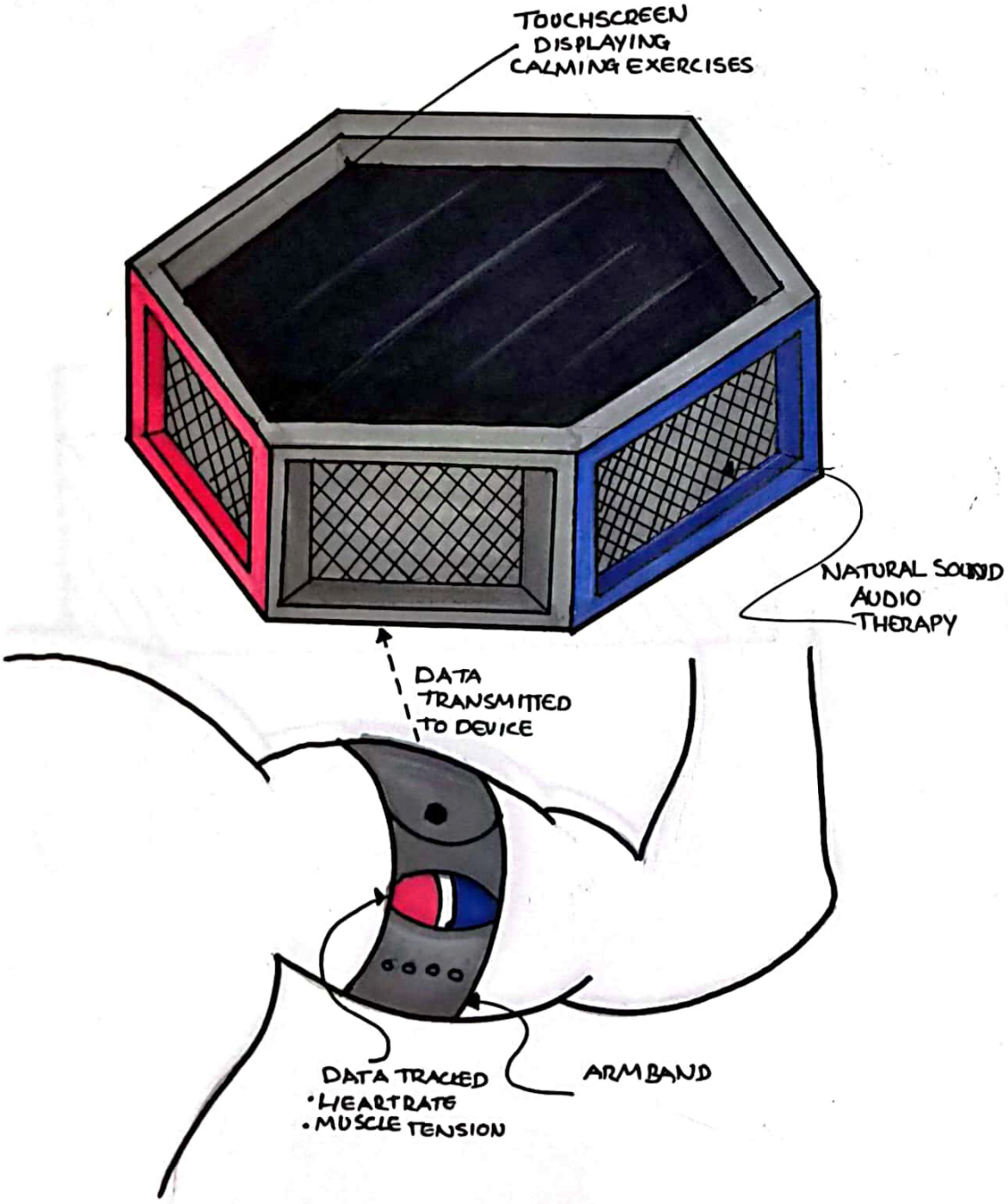
Integration - Interconnectivity

Intuitiveness - Ease of use, Autonomy

Inclusiveness - Accessibility

Morphological Analysis





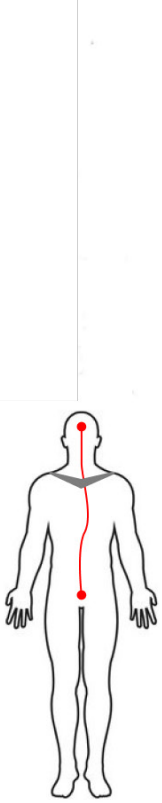
Concept 1

Individual Product Concept

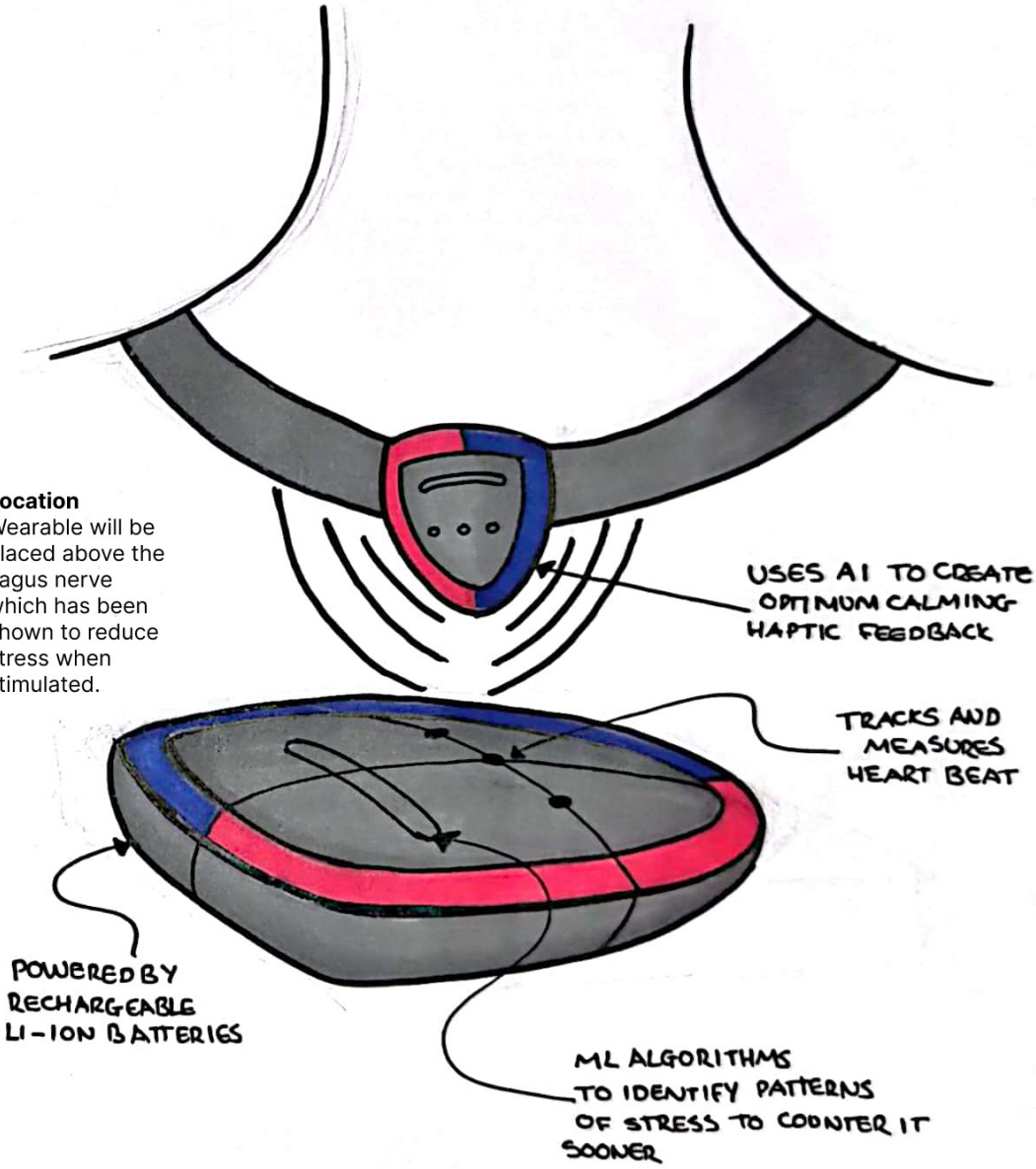
06-12-2023

Nathan Hall 2012939 - Audio and visual therapy device

This concept consists of two products that link together. The first being an arm band that measures both heart rate and muscle tension to track stress levels. Data is then transmitted to a therapy device that intuitively creates calming environments using Lighting and breathing exercises, clearly displayed on the screen.



Location
Wearable will be placed above the vagus nerve which has been shown to reduce stress when stimulated.



Concept 2

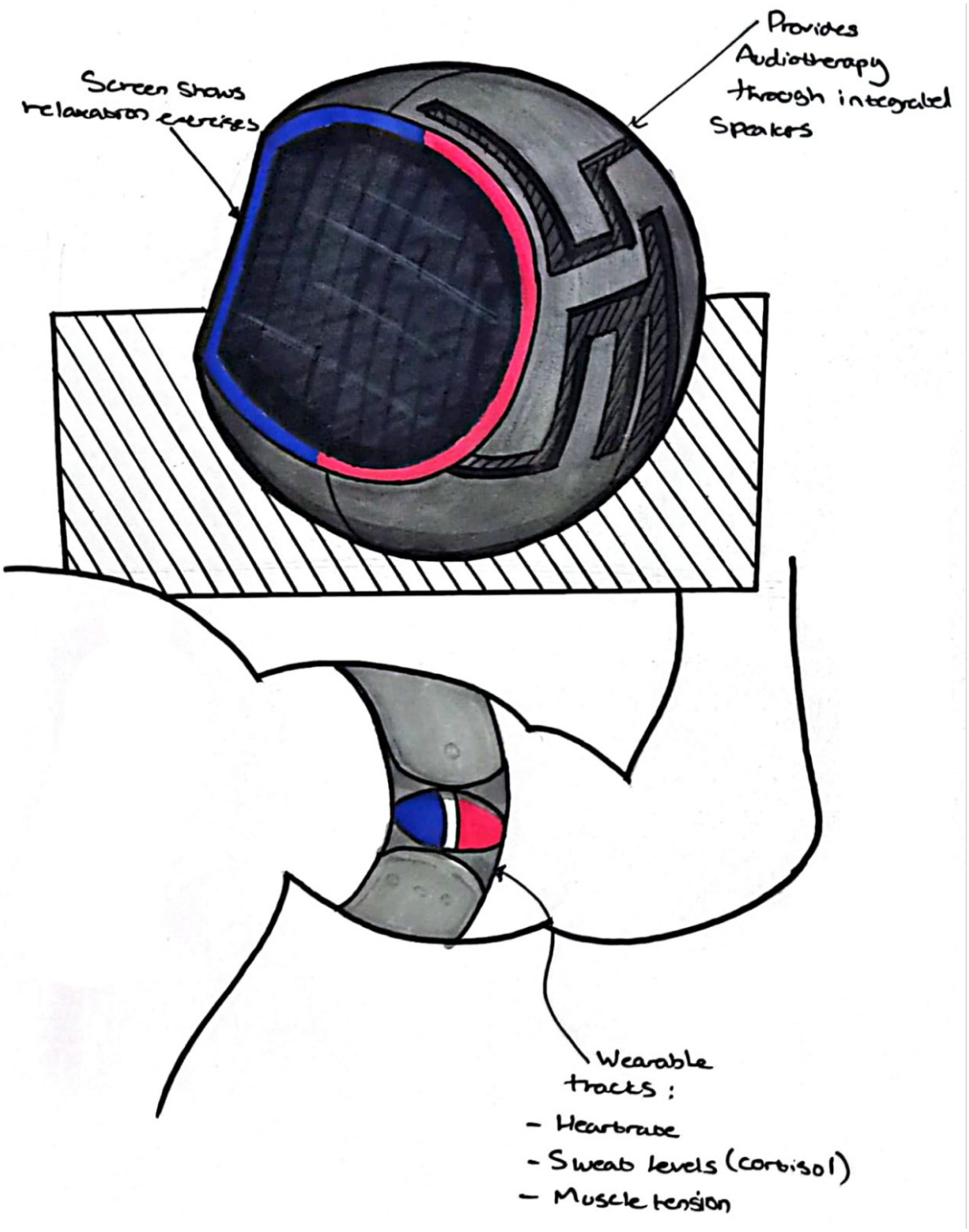
NASA

Individual Product Concept

06-12-2023

Nathan Hall - Vibrational Vagus nerve Device

This device hangs above the users chest. It measures heartbeat, activated by biometric sensors. Upon stress detection it uses haptic technology and AI to create and emit optimal calming vibrations over the vagus nerve. It uses data with ML algorithms intuitively to predict stressful times for pre-emptive counteraction.



Concept 3

Individual Product Concept

06-12-2023

Nathan Hall - Audio-Visual therapy device

This concept consists of two products that link together. The first an armband that uses sweat levels to track cortisol levels and muscle tension. This data is transmitted to a secondary device that uses AI to create an optimal stress reducing environment through light projection and breathing exercises.

