Appendix I: Updated Project Brief

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name	Adar
initials	E
given name	Michal
student number	4987071
street & no.	[redacted]
zipcode & city	[redacted]
country	[redacted]
phone	[redacted]
email	[redacted]

Your master programme (only select the options that apply to you):

IDE master(s): ★ IPD ○ DfI ○ SPD

2nd non-IDE master:

individual programme: - - (give date of approval)

honours programme: ○ Honours Programme Master

specialisation / annotation: ○ Medisign ○ Tech. in Sustainable Design ○ Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair	David Keyson	dept. / section:	HCD / DCC
** mentor	Renate de Bruin	dept. / section:	HCD / AED
2nd mentor			
organisation:			
city:		country:	

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair David Keyson date 02 - 03 - 2021 signature

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: NVT EC

Of which, taking the conditional requirements into account, can be part of the exam programme NVT EC

List of electives obtained before the third semester without approval of the BoE

(X) YES all 1st year master courses passed

( ) NO missing 1st year master courses are:

name J. J. de Bruin date 03-03-2021 signature JdB

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **. Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: (V) APPROVED ( ) NOT APPROVED

Procedure: (V) APPROVED ( ) NOT APPROVED

comments

name Monique von Morgen date 16/3/2021 signature

Initials & Name E Adar Student number 4987071

Title of Project Promoting Physical Wellebing in the Workplace

Promoting Physical Wellebing in the Workplace

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 01 - 03 - 2021

03 - 09 - 2021 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Whether it is from the office office or from the home office, creating a physical work environment is essential for both improving work performance as well as for physical and mental wellbeing of employees. But as jobs are becoming increasingly less active, and working-age adults are spending almost a third of their lives in the office, a majority of their time is now spent sitting at a desk. This time spent in sedentary behavior is increasing rapidly at a global scale, and this is expected to continue to do so without intervention (Mantzari, Wijndaele, Brage and Griffin, 2016).

With the average working-age adult in high-income countries sitting about 9.3 hours per day, sitting has now been deemed the new smoking, and this lack of physical movement results in adverse effects on health, wellness, and employee state of mind (Daum, n.d.; Mantzari et al., 2016). In recent years, the awareness of the effects of sitting has become a prevalent topic of discussion, with many new developments in the areas of adjustable desks, active furniture, and employers attempting to promote wellness strategies meant to create an overall health-enhancing work experience (Patel, n.d.). But even with these new developments, despite their initial enthusiasm, employees often forget or lack the continuous motivation to switch to a standing position, take advantage of active furniture, or get involved in on-site wellness classes, as they may have initially intended and wind up spending more time being sedentary (How Much Time Do Standing Desk Users Actually Stand at Their Desks?, n.d.; Renaud et al., 2020). Here, there is an important question posed: Why does this occur? What is the reasoning behind the user's inability to keep up this new practice, and are there alternative methods that can change this?

The sedentary lifestyle has become an important area of concern, and research suggests that if a person meets or exceeds the recommended daily physical activities, they can still be at risk for the adverse health effects if they continue to spend the day sitting (Mantzari, Wijndaele, Brage and Griffin, 2016). This means that it is imperative to find a way to alter the current office practices as this “sitting disease” has the potential to effect all working-age adults who spend their days sitting at their desk.

This project will look deeper into the practices and habits of working-age adults in high-income countries to determine why this lack of motivation occurs while in the office and the effects different stakeholders may have on it. The goal is to design an interactive solution that encourages the user to adopt long-term beneficial practices toward the development of their physical wellbeing while in their workplace, no matter where that office is.

Reference citations can be found on the following page.

space available for images / figures on next page

introduction (continued): space for images

References:

Daum, K., n.d. 25 Ways You Can Make Your Life Healthier in the Office. [online] Inc.com. Available at: <https://www.inc.com/kevin-daum/25-ways-you-can-make-your-life-healthier-in-the-office.html> [Accessed 9 February 2021].

Imovr.com. 2021. How Much Time Do Standing Desk Users Actually Stand at Their Desks?. [online] Available at: <https://www.imovr.com/how-much-time-do-standing-desk-users-stand-at-their-desks> [Accessed 9 February 2021].

Mantzari, E., Wijndaele, K., Brage, S., Griffin, S., & Marteau, T. (2016). Impact of sit-stand desks at work on energy expenditure and sedentary time: protocol for a feasibility study. Pilot And Feasibility Studies, 2(1). doi: 10.1186/s40814-016-0071-1

Patel, J., n.d. Five Trends Shaping Health and Wellness at the Workplace. [online] Corporatewellnessmagazine.com. Available at: <https://www.corporatewellnessmagazine.com/article/five-trends-shaping-health-workplace> [Accessed 9 February 2021].

Renaud, L., Speklé, E., van der Beek, A., van der Ploeg, H., Pasman, H. and Huysmans, M., 2020. The user and non-user perspective: Experiences of office workers with long-term access to sit-stand workstations. PLOS ONE, [online] 15(7), p.e0236582. Available at: <https://doi.org/10.1371/journal.pone.0236582>.

image / figure 1: References

image / figure 2: Sedentary Lifestyle Statistics Info-graphic from LifeSpanFitness.com

Initials & Name E Adar Student number 4987071

Title of Project Promoting Physical Wellebing in the Workplace

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

As the time spent in sedentary behavior, particularly at the office, is increasing globally and has proved to lead to various adverse effects on the health and wellbeing of working-age adults, it is imperative to determine why users are unable to keep up the long-term beneficial practices towards their physical wellbeing. The project will dive deeper into the context to develop an understanding of the current needs, goals, and behaviors of working-age adults in high-income countries while either at their office office or home office. By doing this, a deeper comprehension can be gained into the reasons behind the lack of continuous motivation to switch to more physically beneficial work practices, such as standing at their desk or getting involved in on-site wellness programs, and a solution can be generated to help move away from these behaviors.

The initial scope of the assignment will focus on work-age adults in high-income countries whose jobs entail working at a desk for most of the day. The project will place an emphasis on the research and synthesis phases of the design process and the end result shall consist of a developed concept.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

This graduation project will focus on the research necessary to understand the needs, goals, and behaviors of working-age adults that lead to their constant sitting and lack of motivation to improve their physical wellbeing while in the office. Through this research and setting an idea of "what could be," the project aims to develop an interactive solution to motivate users towards the long-term improvement of their physical wellbeing..

To ensure the project falls within the scope and IPD specialization, a focus will be placed on creating potential alterations or additions to the physical environment of the workplace. The final solution should be a physical product or range of products capable of being implemented into the employee's workplace (whether that is the office office or home office). A special emphasis will be placed on optimizing the user experience of the concept.

The structure of this graduation project follows an agile design approach based on a cyclic process of analyzing, designing, prototyping, testing, and refining the product. This will be combined with aspects of the Self-Determination Theory and Hooks Model of Habit Formation to design an interactive solution aims at motivating users towards this ideal future and their ability to develop long-term physical wellbeing practices at their workplace