Matrix Evaluation

PRS	Concept 2	Concept 1	Concept 3	Final Concept
Longevity	DATUM	=	=	+
Innovation		+	+	+
Mobility		-	-	=
Integration		+	+	+
Intuitiveness		=	=	=
Inclusiveness		=	=	+
		+1	+1	+4

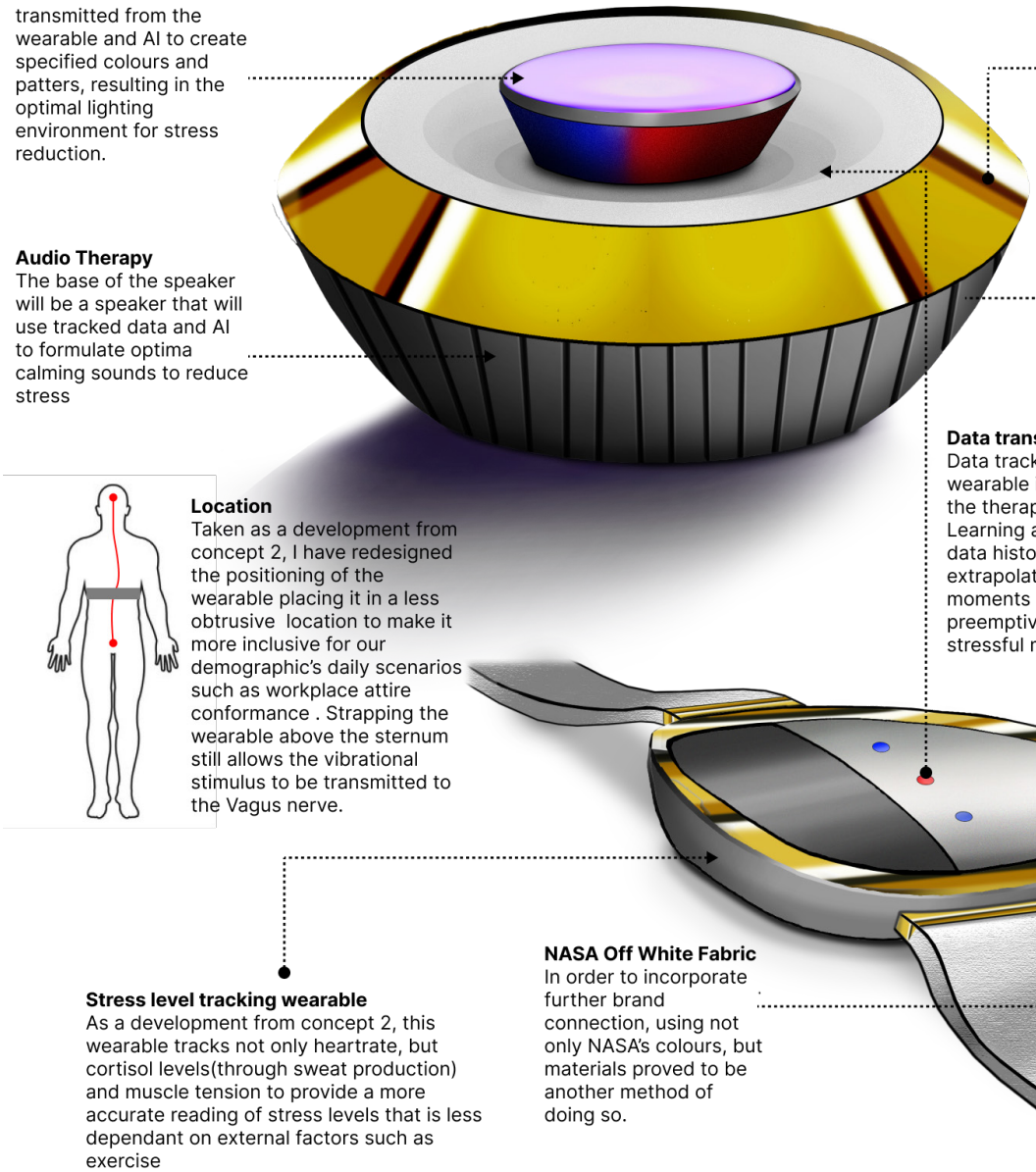
My converged concept will utilise positive features from initial concepts to create a more holistic design that adheres to the brand PRS better.
Some of the features I would like to take forward are:
Detection of cortisol levels : this measurement should be a more accurate reading of stress levels. factors like heartbeat can be affected by things like exercise.
Stimulation of vagus nerve: Research has been done in stimulation of this nerve. It has been proven that stimulating it can reduce stress in individuals (Mayo Clinic, 2018).Things I want to change:
The placement of concept 2 can be quite obtrusive arounf the neck. Having a bulky device hanging here can prove to be problematic for daily scenarios that our demographic might face such as workplace attire, having a large device may give an unprofessional appearance. I want to change the location and design to make it more discrete
Branding: currently the brand colours could be better suited for our demographic by making it sleeker and subtle. Furthermore, incorporating actual materials NASA use, could be beneficial in strengthening brand image.

Light Emitting Projection
This feature utilises data transmitted from the wearable and AI to create specified colours and patters, resulting in the optimal lighting environment for stress reduction.

NASA Gold Coating
Incorporating material that NASA use in spaceflight to showcase further brand identity

Audio Therapy
The base of the speaker will be a speaker that will use tracked data and AI to formulate optima calming sounds to reduce stress

NASA Rubber Bottom
Using the rubber texture from the bottom of NASA space boots for increased durability.



Data transmission
Data tracked from the wearable is transmitted to the therapy device. Machine Learning algorithms will use data history to intuitively extrapolate predictive moments of stress in order to preemptively counteract stressful moments

Location
Taken as a development from concept 2, I have redesigned the positioning of the wearable placing it in a less obtrusive location to make it more inclusive for our demographic's daily scenarios such as workplace attire conformance . Strapping the wearable above the sternum still allows the vibrational stimulus to be transmitted to the Vagus nerve.

Stress level tracking wearable
As a development from concept 2, this wearable tracks not only heartrate, but cortisol levels(through sweat production) and muscle tension to provide a more accurate reading of stress levels that is less dependant on external factors such as exercise

NASA Off White Fabric
In order to incorporate further brand connection, using not only NASA's colours, but materials proved to be another method of doing so.

Final Concept

Individual Product Concept

06-12-2023

Nathan Hall - Vibrational Vagus nerve and Ambient light- Audio therapy device

This concept consists of two products that link together. The first an armband that uses sweat levels to track cortisol levels and muscle tension, then stimulates the vagus nerve through acoustic vibration to relieve stress. This data is transmitted to a secondary device that uses AI to create an optimal stress reducing environment through light projection and breathing exercises.

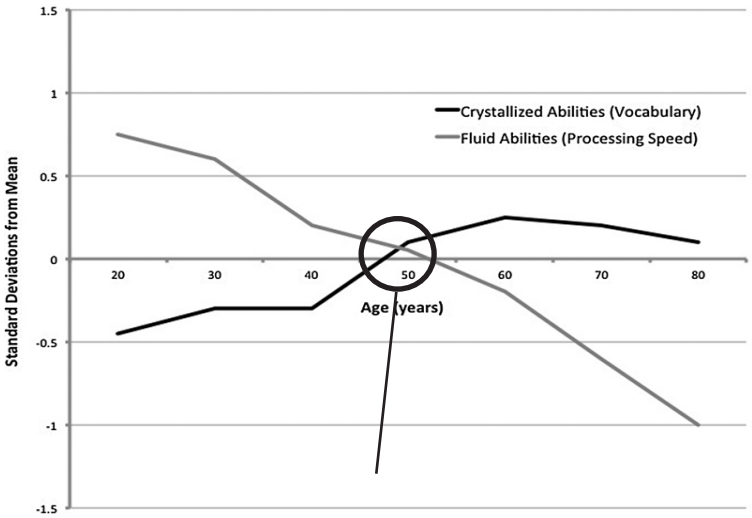
Individual Research

06-12-2023

Thomas Dingwall - Managing cognative decline through stress mitigation

Cognitive ability refers to a group of mental skills and processes that are involved in acquiring, processing, storing, and applying information. It invloves a wide range of mental functions that contribute to various aspects of learning, problem-solving, decision-making, and overall intelligence.

“Cognition is critical for functional independence as people age, including whether someone can live independently, manage finances, take medications correctly, and drive safely. In addition, intact cognition is vital for humans to communicate effectively, including processing and integrating sensory information and responding appropriately to others.” **(S Hear, 2015)**



Identified area of intervention

Notable attributes

- The product should be easily accessible to all identified user groups.

- Any data recorded should be stored and analysed to provide optimal feedback.

- Users should feel comfortable both wearing and using the device.

- Real time feedback should be eaily represented or displayed to the user.

Managing stress through effective coping strategies, such as relaxation techniques, mindfulness, can help mitigate its impact on cognitive abilities. Creating a balanced and healthy lifestyle, including regular exercise and sufficient sleep, is also important for maintaining cognitive function, especially in the face of stress.

Individual Product Requirements

1 Performance

1.1 Mitigate cognative decline by managing stress.
1.2 Provide user centered feedback that can be stored and analysed.

2 Human Factors

2.1 Easy and accessible to use.
2.2 Feedback on mental exercise progress
2.3 Product should fit comfortably in the hand and on the head
2.4 The product will need to be intuative and easy to set up

3 Enviroment

3.1 Suitable for home use.
3.2 Suitable for use a work.
3.3 Should be able to be moved.

4 Size and Weight

4.1 Fit inside bag and pocket.
4.2 Rest comfortably on head without falling off.
4.3 Easy to hold without getting tired

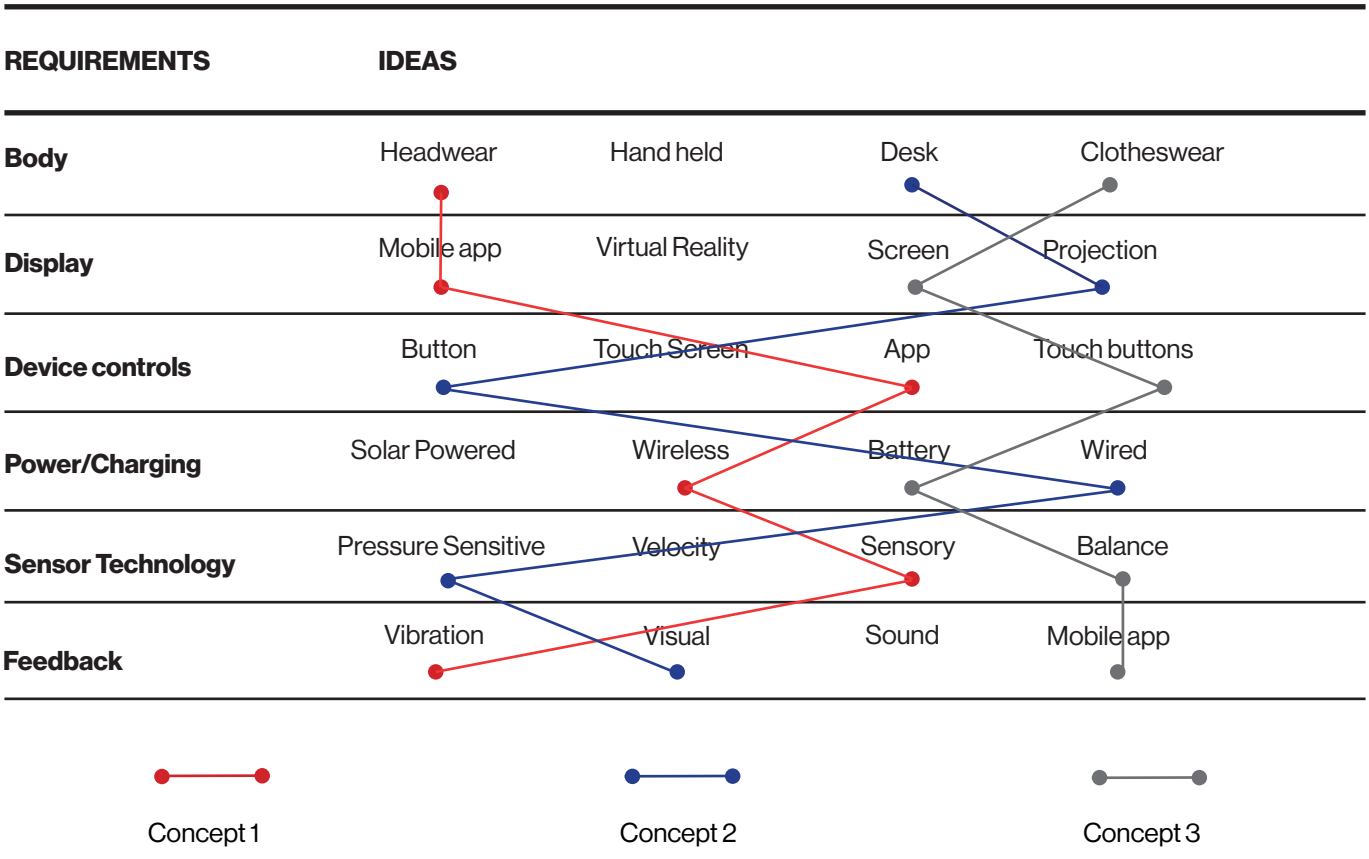
5 Maintenance

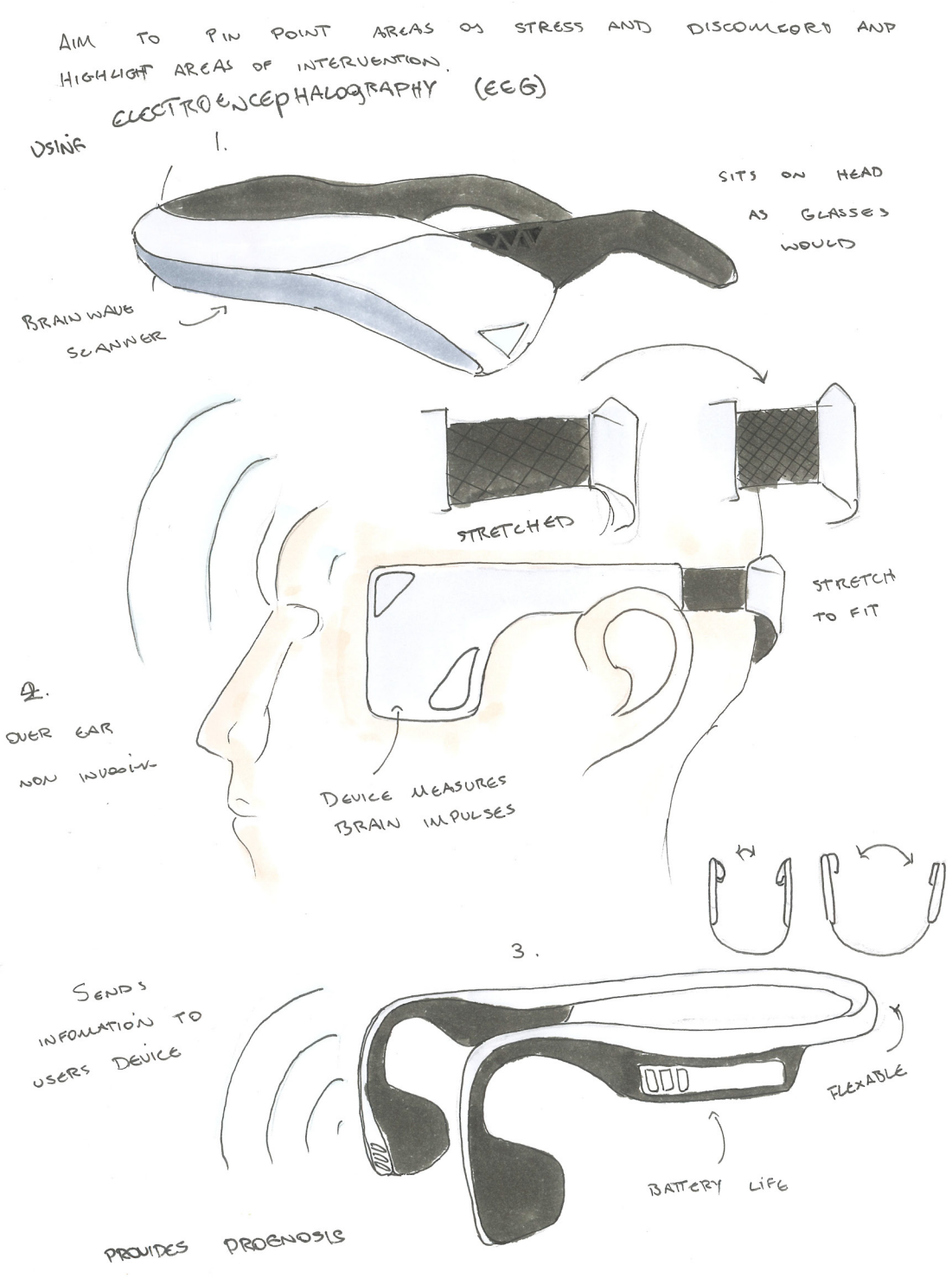
5.1 Little to no maintanance of the device should be required.