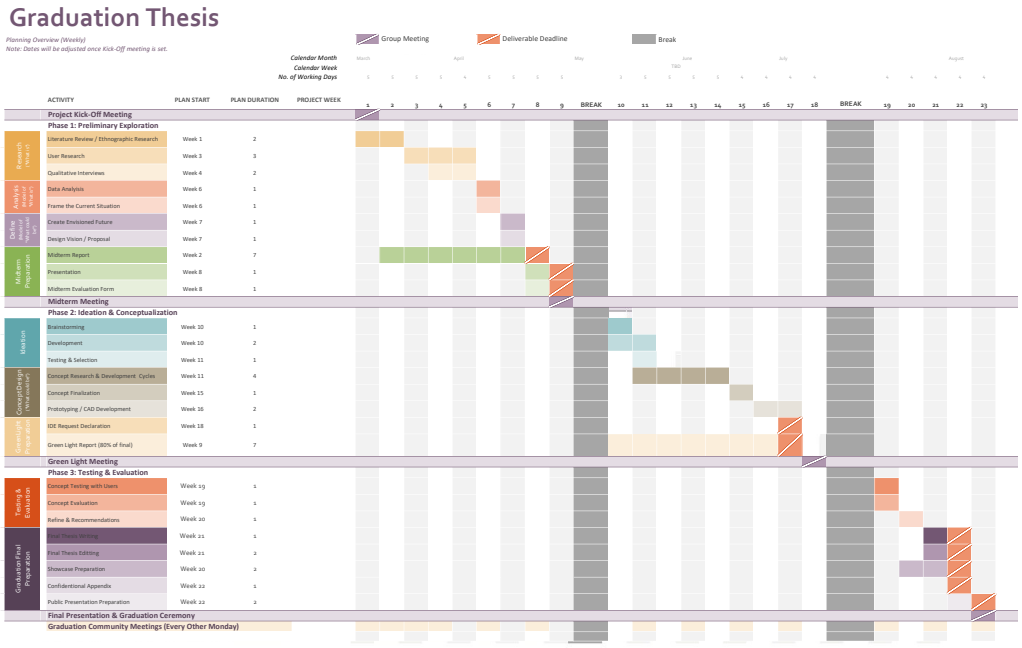
Initials & Name E Adar Student number 4987071

Title of Project Promoting Physical Wellebing in the Workplace

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 1 - 3 - 2021 3 - 9 - 2021 end date



From Kick-off Meeting to Midterm Meeting (40 days):
The first 40 days of the project will be focused on gathering in-depth research on the users and other stakeholders involved to develop a deep understanding of what the current situation is. This will begin with a literature review of the research and information that already exists. During this time (2 weeks), I will also look more deeply into the Self-Determination Theory to ensure that I understand its different aspects. Next, as the user is at the center of the design process, user research involving context mapping and interviews will be prepared and done. Insights from the research will then be formed into factors and clustered to provide a story/model about the current situation. At the end of this period, a week will be allotted to create a story/vision of the ideal future, or what could be.

From Midterm Meeting to Green Light Meeting (40 days):
The next phase of the design process will involve the synthesis of the solution. During this phase, brainstorming will be done to develop various ideas. The top ideas will then be developed upon and a final idea will be selected. In the next few weeks, this idea will be transformed into a concept through a research and development cycle. To determine the areas of focus for the cycle, the initial idea will be broken down into its different components. Once the concept is developed, depending on the concept, a prototype and CAD model will be created. By the end of this phase, the project should be at around 80% complete.

From GreenLight Meeting to Graduation (20 Days):
The final 20 days will be used to conduct concept testing and evaluation with users and to develop the necessary recommendations for moving forward with the project. This period will also be used to finish writing and finalize the thesis report, appendices, showcase, and public presentation.

Initials & Name E Adar Student number 4987071

Title of Project Promoting Physical Wellebing in the Workplace

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

Before starting my masters at TU Delft, I was working as a mechanical engineer. While in this field, I began to realize that although my projects were meant to improve the lives of people, they did not take people into account. This is why I applied to study Integrated Product Design at TU Delft. I wanted to learn how to incorporate the user at the center of the design process to ensure that their wants and needs are the core of my solutions.

During my study in integrated product design, I found that my desire to design to improve the lives of people was further enhanced and that I could use design solutions that improve upon both the everyday and occasional experiences to promote their physical, emotional, and cognitive wellbeing. Throughout my study and projects, I have developed a deeper understanding of how to do this. Unfortunately, due to the current Covid situation, the practice of user research, specifically user testing, was hindered. Through this project, I hope to be able to further develop my expertise in this area by applying extensive practical research. I also want to prove my ability to create a well-designed and working concept that provides users with the intended interactions and experiences.

Through this project, I also hope to learn how to integrate the Self-Determination Theory into my design process as a means of providing users with the tools they need to motivate themselves towards a more positive and healthy lifestyle.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Initials & Name E Adar Student number 4987071

Title of Project Promoting Physical Wellebing in the Workplace

Appendix II: The Workspace

THE WORKSPACE - PROS AND CONS

Open Office

An open office consists of employees working in a single room, either sharing tables or working at independent desks in an unrestricted space. This office layout has been popular in the start-up scene and many big corporations have adopted this design as well.

- \+ Affordable
- \+ Flexible
- \+ Less Restrictive
- \+ Encourages communication
- \+ Egalitarian
- − Lack of Privacy
- − Distractions
- − Spread of germs

Source: (Thompson, 2019)

Cubicles

Cubicles are partly enclosed workspaces with high walls to separate each worker from those around them.

- \+ More private
- \+ Easier to focus
- \+ More room to work
- \+ Personalized work space
- − Can be isolating
- − Requires more space
- − Breeds less interaction

Source: (Office Furniture, 2021)

Page Citations: (Business News Daily, 2020); (Taylor, 2017)

Source: (business.com, 2019)

Hoteling / Shared Office

Hoteling, or shared offices, consists of a system of unassigned seating where employees frequently change work spaces. This is popular in companies where employees often work remotely and don't require a permanent workspace. This way they can shift based on who is in the office on a given day.

- \+ Saves money
- \+ Encourages collaboration
- \+ Changes scenery
- − Confusing
- − Less personal

Source: (Coworker, 2017)

Co-Working Spaces

Co-working spaces usually involve a few people sharing an office or a desk. This layout is similar to that of an open office, but creates a sense of compartmentalization for specific tasks and groups, rather than keeping each employee in a single space.

- \+ Fosters camaraderie and collaboration
- \+ Semiprivate
- \+ Organized
- − Can be distracting
- − Not private enough
- − Not everyone likes a shared space

Source: (Quill LincolnShire, 2021)

Low Partition

This office layout is similar to that of a cubicle, but the walls are low enough to peek over. This is open enough to provide the ability for employees to speak to each other yet separate enough to help employees feel like they have control of their workspace.

- \+ Defined individual work space
- \+ Semiopen communication
- − Noise
- − Lack of Privacy Distractions

Source: (PeopleImages / Getty Images, 2020)

Home Office

The home office is a remote method of working where the employee works from his or her home or a workspace remote from their company's office.

- \+ Schedule flexibility
- \+ Privacy
- − Lack of "professional space"
- − Limits camaraderie and collaboration
- − Lack of boundaries

Appendix III: The Different Types of Motivation

Types of Motivation & Regulation

Nonself-Determined ← → **Self-Determined**

Motivation	**Amotivation** a state in which there is a lack of intention to act. It described the extent to which a person feels ineffective, without purpose, or internally resistant toward an action		**Extrinsic Motivation** Extrinsically motivated behaviors can vary in their degree of self-determination. If the motivation is autonomous, it is characterized by engagement in activities out of a sense of interest, value, and volition.			**Intrinsic Motivation** the most autonomous form of motivation and is the driving force behind engagement in activities out of genuine interest and enjoyment
Regulatory Styles	**Non-Regulation**	**External Regulation** the most controlled form of motivation where the person is driven by externally controlled contingencies such as rewards and punishments rather than values and interests	**Introjected Regulation** Controlled motivation is reflected in behaviors that are governed by various forms of coercion and external pressure. Described engaging with activities because of an internalized sense of compulsion, pressure, towards standards, or self-esteem contingencies	**Identified Regulation** an autonomous form of motivation that described willing engagement in an activity because it is accepted as valuable and worthwhile, even if it is not enjoyable	**Integrated Regulation** the most autonomous form of extrinsic motivation. Integration occurs when identified regulations are fully assimilated to the self, which means they have been evaluated and brought into congruence with one's other values and needs. they are done to attaining separable outcomes rather than for their inherent enjoyment	**Intrinsic Regulation**
Perceived Locus of Causality	**Impersonal**	**External**	**Somewhat External**	**Somewhat Internal**	**Internal**	**Internal**
Relevant Regulatory Processes	Non-intentional, non-valuing, incompetence, lack or control	Compliance, external rewards and punishments	self-control, ego-involvement, internal rewards and punishments	Personal importance, conscious valuing	Congruence, awareness, synthesis with self	Interest, enjoyment, inherent satisfaction

Organismic Integration Theory (OIT)

OIT details the different forms of extrinsic motivation and the contextual factors that either promote or hinder internalization and integration of the regulation of these behaviors (extrinsically motivated behaviors are performed to satisfy an external demand or reward contingency)

Cognitive Evaluation Theory (CET)

- framed in terms of social and environmental factors that facilitate versus undermine intrinsic motivation
- the social-contextual events that conduce toward feelings of competence during action can enhance intrinsic motivation for that actions
- the feelings of competence will not enhance intrinsic motivation unless accompanied by a sense of autonomy
- people must not only experience competence of efficacy, they must also experience their behavior as self-determined for intrinsic motivation to me in evidence

Appendix IV: User Research Setup and Results

USER RESEARCH: THE WORKING ADULT

Study 1: Auto-ethnographic Research

The auto-ethnographic study consisted of a self-study occurring over the course of three weeks. In the study, I assessed my own experiences using the sit-stand desk in two scenarios:

Working Alone
Working with coworkers in the room (some used the sit-stand desks and some did not.)