6 Sustainability

6.1 Product should be designed for disassembly to allow for repair and recycling.

Morphological Analysis





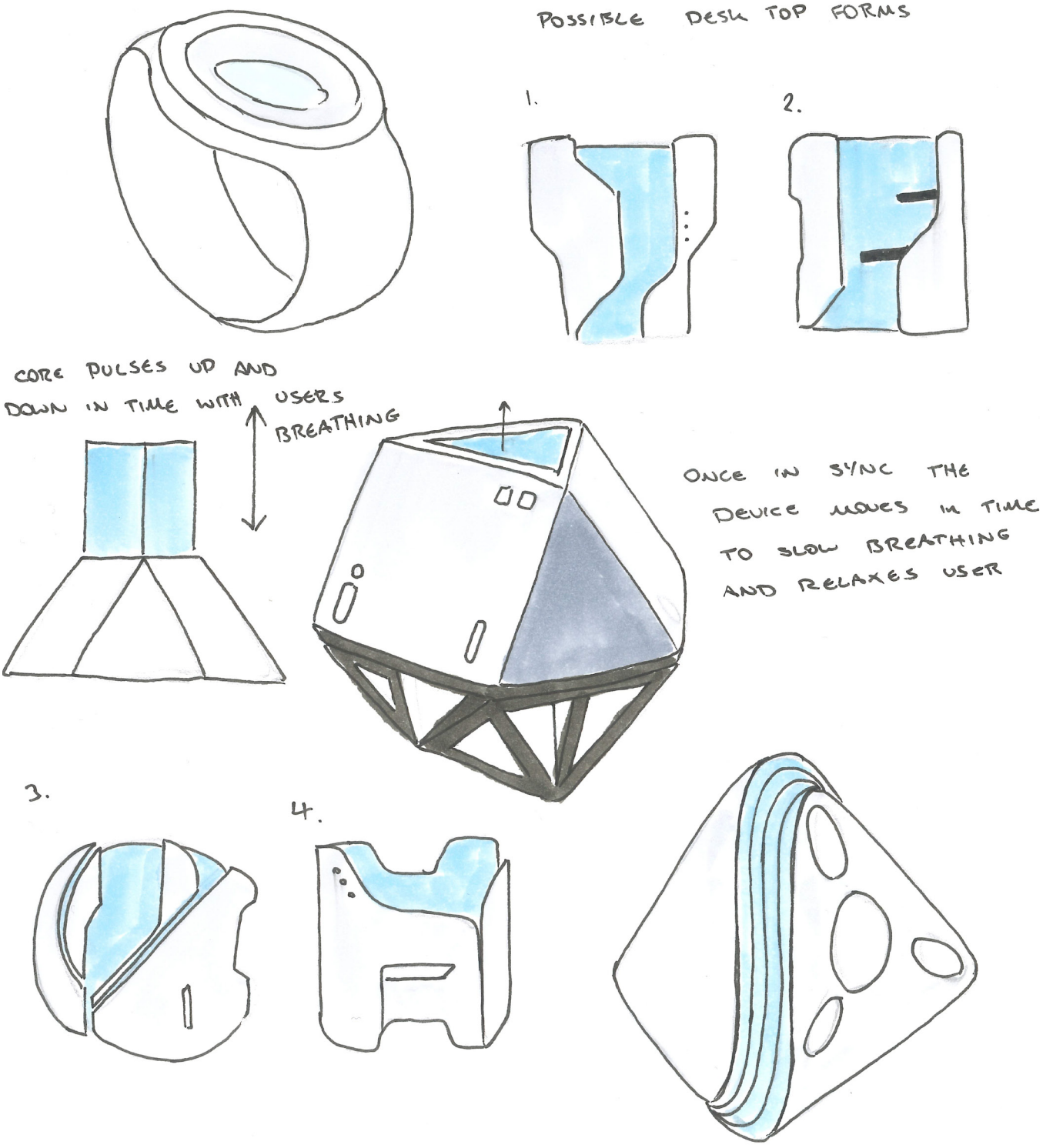
Concept 1

Individual Product Concept

06-12-2023

Thomas Dingwall - Stress Brainwave Scanner

Using imbedded EEG technology, this wearable brainwave scanner will be able to detect stress levels, relay that information to its AI based mobile app and provide real time guidance and solutions to the user. Above are three possible variants with differing levels of visabilty.



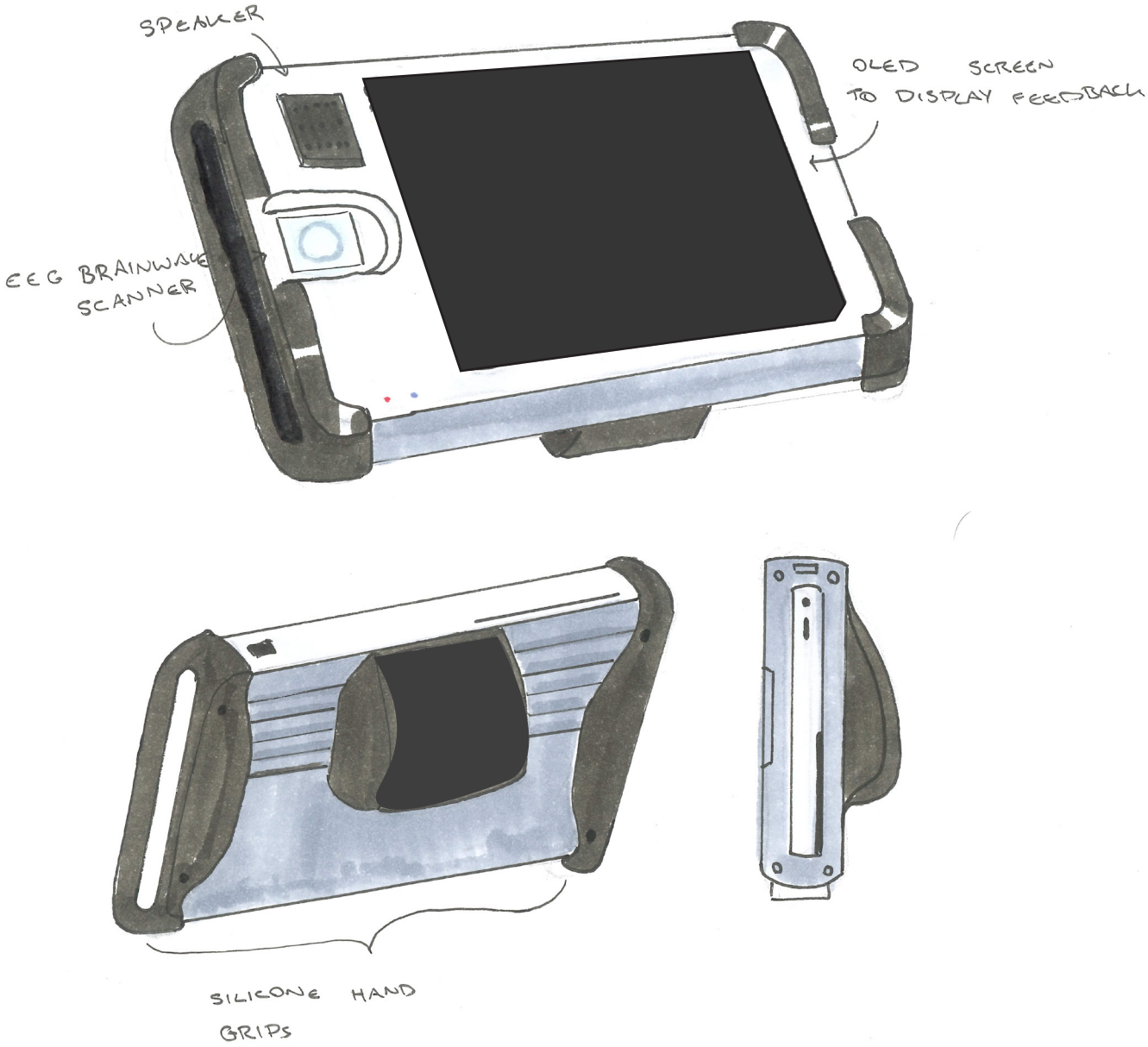
Concept 2

Individual Product Concept

06-12-2023

Thomas Dingwall - BioRythm Re-Sync Device

This desk device monitors the users breathing and mimiks the identified heart/breathing rate with a pulsating inner core. The device aims to help re-sync the users breathing by pulsating at the correct bpm to relax the user.
The device will come with onboard lights to further promote better breathing.



Concept 3

Individual Product Concept

06-12-2023

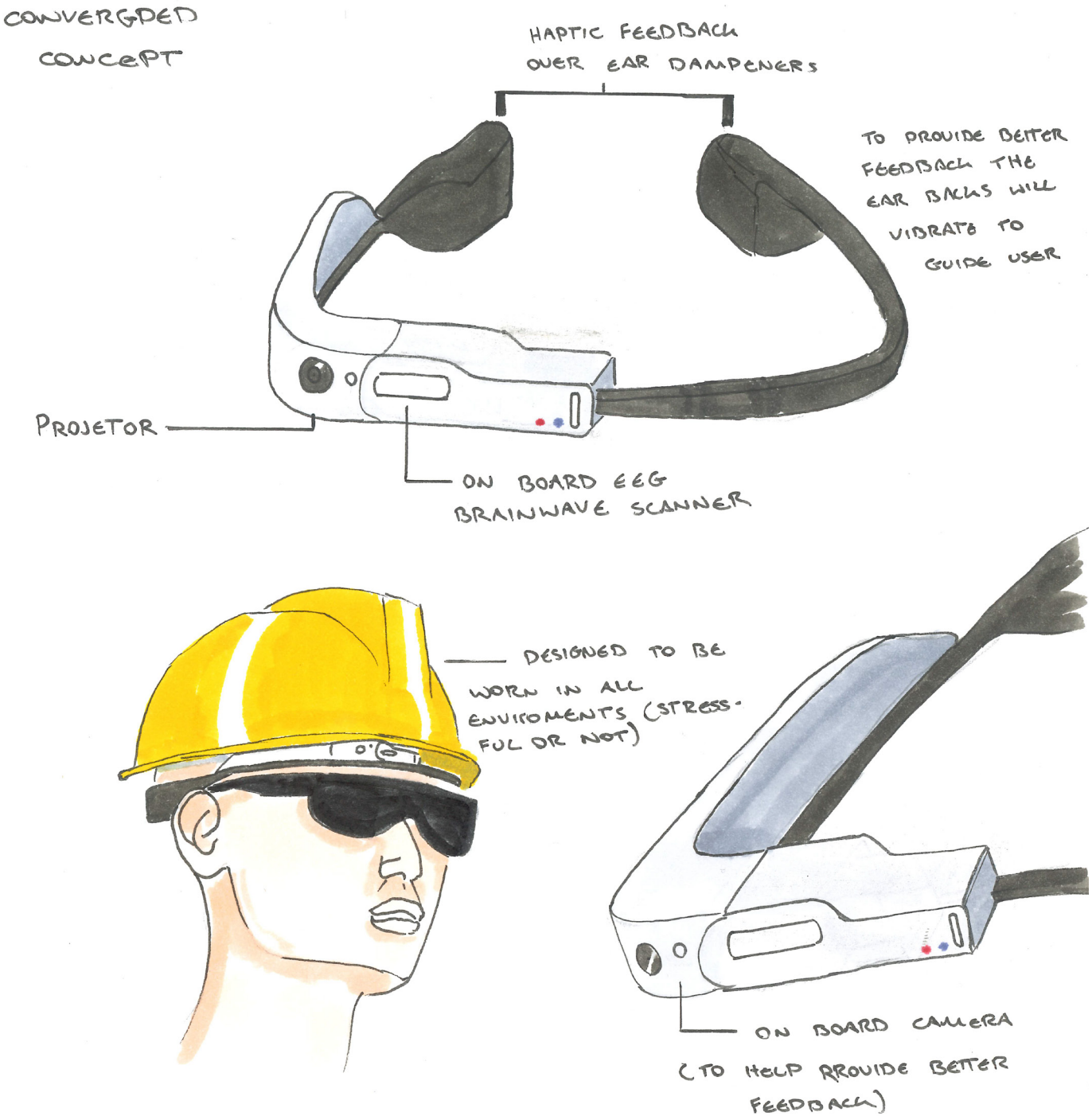
Thomas Dingwall - AI Haptic Feedback Relief Device

Using an onboard pupil scanner this AI haptic feedback device will analyse the users brain and provide suitable tasks to the user, that will then be used to measure their cognative performance. The data will then be analysed and a user level will be provided. Suitable tasks will then be provided to keep the brain stimulated.

Matrix Evaluation

PRS	Concept 1	Concept 2	Concept 3	Final Concept
Advanced Technology	DATUM	=	-	+
Intuitive		+	-	=
NASA Brand Image		=	+	=
AI Capability		=	=	+
Inclusive		+	=	=
Enviromentally friendly		-	+	+
		+1	0	+3

A Peugh analysis to find specific attributes to be used in the final concept.



Final Concept

NASA

Individual Product Concept

06-12-2023

Thomas Dingwall - Wearable Bio Rthym feedback device

The final conept includes an onboard personal projector that works in conjuction with an EEG scanner to measure user brainwaves and provide real time analytics via the projector.
The device was designed to be accesible to anyone in any enviroment. The device also provides haptic feedback via motors located in the rear of the device.

Individual Research

06-12-2023

Henry Leeson - Product Concept for Proprioception

Proprioception, or our sense of body position and movement independent of sight, declines with age. This has an effect on balance, coordination, and spatial awareness, increasing the risk of falls in older adults. Because of the reduced ability to detect subtle body changes, adapting to movements and uneven surfaces becomes more difficult, increasing the likelihood of an accident. Recognising these changes emphasises the importance of interventions to maintain proprioceptive function and prevent falls in the elderly. (Ribeiro & Oliveira, 2007). The figure below shows the systems which allow position and movement to be sensed: 10% from vision, 20% from the balance organs (vestibular system), and 70% from proprioceptors across the body.

70%

Proprioceptors across body

10%

Vision

20%

Balance

Problems:

4. Risk of Functional Decline:

Poor proprioception may result in functional decline, affecting the ability to perform routine tasks independently. (Goble et al., 2009)

1. Balance and Stability:

Aging processes often lead to a decline in proprioceptive acuity, affecting balance control and increasing the risk of falls and injuries.

2. Reduced Joint Sensitivity:

Aging-related changes in joint structures and sensory receptors lower joint sensitivity, impacting the body's ability to perceive motion and position accurately.

3. Impaired Coordination:

Proprioceptive deficits contribute to altered gait patterns and reduced coordination, affecting mobility and daily activities. (Ribeiro & Oliveir, 2011)

Design Intention

To implement an immersive and interactive proprioceptive enhancement experience for users, addressing the specific challenges related to declining proprioception, especially prevalent among aging individuals. Fusing ergonomic design with advanced sensor technology, the product will offer a user-friendly, ZZadaptable, and customizable solution that engages users in proprioceptive exercises and activities

Individual Product Requirements

1 Performance

1.1 Ensure high accuracy in tracking body movement, weight distribution, and force application.

1.2 Offer adjustable difficulty levels to accommodate users' diverse skill levels and needs.

2 Human Factors

2.1 Ensure the product range is accessible and user-friendly for individuals with varying physical abilities.

2.2 Design devices with ergonomic considerations to maximize comfort and usability during training sessions.

3 Enviroment

3.1 The product range must function effectively in various environments, including indoor spaces, outdoor settings.

3.2 Components should withstand a range of temperature and humidity conditions.

4 Size and Weight

4.1 Aim for a balance between functionality and portability, allowing users to easily transport or store components as needed.

4.2 <250x250x250mm

4.3 < 1kg

5 Maintenance

5.1 Design components to withstand regular use and potential impact.

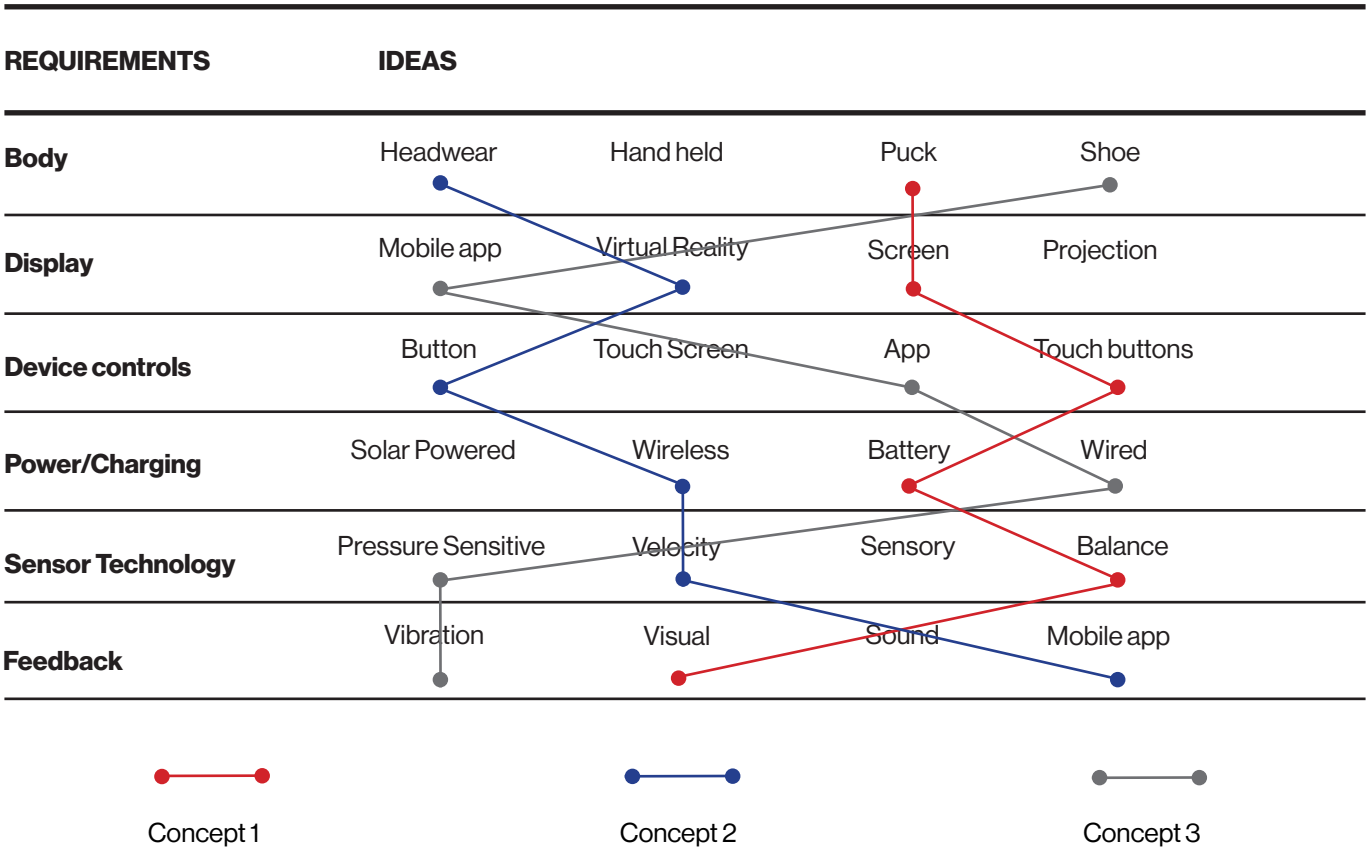
5.2 Implement components that are easy to clean, service, and repair, ensuring extended product life.

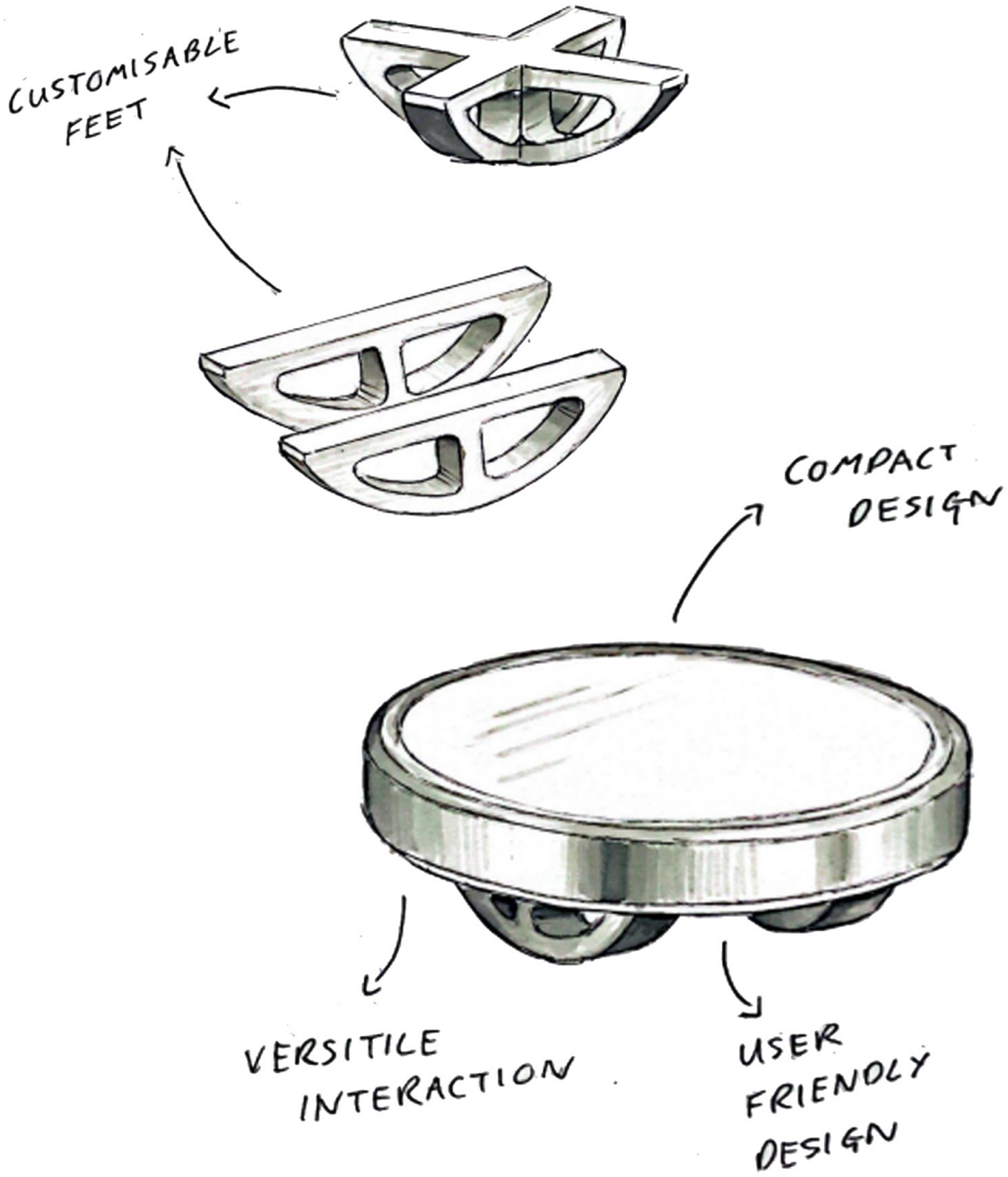
6 Sustainability

6.1 Prioritize eco-friendly and sustainable materials in the manufacturing process.

6.2 Design components for easy disassembly and recycling.

Morphological Analysis





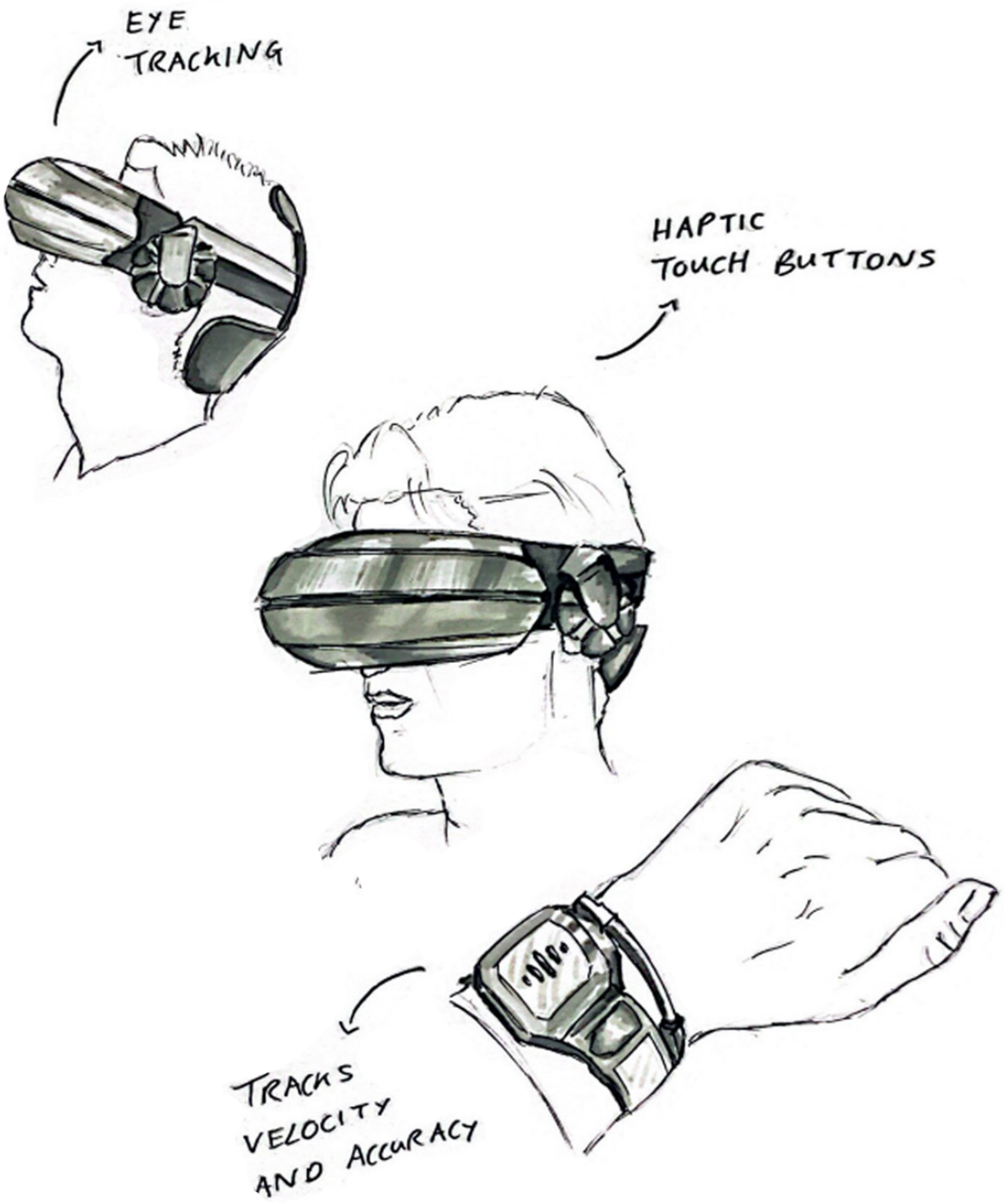
Concept 1

Individual Product Concept

06-12-2023

Henry Leeson - Adjustable balance boards

Concept 1 is an set of individual balance boards which come with various feet for different difficulty levels, ensuring a tailored experience. The built-in screen provides real-time feedback based on your efforts, aiding in improving balance and spatial awareness. The user can use this product while standing or in a plank / kneeling position.