This study allowed me to get better acquainted with sit-stand desks and to better understand what the participants who I interviewed may be experiencing.

Method

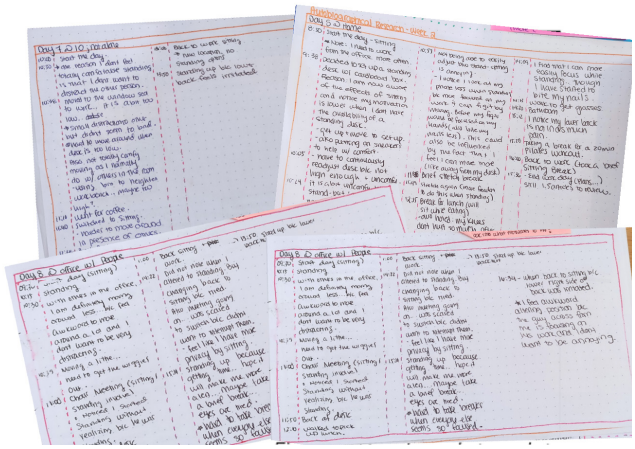
The study involved documenting my sit-stand transitions, observations, and feelings over the course of the day for three weeks. Insights of my experiences were recorded by hand using a basic template consisting of the day, the scenario, and the time of each written note. The note taking generally began between 08:45 and 10:15, depending when I started my workday, and typically finished around 17:00, when the workday was complete.

Participants

For this study, I, as the designer, was the only participant.

Equipment

Throughout the study observations and experience notes were recorded in notebooks on hand-made templates.



Procedure

Step 1: Arrive at destination of work. This was often either my home office or a desk on the TU Delft campus.
Step 2: Set-up materials (notebook and pen) and draw out basic template.
Step 3: Execute research study (take notes on sit-stand transitions, observations, and feelings throughout day)

Results

Week 1:
- Research was the initial reason I started to stand.
- Transition between sitting and standing seems to relieve some discomfort and fatigue
- I initial attempted to adjust position every 20-30 minutes (based on research), this was difficult and broke my concentration

- Standing led to a desire/inclination to move around more
- After a few days, I became more conscious of the pains in my body that occur when sitting for too long.
- I kept forgetting to stand (too focused on work), so I created a reminder that when off every 30 minutes
- On days that I did not stand enough, I felt guilty – not because it is good for me but because I know I should be doing it

Week 2:
- Trying to stand more often as I become more aware of the adverse effects from prolonged sitting
- Altered my shoes to sneakers so that standing was more comfortable
- I notice I look at my phone less often when standing
- Started taking stretching breaks while standing (I don't think this as often when sitting)
- Starting to find out that I am able to focused better when standing (gradually adjusting)
- Sometimes I use breaks (like coffee) to transition my desk
- I am noticing that my lower back is in less pain now that I am transitioning my position more often
- I feel more alert and energetic while standing
- Although I still need reminders, I am able to better adjust now according to how my body is feeling
- When at the office, I don't stand as often because I feel like I will distract my peer
- Not as comfortable to move around while standing when there is another person there

Week 3
- I am definitely more aware of my body now
- I find I stand up more often right after lunch because it helps with my energy levels
- There is another person who uses the sit-stand desk at the office, it helps to remind me to stand up
- If I don't stand I often feel guilty when seeing the other person stand
- The more I use the sit-stand desk the less uncomfortable I feel (less feelings or care of distracting others since they dont seem to be distracted)
- I have noticed that when I am standing, others in the office feel freer to talk to me (even if they are not standing)

Study Limitations

The findings of these studies provided me with insights to what potential users are experiencing in their day-to-day workplace sit-stand desk use. The study was limited as it was biased since I am the designer and some of the days I did not have access to an electric/manual sit-stand desk but built one using cardboard boxes.

Study 2: Online Questionnaire

Prior to the interviews, a survey was sent out to potential participants to determine whether they qualified for the research study. To qualify, participant were required to conduct desk-based work for at least 6 hours per day and have had access to a sit-stand desk for a last three months. The questionnaire also asked questions aim at gaining insights to the participants work experience and access to elements meant to promote their physical wellbeing at the workplace.

Method

Research questions were selected and arrange an order starting with broad questions transition to more specific questions.

Participants

Overall, 11 of the 18 participants who filled out the survey qualified for the interviews. These individual ranged from avid sit-stand desk users (standing for at least 50% of the day) to those who rarely or never used the standing feature of the desk (standing for a maximum of 10% of the day).

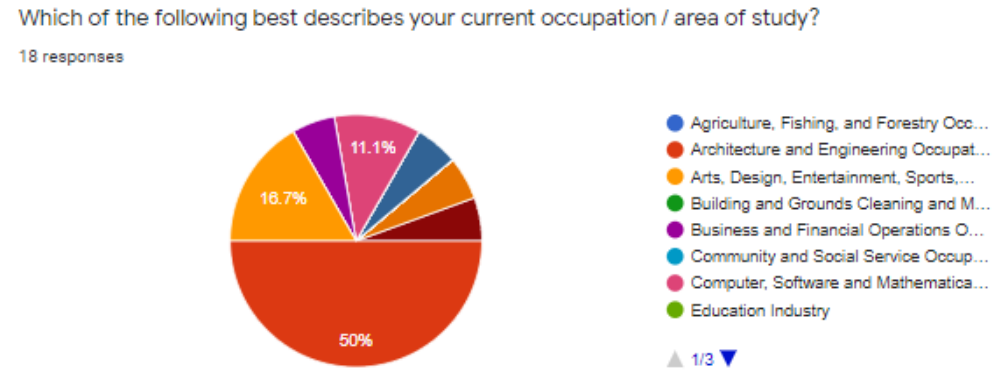
Participants were working adults falling within the age range of 21 - 45 years old. Each participant was a desk-based working living either in The Netherlands, the United States, or Israel. These participants were selected as I had many contacts in these three countries. Participants were also selected based on a diverse background with the aim to gain participants with various backgrounds in occupation and roles in the industry.

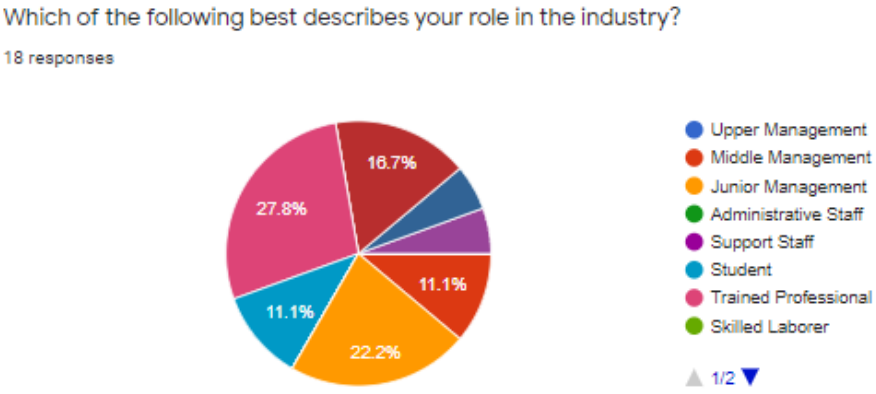
Equipment

For the Online questionnaire, Google Forms was used.