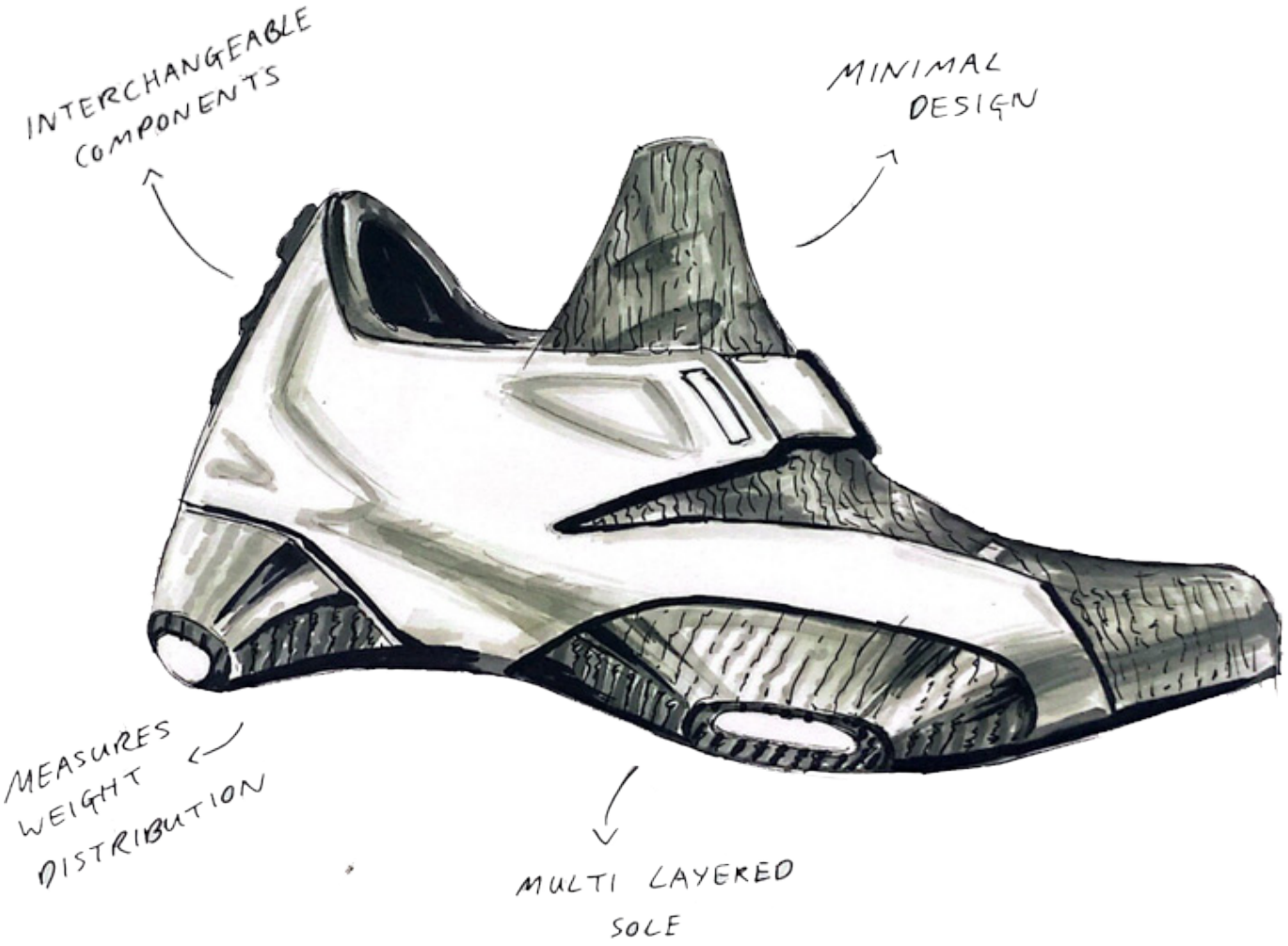
Concept 2

Individual Product Concept

06-12-2023

Henry leeson - VR Proprioception tracker

Concept 2 features an advanced armband that tracks movement and velocity, providing detailed insights into your body's positioning. Paired with a versatile headset offering customizable modes for proprioceptive exercises, this kit elevates body awareness and spatial perception for improved balance and coordination.



Concept 3

Individual Product Concept

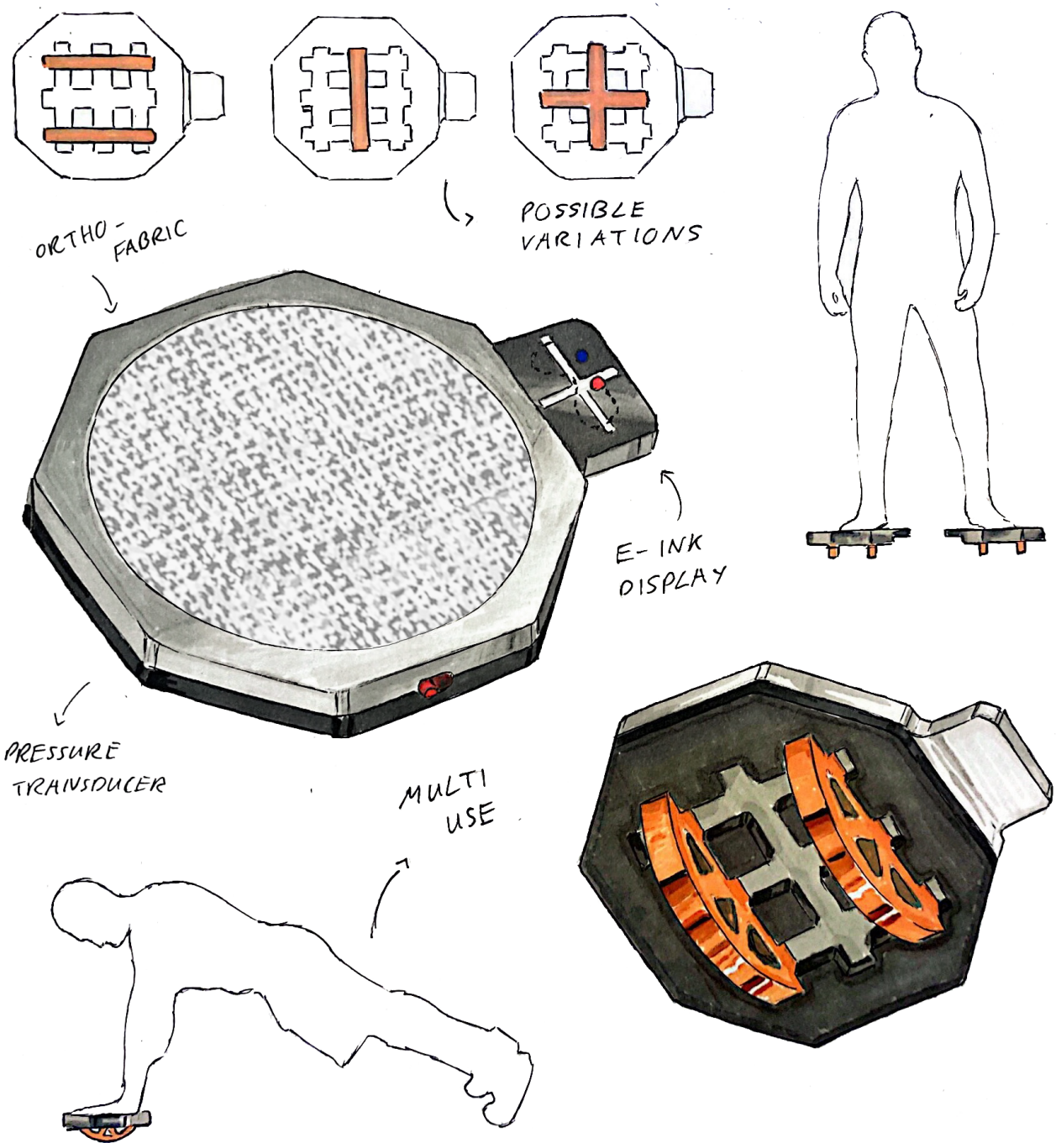
06-12-2023

Henry Leeson - Tracking shoes

Concept 3 is a pair of shoes which are equipped with cutting-edge sensors that meticulously measure weight distribution and force discrepancies as you move. By precisely tracking these imbalances, our shoes offer real-time feedback, empowering you to refine proprioception and enhance spatial awareness.

Matrix Evaluation

PRS	Concept 1	Concept 2	Concept 3	Final Concept
Advanced Technology	DATUM	+	+	+
Intuitive		=	-	=
NASA Brand Image		=	+	+
Full Body Proprioception		=	-	=
Inclusive		-	=	=
Timeless		-	-	+
		-1	-1	+2



Final Concept

Individual Product Concept

06-12-2023

Henry Leeson - Product Concept for Bone Density and Muscle Mass

These boards measure weight distribution using pressure transducers and feature an e-ink display with interactive game modes. Follow the dot's movements on the display by adjusting your weight distribution and angle, refining balance and spatial awareness in an engaging training experience.

Individual Research

06-12-2023

Harry Chubb - Product Concepts for Joint Health and Mobility.

To maintain a high quality of life and allow individuals to partake in daily activities comfortably, a preventive approach to joint-health should be used.

The following three innovations seek to enhance joint health through early problem identification and treatment. This is vital in preventing further chronic health conditions such as rheumatoid arthritis or osteoporosis.

“Severe joint pain is more common among adults with arthritis who also have other chronic conditions including diabetes (40.9%) and heart disease (34.1%), and among adults with a disability (45.6%).”

- Centre for Disease Control and Prevention.

“Compared with other chronic diseases there is a lack of definite measures in OA {osteoarthritis} that can be useful as endpoints in intervention studies.”

- Jonsson H, 2016.

“Patients should seek help within six weeks of symptom onset, and early management should be directed by a rheumatologist. The recommendations also suggest patients at risk for chronic arthritis should begin a course of disease-modifying antirheumatic drugs (DMARDs) within three months after symptoms appear.”

- Levine B, 2023.

“The general paradigm is if you don’t treat RA, it goes badly. You will have long-term disability, losing joint function and mobility,” explains Niewold. “It’s also probably better for your cardiovascular system, as there is early atherosclerosis and cardiovascular morbidity in RA. Most of the studies are supporting the idea that early intervention and active treatment helps prevent that downstream complication.”

- Niewold T,

UQ’s Arthritis Queensland Chair of Rheumatology at the UQ Diamantina Institute Professor Ranjeny Thomas said while currently there was no cure for rheumatoid arthritis, taking preventive steps to reduce the risk of developing disease was the best way to reduce the need for lifelong medication.

- Koller-Smith L, Thomas R, 2022.

Individual Product Requirements

1 Biocompatibility

1.1 Materials used must be non-irritating and hypo-allergenic to human skin.
1.2 Consistent use of the products should not pose any health concerns for the user.

2 Effective Therapeutic Use

2.1 Each product must be beneficial to the user's health.
2.2 Products should prevent/ mitigate chronic conditions.

3 Comfort and Ergonomics.

3.1 For a range of user body types the products must be lightweight, flexible, and well-fit to the user.
3.2 There must be no interference with natural body movements.
3.3 The product must be usable during other everyday tasks.

4 Durability

4.1 Products must withstand regular and prolonged usage.
4.2 Parts need to be repairable and replaceable.
4.3 Maintenance should be rare with easy-clean features for all products.

5 Convenience

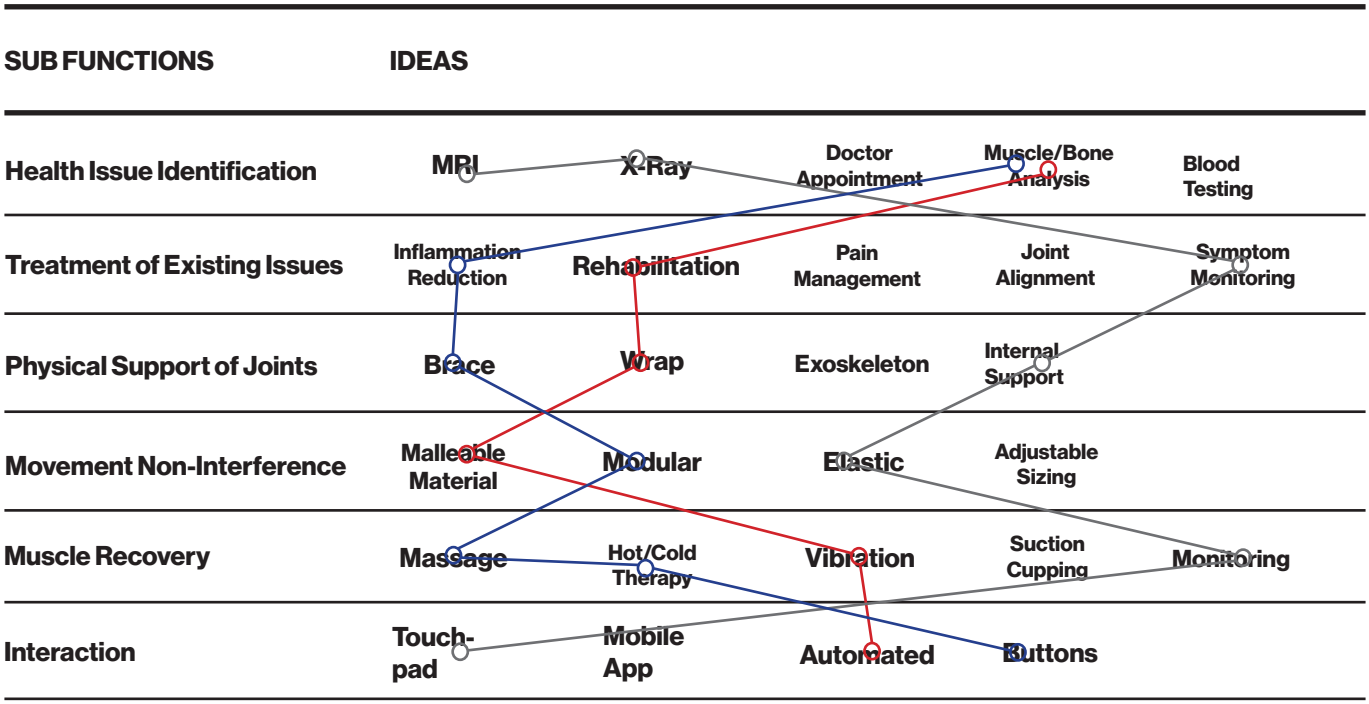
5.1 Users should be able to carry and move the products with ease.
5.2 Products should allow for multi-tasking during use.
5.3 A long battery life should be available.