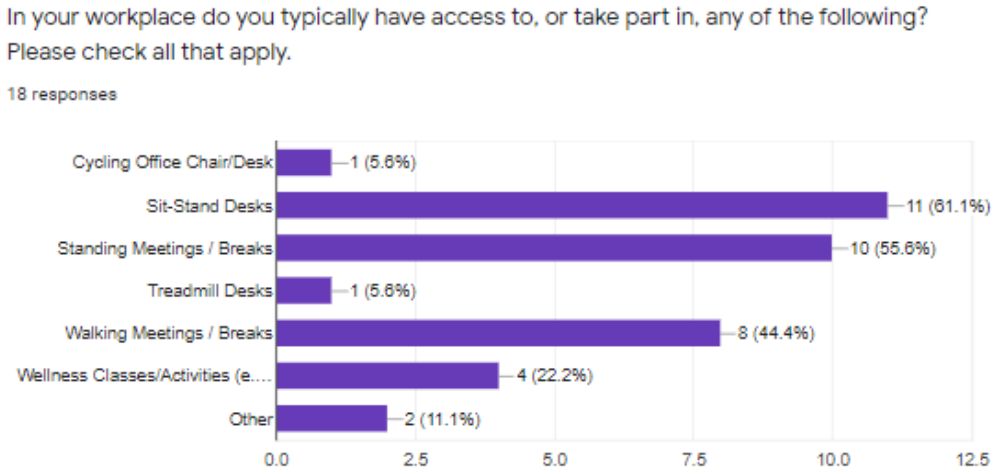
Results

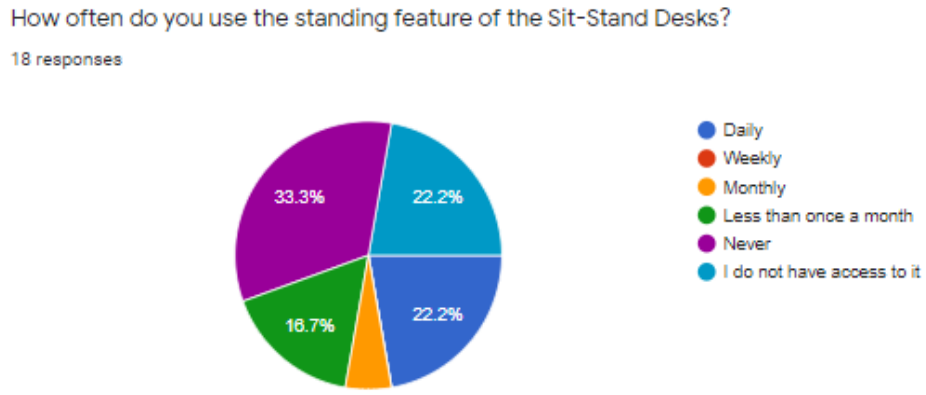
Demographic Information





Typical Work Experience & Access to physical wellbeing elements





Study Limitations

This study included a sample size of 18 adults, 11 of which had daily access to sit-stand desks. The study is limited by a relatively small sample size consisting of working adults who were well-known by myself. Therefore, it may not provide an accurate overview of a diverse population of working adults and their experiences.

Study 3: Interviews with Working Adults

The goal of this research study was to better understand the current user experience and interaction with their sit-stand desk and to see what their perceived barriers and facilitators are towards using it. The study is aimed at looking at users who both use the standing feature of the desk often as well as users who do not. By doing this, the goal is to understand the differences in the views of the desks as well as the environment in which they are used.

This study was broken up into two parts in the report. The first part looks specifically at users who have access to sit-stand desks and have low to no utilization. This part of the interviews was meant to verify the barriers that these working-adults face towards using their sit-stand desks. The second part involved working-adults who have moderate to high utilization of the sit-stand desks. This part of the interviews was meant to look that what facilitators help these users to use the desks as much as they do and which aspects can be used to help those who have low to no utilization levels.

Method

Face-to-face interviews were used to better understand the working adults' experience with their sit-stand desks and to verify the conclusions created based on the literature analysis. These interviews provided new insight to user opinions, motivations, and behvaiors concering their use of sit-stand desks and what factors contribute to it.

Participants

Overall, 11 of the 18 participants who filled out the survey qualified for the interviews. These individual ranged from avid sit-stand desk users (standing for at least 50% of the day) to those who rarely or never used the standing feature of the desk (standing for a maximum of 10% of the day).

Participants were working adults falling within the age range of 21 - 45 years old. Each participant was a desk-based working living either in The Netherlands, the United States, or Israel. These participants were selected as I had many contacts in these three countries. Participants were also selected based on a diverse background with the aim to gain participants with various backgrounds in occupation and roles in the industry.

Equipment

Each interview was held online using Zoom. l interviews were recorded upon vebral acceptance of the user.

A tempate (see page later on) was created as a base for the interviews, including a brief introduction and the interview questions.

Otter.com was used to transcibe all the interviews.

Procedure

Step 1: Start Interview with particiant

Step 2: Provide breif introduction to the thesis project and a general overview of what the

interview will cover:

"One of the leading workplace trends today is the focus on employee wellbeing by their employers. This emphasis falls primarily within the areas of psychological wellbeing and physical wellbeing. One of the key ways employers are attempting to promote physical wellbeing in the workplace is through the installation of sit-stand desks for their employees. But even though they are doing this, research shows that many employees, including those who initially desire the desks for personal reasons, are not using the desks and are sitting more than they may have initially intended. The goal of my research is to better understand the interaction working-age adults have with their sit-stand desks and why they may not be using their desks in the standing position."

Step 3: Ask user for coent record the interviewLet them know that the recorder will only be used for analysis purposed and no images or names will be used in the final report. *Start recording upon consent.*

Step 4: Conduct Interview based on the preset questions:

PreQuestion: What kind of Sit-Stand Desks you have? (Electric/Manual)

Question 1: Why did you first get your sit-stand desk? (your choice, installed by employer, etc.) How often do you use your desk (per week? Per day?)

Question 2: What do you like about your sit-stand desks? What don't you like?

Question 3: How often do you use your desk in the standing position? Why do you think you don't use it in this position? (What are the barriers – think environment, objects around you, people around you, etc.)

Question 4: When / if you use the desk in the standing position, what is your reason for this transition?

Question 5: What do you think you would need to promote or encourage you to use the desk in the standing position more often? What would be your ideal scenario to do this?

Step 4: Following interview with a breif discussion on the topic.

Step 5: Upload voice recording to Otter and transcribe the document.

Data Analysis

To best analyze the results, a clustering method was used to group the data gathered from the participants into correlated categories of facilitators or barriers. In this case, if multiple participants mentioned something then the data from each participant was clustered together to form a category or opportunity for consideration.

These clusters were then categorized based on the levels of physical, social, psychological, and behavioral.

Results

An overview of the results and the clusters are presented below. An additional figure is included at the end to present the facilitators and barriers and the commonilty of each being mentioned. This commonality is presented based on the size of the circle. As the circle becomes larger in size it means that the factors was mentioned by more participants.

Worry About Distracting Others
- Users feel uncomfortable to raise and lower their desk because of the noise:"When the desk is noisy I don't want to disturb people, so I use it less"
- The up-down transition may be distracting to others: "I fear I will disturb my coworkers when transitions the desk..."

Office is not adapted to accommodate desks
- The cords for electronics are too short when desk is raised: "If you want the functionality, you have to order special chords."
- The chair can be in the way: "If I cannot move my chair out of the way, it is problematic"

Fear of decreased productivity
- Fear that standing will lead to a decrease in productivity: "can not be 'in the zone' when standing"
- Sitting is better for harder work: "I want to be sitting for more tedious work," "When I sit I can be more focused and productive."

General Poor Desk Design
- Not designed for all dimensions: "If it is personalized and it is not your own, its annoying because it is not adjusted to your height."
- Too long and annoying transition: "Switching back and forth between sitting and standing gets annoying." "It takes too long to make the transition."

Sitting feels more relaxed
- Sitting feels more relaxed and allows for greater focus: "Sitting feels more relaxed and then I can focus on reading and not have to support myself."

Transitioning interrupts work-flow
- Transitioning between sitting and standing results in a break in concentration: "When I am focused and sitting, it is disturbing to have to switch to standing and it breaks my work flow."

Increased Visibility & Psychological Discomfort
- Increased visibility of self: "I would feel awkward being the only one standing."
- Increased visibility of screen: "I always feel self-conscious when someone walk behind me and sees my computer."
- Increased visibility of Others: "there are no walls in the open office, you see everything" "sometimes I feel awkward standing and looking over my co-workers."

Static Company Culture
- If no one uses it, it becomes more difficult to be the first: "there is a perceived pressure to stay sitting." "Only 2 people in my office use the desks so I am sure they feel weird."

Sitting is a habit
- Sitting is a habit that environments are designed for: "sitting is just easier and once you are accustomed to it, using the desk seems annoying"
- Forgetting to transition to standing: "the hardest part is remembering to use it since you are working and may be really focused."
- Altering position can be tedious: "standing is probably the most important posture but also the most annoying to get to"

Lack of Knowledge / Awareness
- Unaware that PA does not compensate for sedentary behavior: "I was biking to work so I felt like I was getting a good amount of daily activity"
- All-or-nothing mentality: "I switch to sitting for comfort.. I was never good at standing for 8 hours"

- Belief that good standing posture is harder to achieve: " I think it is harder to stand in good posture when you are standing for work."

Discomfort/Fatigue from Standing
- Standing is initially uncomfortable: "standing would make me tired and lead to physical discomfort"
- Sitting is more comfortable: "I feel extremely comfortable sitting down and I never felt the need to alter my desk height"

Lack pf Follow Through from Management
- No following through from management: "there is no follow through.. its like buying a sit-stand desk is a magic bullet for fixing office sedentarism"

Facilitators

Standing /Changing Posture Reduces Discomfort
- Changing posture reduces discomfort: "I have back problems so it definitely helps to stand"
- Aware that changing posture is important: "I think I sit a lot during the day so it is important to have many different postures"

Standing allows for spontaneous movement
- Standing makes it easier to step away from desk: "If I am standing, I walk around my office more and sometimes just walk in circles for a minute."
- Standing makes it easier to move: "I feel like I can be a bit more dynamic when I stand."

Increased productivity / focus
- Increased productivity/focus while standing: "If I am worried abouta lot of stuff I have to do, standing sometimes makes me feel like I am more engaged"
- Standing is better for more alert work: "I would rather be standing for things I need to be more alert for like presentations and meetings."

Proper Design allows for ease and convenience
- Smooth transition: "My desk allows me to easily transition from sitting to standing without having to move my stuff."
- It is good as it is: "I don't think I would change anything"

Task-Oriented Reasons
- Task-Oriented Transitions: "I do different tasks when standing than I do when sitting"
- Altering desk-height when taking breaks: "I think it would be easier to alter my desk height when I take a break so it doesn't break my concentration."

Standing Increases energy and Mood
- Standing increases energy: "I feel like I am a little bit more energetic when I am standing"
- Standing enhances mood: "I also feel motion changes, like my mood gets better"

Body Cues lead to adjustments
- Body Cues for transitions: "Now I notice the pains from sitting more, so I can use that as an indication to standing"
- Greater consciousness of body with sit-stand practice: "I did feel the pains before using the desks, but maybe now I am definitely more conscious of it now"

Peer Support
- Others act as a reminder: "If others didn't use the desk, it might take me longer to use it because I wouldn't think about it as much."
- Positive support from co-workers: "I wouldn't have been putting it up myself if no one else was doing it before." "what converted me was that I saw some of my coworkers lead by example"

- Influence of supervisors: "...
- Lack of social pressure: "there is no social pressure, people can see me standing, but it never really occurred to me that someone would find it weird."

Decreased Workplace Visibility from Others
- Access to privacy potentially results in increased use: "when I am alone in the office, I use the desk in the standing position more often."

Active Company Culture
- Standing is normalized: "better when standing is normalized in the office"
- Active Company Culture: "Using the standing function of the desk and being active is part of the company culture."

Gradual Change
- Gradually getting adjust to working in the standing position: "In the beginning, I had a hard time altering my design height because I felt it affected my productivity, but as I got more used to it, it became easier"
- Gradually getting adjusted to physically standing: "I knew I could just stand all the time at first, so I started small (2 or 3 transitions during the day) and then built up from there"

Standing is like changing scenery
- Standing feels like a change in environment: "Kind of like changing the environment and somehow it keeps you going." "When standing, you are like conceptually changing your environment since you change your view of it."

Positive Influence of Hierarchy
- When boss or supervisor uses it, it influence the working adult: "My boss is actually the guy who I saw using it and then I decided to use it more"

Feelings of Guilt
- Guilt from not using it: "I bought the desk for myself, and now there is a guilt feeling where I am not doing it but I feel like I should be doing it"

Summary

The Key Barriers:
1. Sitting is a habit, so it is easy to forget to change
2. Working in a static environment and lack of support and use by coworkers
3. Psychological discomfort at being the only ones to use it
4. Fear of decrease productivity / standing only works for certain tasks
5. Lack of awareness of how to best utilize the sit-stand desks.

The Key Facilitators:
1. Body & Mind Indicators (physical & psychological benefits)
2. Task-Based Transitions
3. Social Support
4. Reminders

Study Limitations

This study included a sample size of 11 working adults who had access to their sit-stand desks. The study is limited by a relatively small sample size consisting of working adults who were well-known by myself. Therefore, it may not provide an accurate overview of a diverse population of working adults and their experiences. In addition, many of the adults were currently working from home due to the Covid restrictions set in place. This could potentially skew the results of they survey as they analyzed their current experiences rather than there experiences of working with a sit-stand desk in the open-office environment.

User Interview Responses

Facilitators

Physical (Internal)

- Reduction in Discomfort
- Body Cues lead to adjusting posture
- Standing makes it easier to move around
- Increased awareness of body pains

Physical (External)

- Access to privacy when using desk
- Easy & Smooth Transition

Social

- Standing is normalizated
- Increased social interaction
- Coworker utilization of desks (support / influence)
- Active Company Environment
- Common use by supervisors

Psychological

- Improves energy & mood
- Feelings of Guilt
- Increased Productivity / Focus
- Feels like a change of scenery

Behavior

- Task-Oriented Transitions
- Knowledge of need for gradual adjustment
- Making transition during breaks

Barriers

Physical (Internal)

- Discomfort / fatigue from standing
- Have all-or-nothing mentality
- Sitting is just more comfortable

Physical (External)

- Too long and annoying desk transition
- Office is not adapted to accomodate desks
- Poor Desk Design
- Transitioning interupts work flow

Social

- Static company culture
- Lack of follow-through from management

Psychological

- Worried about disturbing others
- Increased visibility of others
- Increased visibility of screen
- Increased visibility of self
- Fear of Decreased Productivity / Focus