6 Ease-of-use

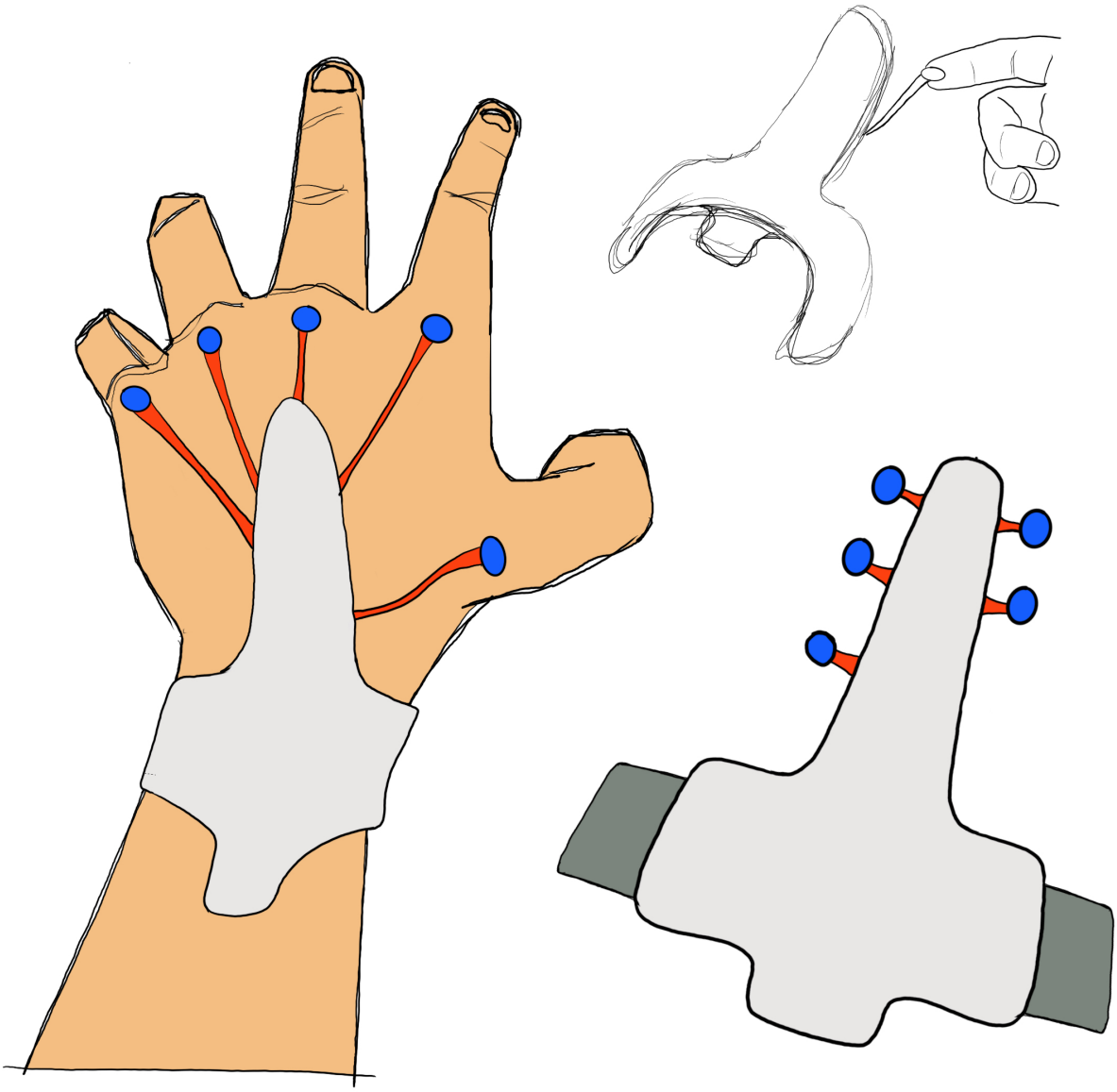
6.1 All products must be simple to use.
6.2 There must be a balance between form and function.

Morphological Analysis

Having defined the desired main function for the concepts as prevention of joint health issues, morphological analysis is used to define sub-functions and the potential ways in which these will be achieved in order to support the overall function of the product.



Vibration therapy works by stimulating muscles and ligaments to increase blood circulation, ultimately helping reduce pain and inflammation, promote immune response, and improve joint strength and flexibility, among other benefits. (Garver, M 2021)



Concept 1

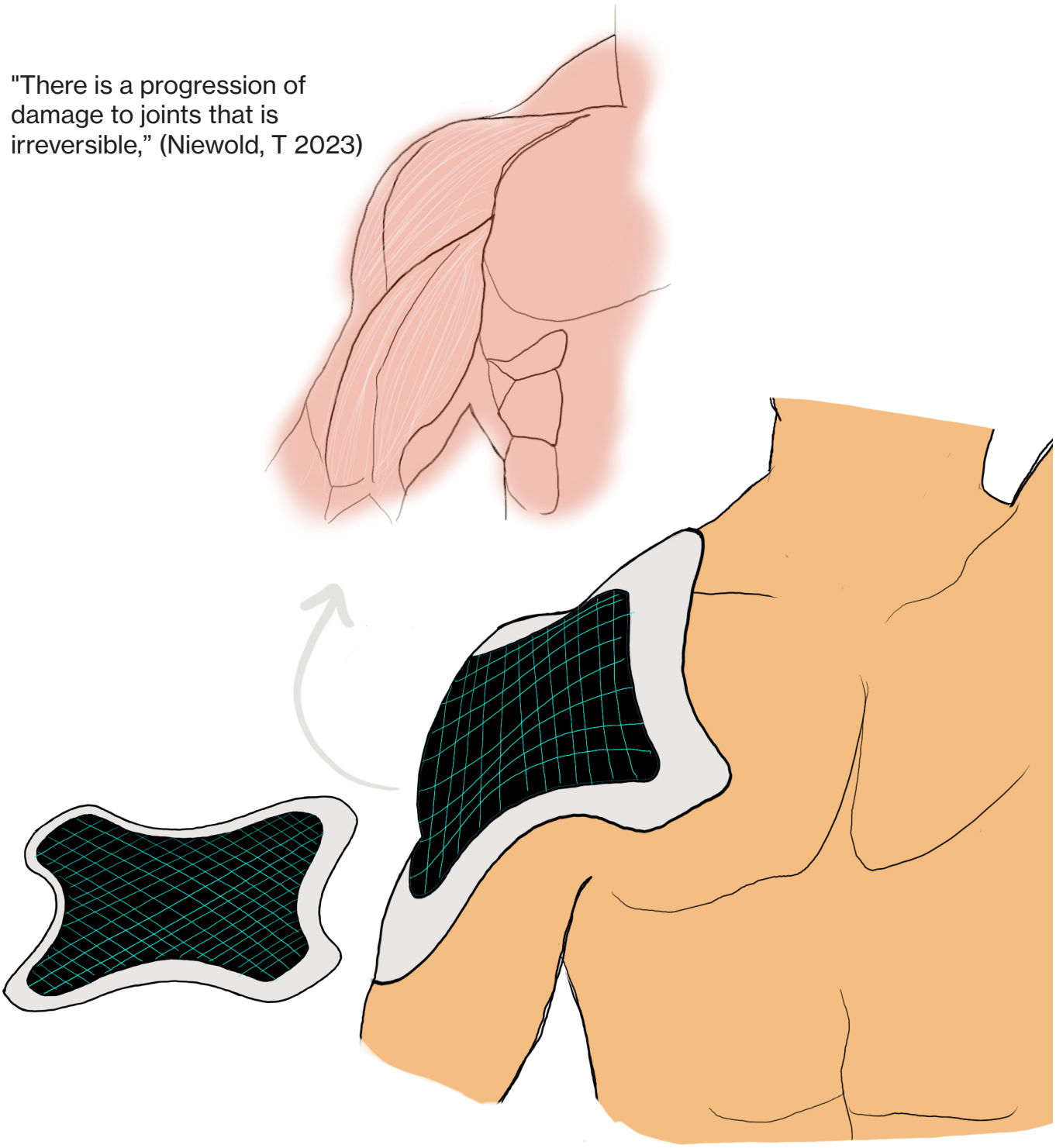
Individual Product Concept

06-12-2023

Harry Chubb - Vibration Joint Band

Concept One is a vibration therapy device which is designed to be unobtrusive and used throughout the day. Through its sleek design this product will automatically activate at a prescribed duration and frequency in order to best benefit the user wearing it. It works through a main strap wrapping around the primary joint (the wrist in the images above) with nodes that can be placed on secondary joints (the knuckles in this example) by the user. This provides comprehensive treatment in a preventive or rehabilitation form.

"There is a progression of damage to joints that is irreversible," (Niewold, T 2023)



Concept 2

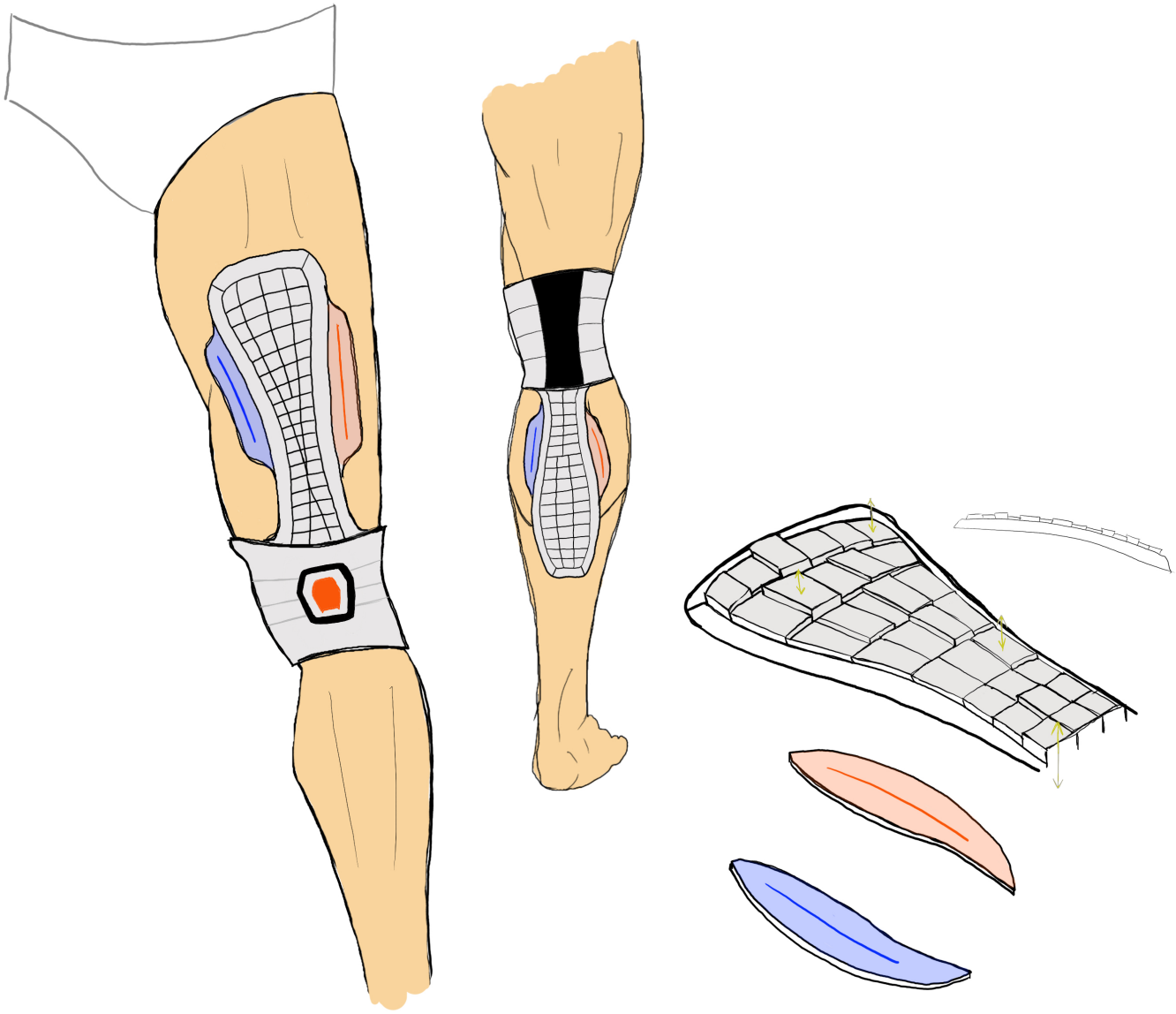
Individual Product Concept

06-12-2023

Harry Chubb - Advanced Imaging Pad

Focusing more on diagnosis of potential joint health issues, concept two is a device that will allow for fast and detailed imaging of the human body. Through either X-Ray or MRI scan types this futuristic device creates a window into the human body without the need for large and time-consuming methods. It is designed to be malleable in order to cover any area of the human body that needs to be scanned. A product like this would allow for faster diagnosis of patients in a world where the strain on public health systems is an ever-present issue.