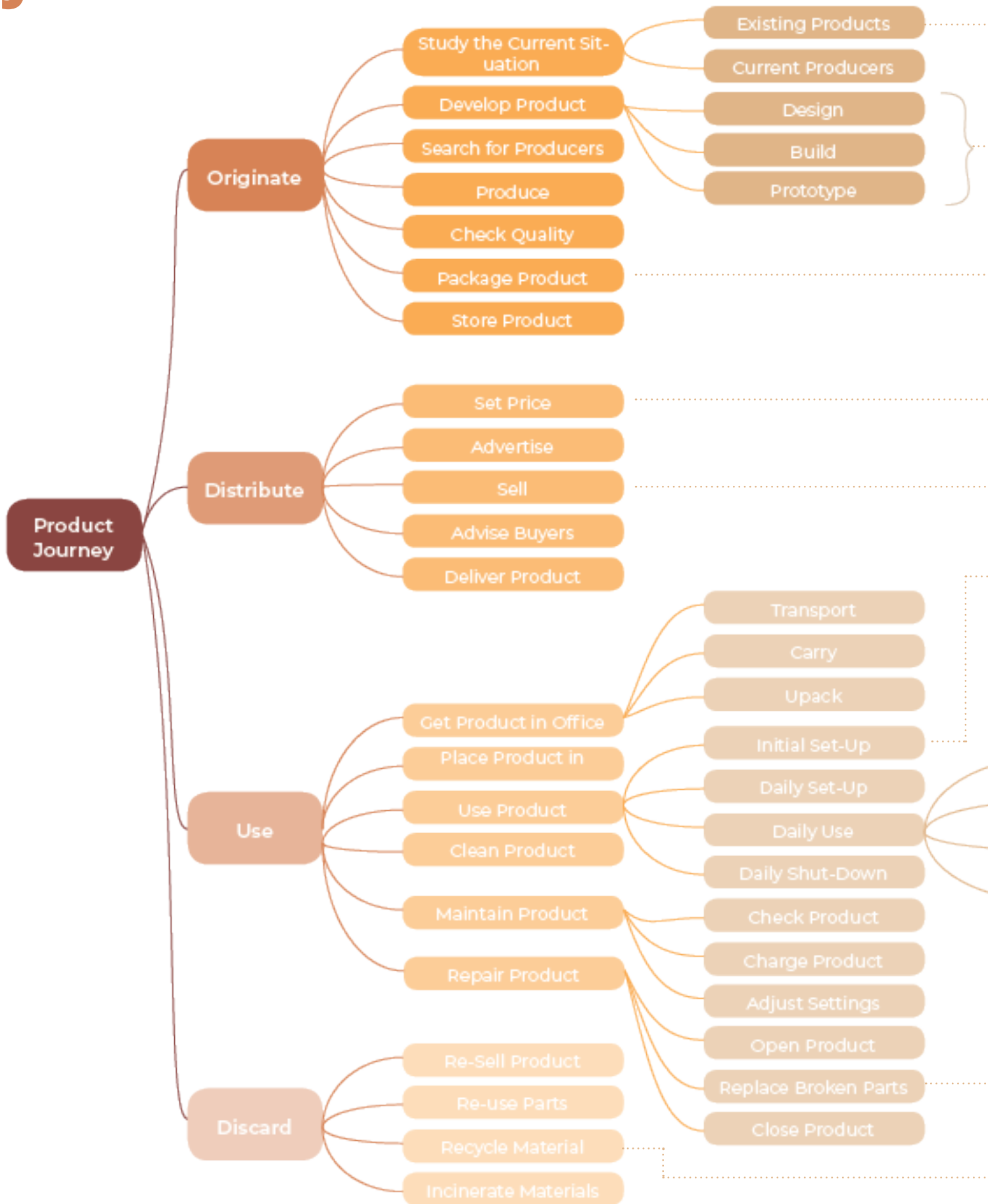
Behavior

- Sitting is a habit
- Forgetting to change position

Figure: Overview of Participant Results. Note: The larger the circle the more often the factor was mentioned by participants.

Appendix V: Product Journey Map

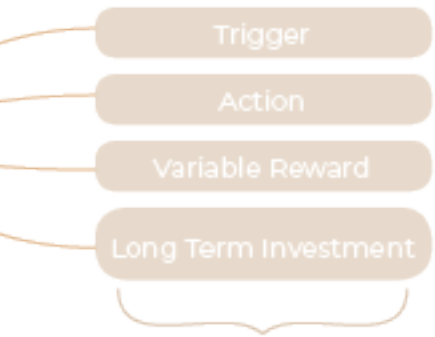
PRODUCT JOURNEY MAP



Inspired by The Delft Design Guide

REQUIREMENTS

DESCRIPTION	DEMAND/WISH
The final solution shall be unique and innovative	Wish
The final solution shall be built and prototyped within the project time frame	Demand
The final solution shall be easily packaged and stored	Demand
The final packaging should (re)usable for personal product transport (hybrid)	Demand
The final solution shall be affordable to both the employer (on a business level) and the employee (on a personal level)	Wish
The final solution should be appealing to the user	Demand
The final solution shall be easily installed/integrated into the workspace	Wish
The final solution shall not require closing of any part of the office for construction	Wish
The initial set-up/installation (on computer) should be relatively quick (e.g. ~ 10-15 minutes)	Demand
The final solution shall be easily accessible by the user (e.g. an arm length away)	Demand
The final solution shall be simple and easy to use/comprehend	Wish
The total daily interaction with the product should not take away from user's work time (e.g. max 15 min/day)	Demand
Should be able to automatically converse energy when not in use	Demand
Should be able to charge while in range of user's workstation	Demand
Should be able to be easily taken apart and repaired with common parts	Demand
Should be made of sustainable materials that can be re-used or recycled at end-of-life.	Demand



Hook's Model for Habit Formation

Appendix VI: Idea Evaluation Setup and Results

IDEA EVALUATION & TESTING

Research Objective

Phase 1:
To test the three key sit/stand facilitators and see which provided users with the best experience and support in the sit-stand practices.

- Social Support – the facilitator that promoted the use of sit-stand desks by most of the moderately active and highly active users
- Body & mind cues – the reason that most highly motivated users continue to use the sit-stand desks and base their decision to transition between positions.
- Task-based transitions – the most often suggested means of altering the desk from the low active and not active sit-stand desk users

Phase 2:
To conduct a product concept evaluation and itemized response to evaluate the three initial concepts and determine which features should be combined in the final product.

Method

Participants

Nine IO master students participated in the study. These participants were used as they were allowed into the IO faculty and also fell into the category of users who rarely used sit-stand desks in the standing position. Some of the students had common access to the desks and some did not.

Schedule

Concept		Group 1 - Social Support		Group 2 - Task-Based		Group 3 - Body & Mind	
Location	Coordinator	Section 1		Section 3		Section 2	
Time							
13:10	Set-up						
13:20							
13:30							
13:40		Group 1 Arrives		Group 2 Arrives		Group 3 Arrives	
13:50	Brief Introduction	Brief Introduction		Brief Introduction		Brief Introduction	
14:00	Group Intro.	Group Intro.				Group Intro.	
14:10	Group Intro.		Working - 1 transition	Group Intro.			Working
14:20					Working		
14:30							
14:40							
14:50	Send Cue - 15:40 Group 3					Send Cue & Survey - 14:40	
15:00	Discussion		Discussion				
15:10							
15:20							
15:30							
15:40	Send Cue - 15:40 Group 3		Working - 2 transitions			Send Cue & Survey - 15:40	
15:50	Discussion				Discussion		
16:00							
16:10							
16:20							
16:30	Send Cue - 15:40 Group 3					Send Cue & Survey - 16:30	
16:40	Discussion				Working		Discussion
16:50							
17:00							
17:10							
17:20	Survey		Survey		Survey		Survey
17:30							
17:40	Thank Everyone		Pack-up		Pack-up		Pack-up

Room Set-up

As shown in the figure on the following page, the room was split up into three sections and the group was divided into three groups, with each group testing a different key facilitator (social support, body & mind cues, task-based transitions).

** Due to Covid, there are a limited amount of people who can be in the faculty at a time and a limited number of rooms that could be used. I was only able to get this room for the afternoon which is why I split the group into three different groups with each group testing the facilitator for the duration of 3 hours.

Method

For this study,p participants were split into three groups with each group testing and evaluating one of the three key tools: social support, body & mind cues, and task-based transitions. During the study observations were taken concerning each group's actions followed by a discussion and a concept evaluation.

Observations

Throughout the three hour period, I had a notebook and took observations on the actions of the three different groups. These observations were then compared to the participant responses.