The application of cold therapy within 1 hour after exercise could reduce the pain of DOMS patients within 24 hours after exercise. (Wang Y, Zhang Y 2014)
Heat treatment could reduce the pain of patients. It had obvious effects on the pain within 24 hours and over 24 hours. (Wang Y, Zhang Y 2014)



Concept 3

Individual Product Concept

06-12-2023

Harry Chubb - Hot/Cold Massage System

The third concept is a treatment device blending a range of common practices into one innovation. The massage pads focus on recovery of the surrounding muscles of the joints, known to be a factor in joint health issues, whilst the core strap targets the joint itself. Through an innovative, mechanised massage system, this product will treat users without leaving them immobile. The cold and hot controls will treat the muscles in accordance to the user's required recovery method. The strap around the joint utilises a vibration therapy technique.

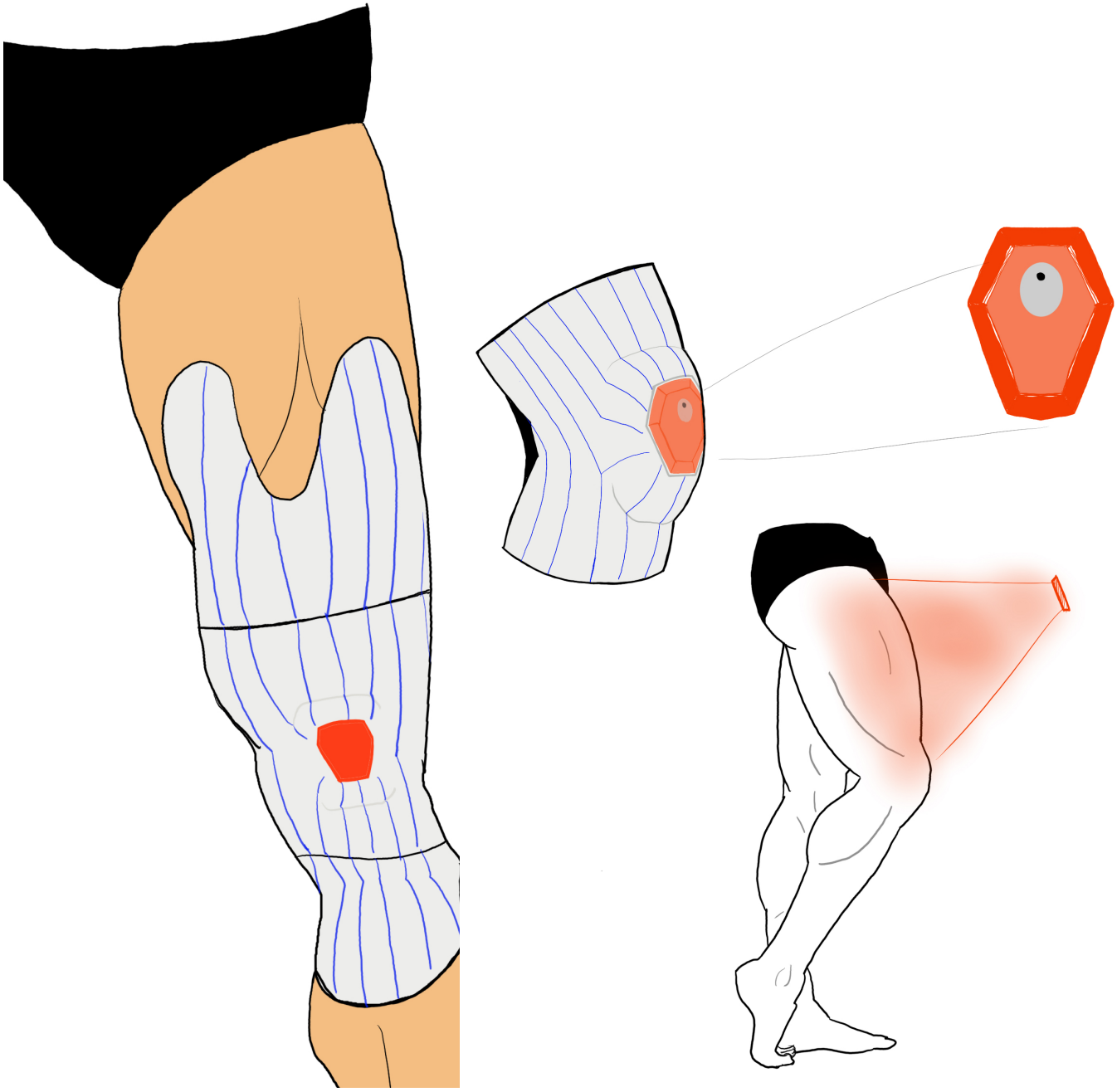
Matrix Evaluation

PRS	Concept 3	Concept 1	Concept 2	Final Concept
Identification	DATUM	=	+	+
Treatment		-	-	=
Physical Support		-	-	=
Non-Interference		+	+	+
Recovery		=	-	=
Interaction		+	+	=
		0	0	+2

Through evaluating the concepts against each other, with concept three as a datum, there are key areas of improvement that have been identified.

Concept three is a strong concept because of it's therapeutic value but the design itself lacks strong interaction points and is more obtrusive than the other concepts when being used. In order to optimise this design it is important that it is designed in an innovative way which does not interfere with the user's movements or everyday tasks. A more conceptual technology should be used in order to achieve this.

Another major weakness is the lac of problem identification in this product. Although it holds value in its means of recovery and treatment, the aim of the concept should be to also help identify before chronic disease development. Integration of techniques used in concept two would fill this gap and finalise the design of the product.



Final Concept

Individual Product Concept

06-12-2023

Harry Chubb - Smart Scan

Through the matrix analysis of the concepts comes the converged concept. This device innovatively scans the body area in question through a micro-scanning device which will image and analyse the muscle/joint area. The analysis will inform the device where the affected muscles are and if there is any issues with the joint itself. Once plugged back into the brace the analysis conclusions (where needs treatment) will cause the brace to form around the body area as required for optimal treatment. Once formed the product will treat as required; massage, heat/cold therapy, vibrational therapy.

Individual Research

06-12-2023

Bora Sen - Product Concept for Cardiovascular Endurance, Lung Capacity

The importance of cardiovascular endurance, lung capacity, and health becomes significantly more impactful in people's daily lives and athletic pursuits as they age. The three concept designs you will see have been created with the aim of improving and maintaining these features of the human body for overall health. The final design is a culmination of the most crucial elements of these three products coming together.

VO2 max values, heart rate, and measurements such as the strength, frequency, and volume of breathing allow us to learn a multitude of information about the user's body. Through assessing these values, it is possible to determine the status of cardiovascular endurance and lung capacity and health.

Individual Product Requirements

1 Performance

1.1 Improve cardiovascular endurance
1.2 Improve lung capacity and health
1.3 Helps quiting breathing through your mouth.
1.4 Tracking data during the day

2 Human Factors

2.1 Easy and accessible to use.
2.2 Feedback on exercise progress

3 Enviroment

3. Suitable for daily use.

4 Size and Weight

4. Can fit in your cargo pant`s pockets.

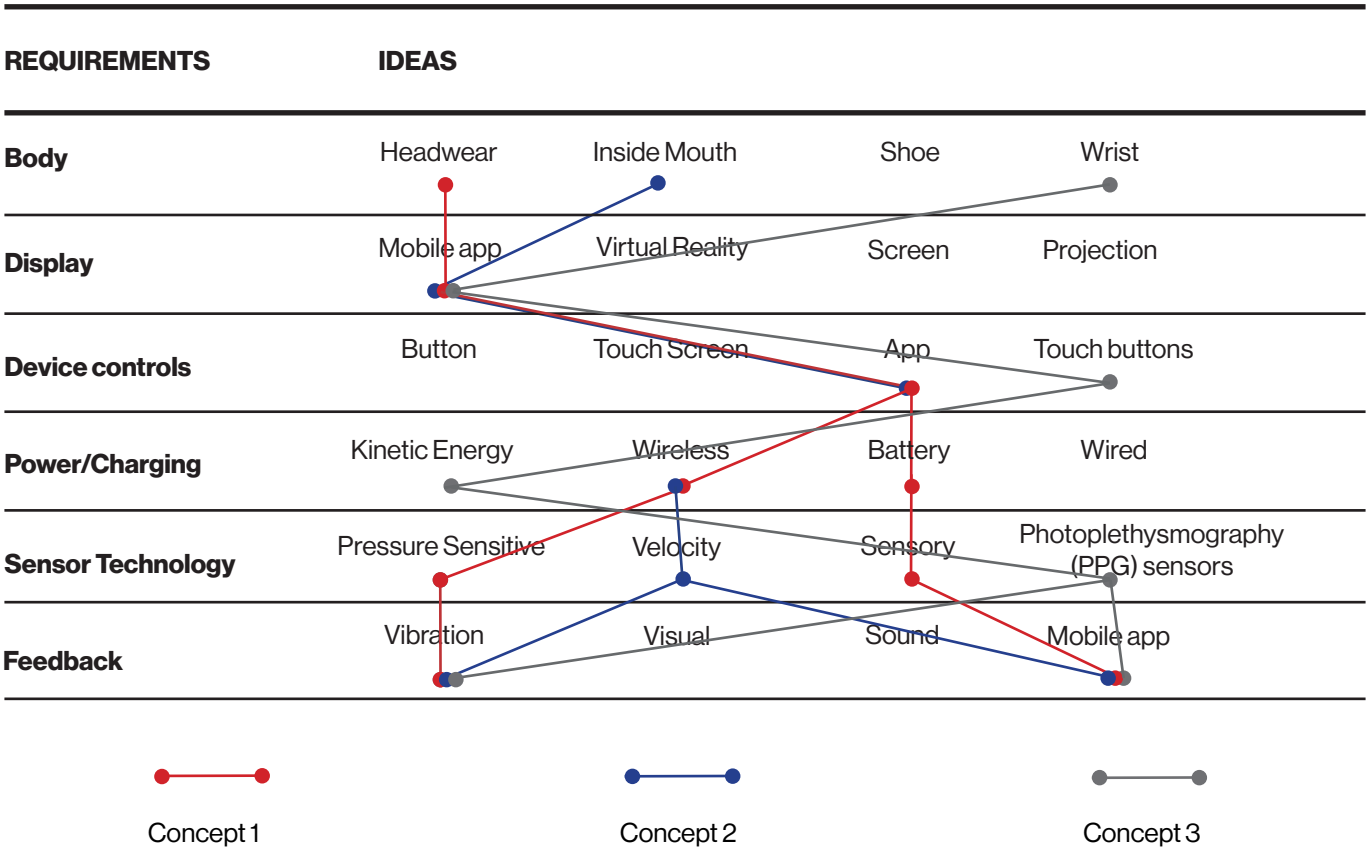
5 Maintenance

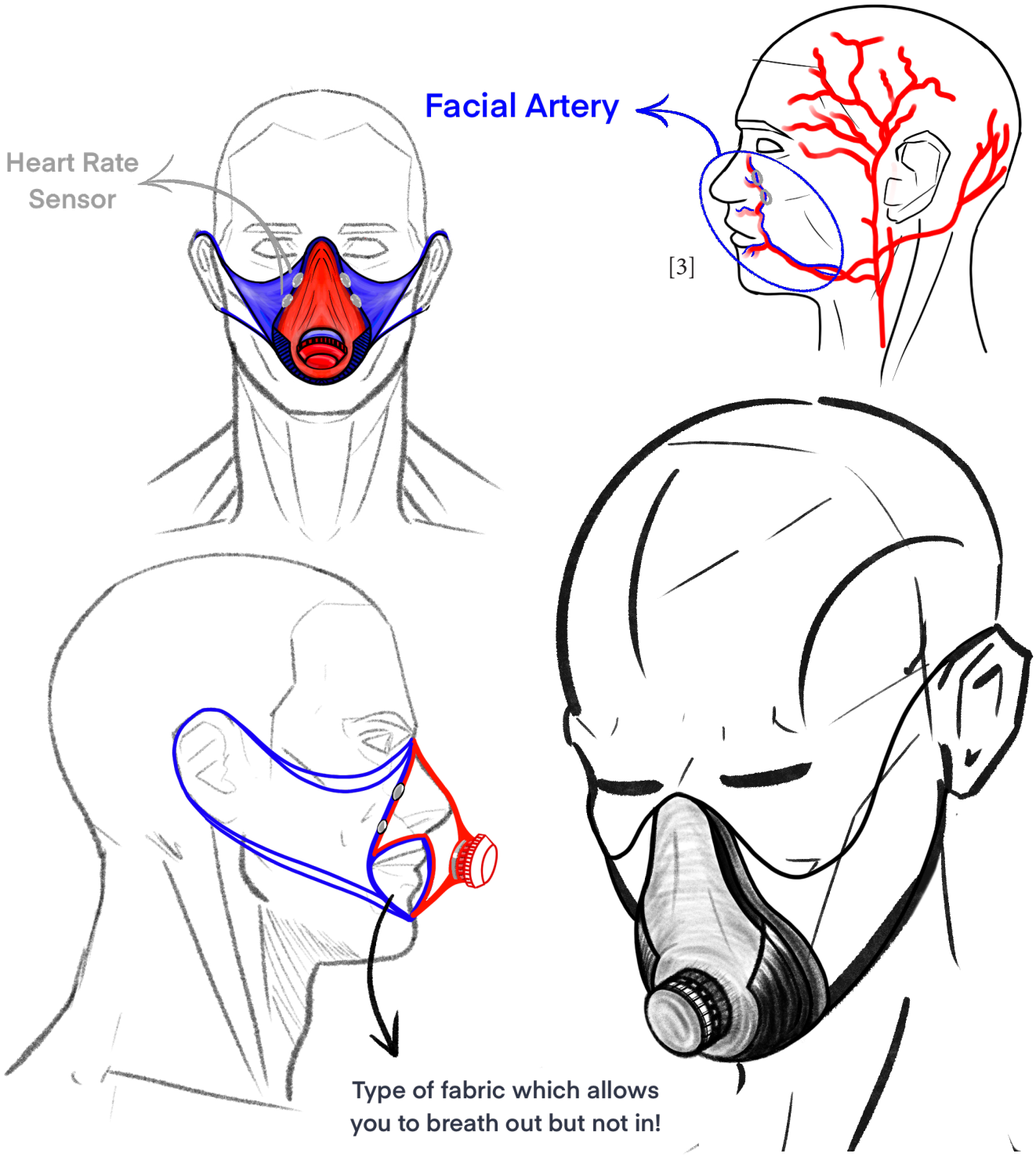
5.1 Little to no maintanence needed
5.2 Cleaning should be required for this device.
5.3 Cleaning should be required for this device.

6 Sustainability

6.1 Product should be designed for disassembly and it should not leave any waste behind.

Morphological Analysis





Concept 1

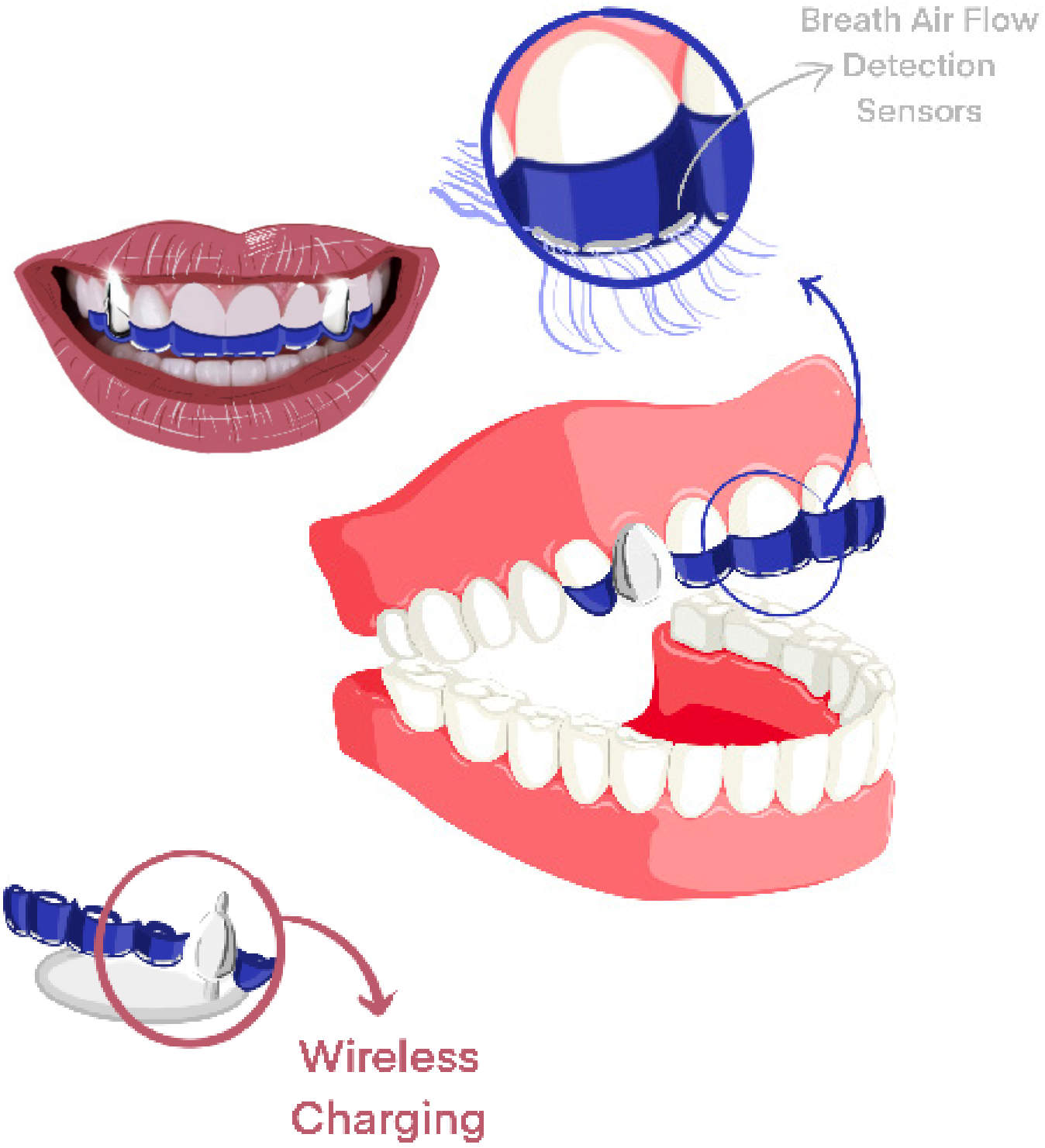
NASA

Individual Product Concept

06-12-2023

Bora Sen - Multi Purpose Breathing MASK

This mask is a multi-purpose mask which can measure your Vo2MAX levels, lung capacity, heart rate, lung health and performence of your lungs and heart when you are exercising. These datas let us determine user`s cardiovascular endurance levels and lung health and capacity. This mask also can restrict your airflow, which lets the user change their oxygen intake levels.



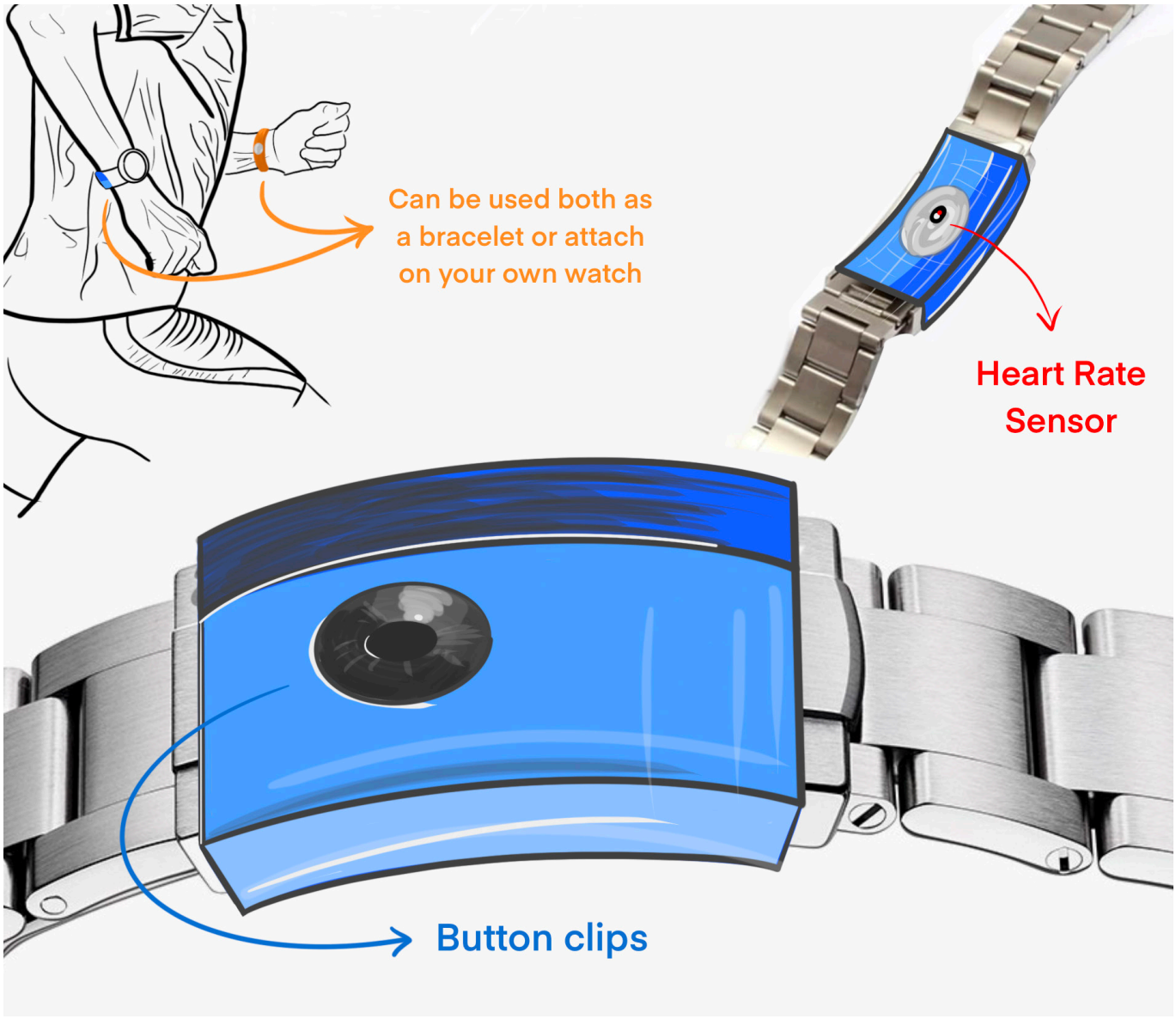
Concept 2

Individual Product Concept

06-12-2023

Bora Sen - Breath Measuring Grills

This smart mouthpiece can provide us with a multitude of data, including the user's breathing frequency, blowing force, breath volume, and values such as oxygen and carbon dioxide levels. Moreover, when the user breathes through the mouth, it can provide haptic feedback based on the user's preference, facilitating the habituation of breathing through the nose.



Concept 3

Individual Product Concept

06-12-2023

Bora Sen - One Fits All Heart Rate Sensor

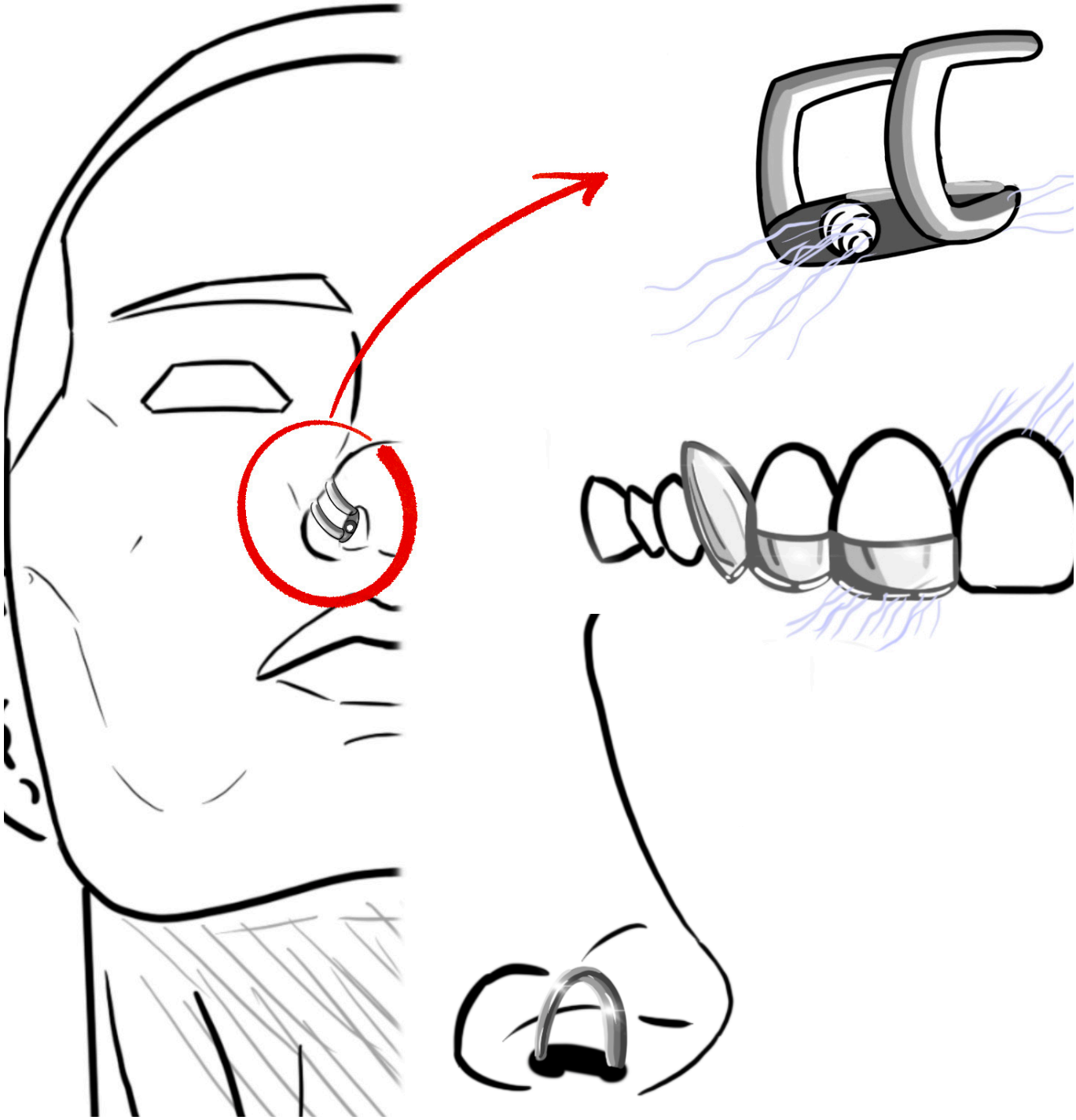
This heart rate sensor is designed in a different way from other sensors, allowing it to be easily attached to any watch.
This device, capable of providing us with all the data we can obtain from heart rate, will continue to be a favorite not only with traditional watches but also in the future for those who still do not wear smart watches or smart wristbands.

Matrix Evaluation

PRS	Concept 1	Concept 2	Concept 3	Final Concept
Advanced Technology	DATUM	+	-	+
Intuitive		=	=	=
NASA Brand Image		=	+	=
Simplicity		+	=	+
Inclusive		=	-	+
Timeless		=	-	+
		+2	**-2**	**+4**

As we can see, the second concept I created after the initial design is a significantly different product, incorporating advanced technology. This makes second concept a highly suitable design for this project.

Although I felt somewhat lacking in the third concept I developed, I believe that with the final design concept I recently created, I have reached the desired point. Combining best features of all three concepts.



Final Concept

Individual Product Concept

06-12-2023

Bora Sen - Smart Jewellery

These smart accessories can accomplish much more than their small size might suggest. With the piece attached to the nose, we can access a wealth of information related to heart rate and breathing. The teeth grill can measure a lots of data, ranging from the carbon dioxide in the user's breath to the frequency of their breaths. These measured data subsequently enable our application to provide the most accurate measurements regarding cardiovascular endurance and lung health capacity.

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