Discussion

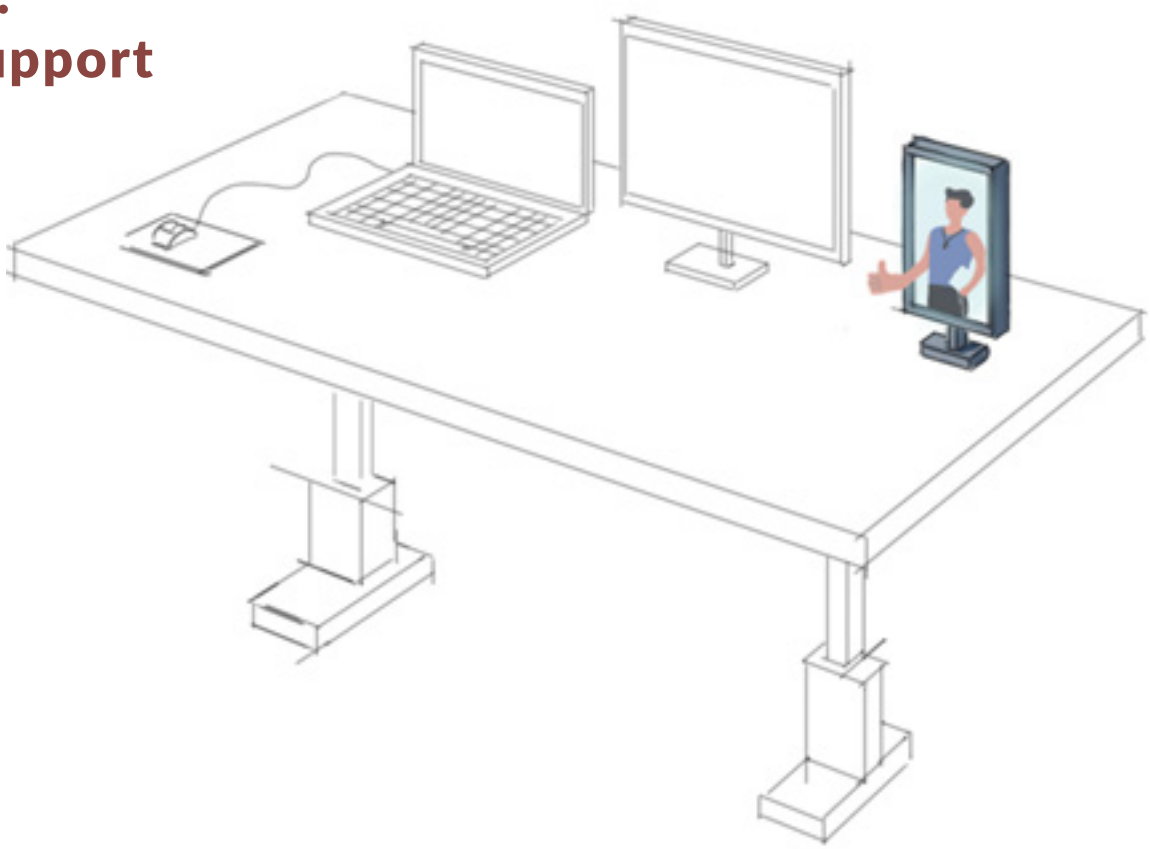
Discussions were held with each group (separately) at different periods during the afternoon (the schedule is on the following page). During these discussions, we discussed their key facilitator, how they experienced it, if it would be able to motivate them to stand-up more in the future, and potential threats they may experience when using it in their workplace.

Survey

At the end of the study, participants were asked to fill out a brief survey to:

1. Evaluation their experience
2. Evaluate the three concepts – this way they could evaluate the concept that utilized their key facilitator and compare it to the other two concepts. At the end they were asked to explain which concept would support them the most in developing sit-stand habits and why.

Idea 1
The Desktop Coach
Key Tool:
Social Support



The Design

The Desktop Coach is an intelligent virtual coach who brings the user together with a team to set goals, gain support, provide motivation, reminders, and rewards to help the working adult reach their sit-stand goal. At the beginning of each day, the user either sets a personal goal, buddy up and join a coworker's goal, or join the company's challenge. Users have control over the coach by setting which goals they want to achieve and the level of motivation they want to be provided, while also being able to track the long-term progress they are making. The goals presented to the user fall into specific levels, which the user will move up in as they become more competent in their ability to alter their position.

The coach will also provide tips and tricks to help the user develop better sit-stand practices.

The Key Tool

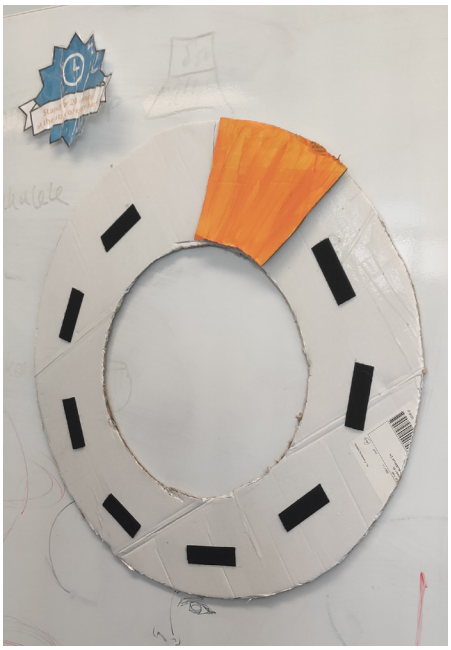
- Social Support
- Reminders

ey Eeatures

- An intelligent virtual coach that brings the user together with a team to set and accomplish goals.
- Uses social support as the key motivational factor.
- The Desktop coach provides tips, reminders, encouragement, updates on progress, and rewards when goals and challenges are accomplished
- Only-at-the-office solution which user can sign-in to get their personal data.
- User has full control over their goals.
- Physical tablet placed on desk.

Method

Prototype



For the social support testing, a prototype was created using cardboard. Two cardboard circles were cut out and the second was additionally cut into 9 pieces (3 pieces per participant). Velcroe was added to allow for the nine pieces to be attached to the full circle as participants completed their sit-stand transitions. Three “challenge” cards were also created and laminated.

Set-Up Check-List

Arrange the desks following the figure below
Tape up progress tracker
Put up participant place cards

Procedure

Phase 1: The Key Tool

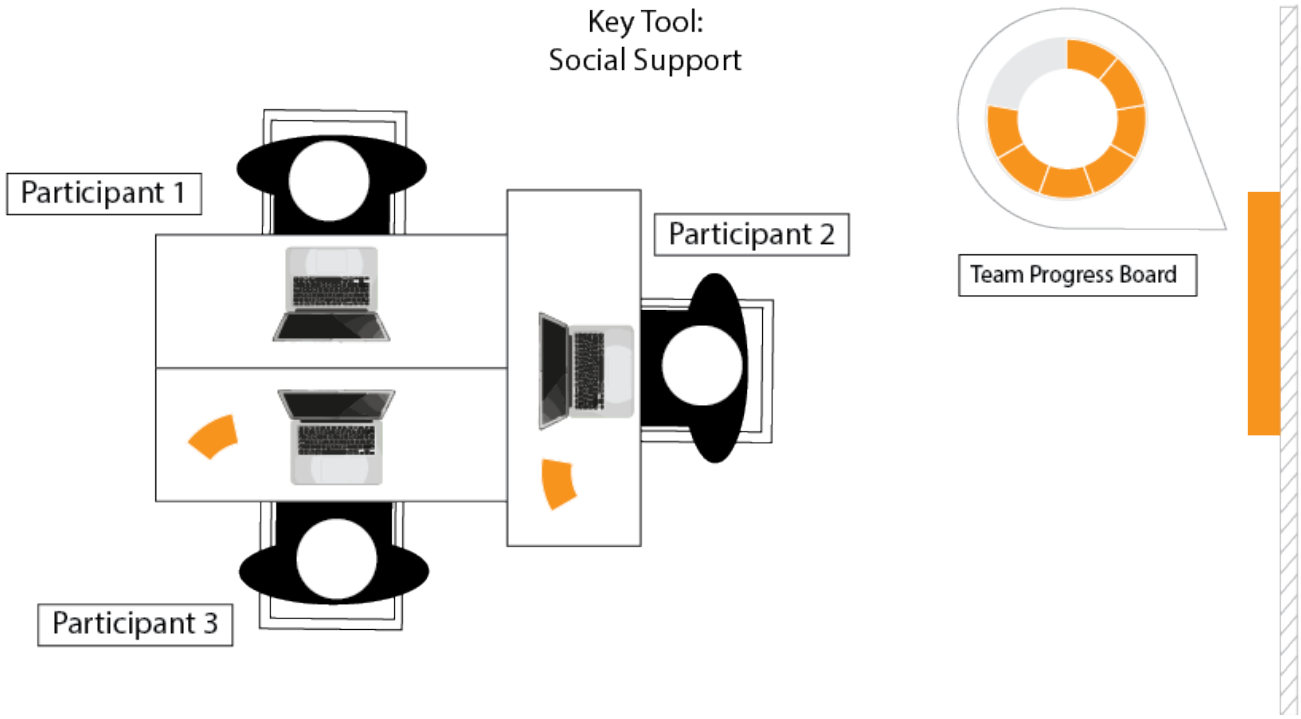
Once Group 1 has each taken their spot at their desks the following dialogue will be read to them:

“Today you will work together to transition between sitting and standing based on a group challenge which you will pick together. As you accomplish each transition or step towards accomplishing the challenge you willl each take one of the orange markers and place it on the progress tracker. This way you will be able to see how your individual accomplishments add together towards your team’s goal.

Today there are three challenges you can pick from:

- Alter sit-stand position every 30 minutes
- Stand 3 times for 25 minutes
- Stand for 20 minutes at the start of every hour

Once you have decided which challenges you



would like, you can place it on the board and begin working on your own work."

Procedure Check-List:

Have team select challenge from three different laminated sheets.
Tape challenge up on board above progress circle.

Phase 2: Discussion

Following the schedule, a discussion session will be held with the participants in this group.

The following dialogue will be said followed by the listed questions.

"The reason for this tool is that many participants found that they began to pick up the standing habit because they saw their coworkers or supervisors doing it. This social influence and support allowed them to feel more at ease when transitioning their desks. Studies also show that peer support (especially ones who are going through the process together) is an important motivator for behavior change.

Your key tool is part of a concept where social support and team challenges are meant to bring employees together to reach a common goal, which in this case is a gradual progression towards altering their position more often. This means not just standing, but splitting their time at work between sitting and standing since the transition is the most important part. In this concept, the employee is able to select whether they want to set their own goal, buddy-up with a coworkers and join their goal, or join the company's challenge. As the employee becomes more competent in standing, the goals will get "harder" and "harder," a.k.a the employee will be asked to alter their position more often until the final goal is reached. This concept consists of a digital tablet which will be placed on the desk and used to sent encouragement, notifications, tips, rewards, updates on progress, and reminders."

Questions:

1. How do you feel about this tool to help you limit the amount of time you spend sitting?
2. What are some limitations or threats that you think this approach could face in the future when attempting to help users stand-up more often?
3. To make this approach work better, what are things that you would added so that it better suits your needs?
4. What do you think about keep the product and reminders digital?

Results

The following results present quotes mentioned by the participants:

1. How do you feel about this tool to help you limit the amount of time you spend sitting?

- "The tool was good to see the amounts of sets, however I wouldn't say the fact that the entire team has put an element at once is a bonding fact. I would say that the fact that we were elevating and lowering the desks together was quite bonding."
- "It could help to change the dynamics of the office environment. The fact that an it has a reminder also helps to stay on track and do become lazy."
- "...funny, but nothing special (the progress board) since I forgot to use it"
- "it was nice to have small interactions with my colleagues"
- "as a restless person, I would have liked to change the position more often without having to wait for time/ colleagues."
- "I want to decide when to change (ADD), but it's nice to have a reminder to change positions (lift the table)."
- "I do believe that doing it in a group was more effective."
- "I wasn't thinking about changing and when somebody pointed it out, it was like a group activity for few seconds"
- "When simply talking about motivation, I think it would push me to stand-up more, especially when peer pressure is in play"

2. **What are some limitations or threats that you think this approach could face in the future when attempting to help users stand-up more often?**

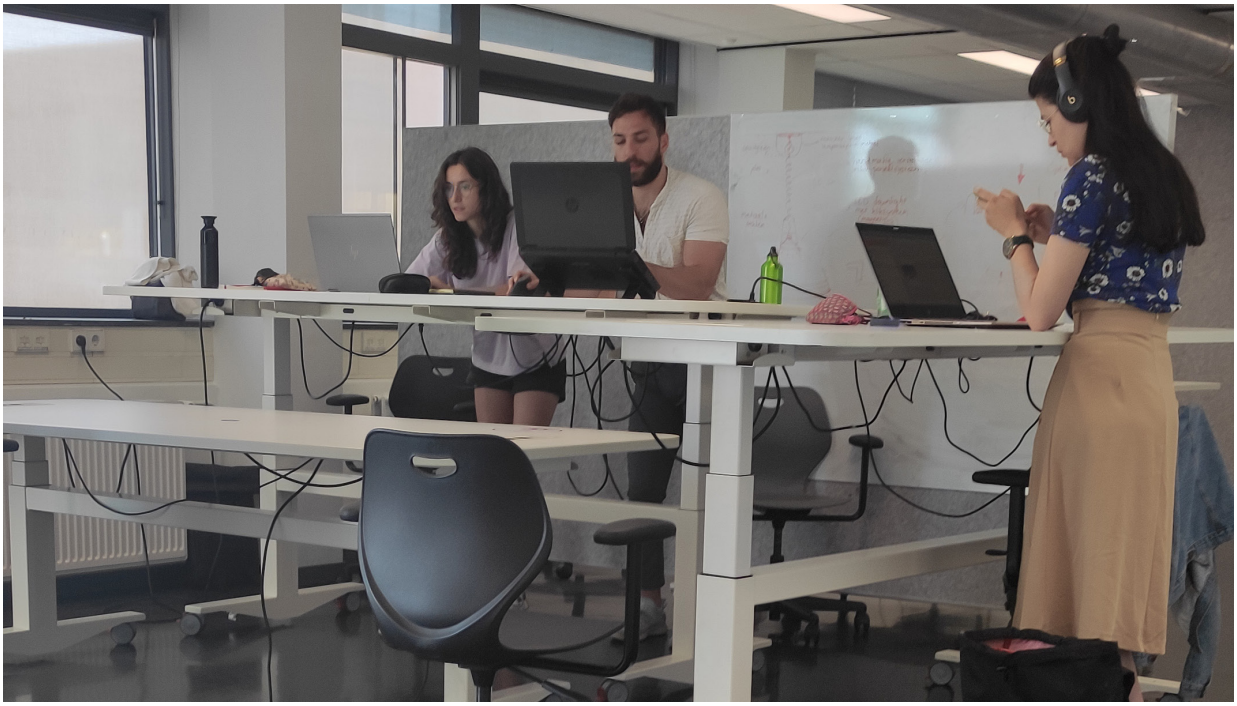
- “For me one barrier would be the noise of the desks, although it was not that loud you could still hear it.”
- “towards the end it also makes you aware of the fact that perhaps it’s also your time to raise the desk”
- “Once this element is normalized in an office environment I wouldn’t say there is any social barrier, in fact within an afternoon I could already feel the stand up desks as part of the routine.”
- “If I think that for some it may be uncomfortable to change (awkward transitions).”
- “I believe a service is a bit overkill for the idea and a simple hardware”
- “the proximity of the table arrangement: it is not super nice to be standing next to a person that is seating, especially that the chair needs to go somewhere and could block the path.”

3. **To make this approach work better, what are things that you would added so that it better suits your needs?**

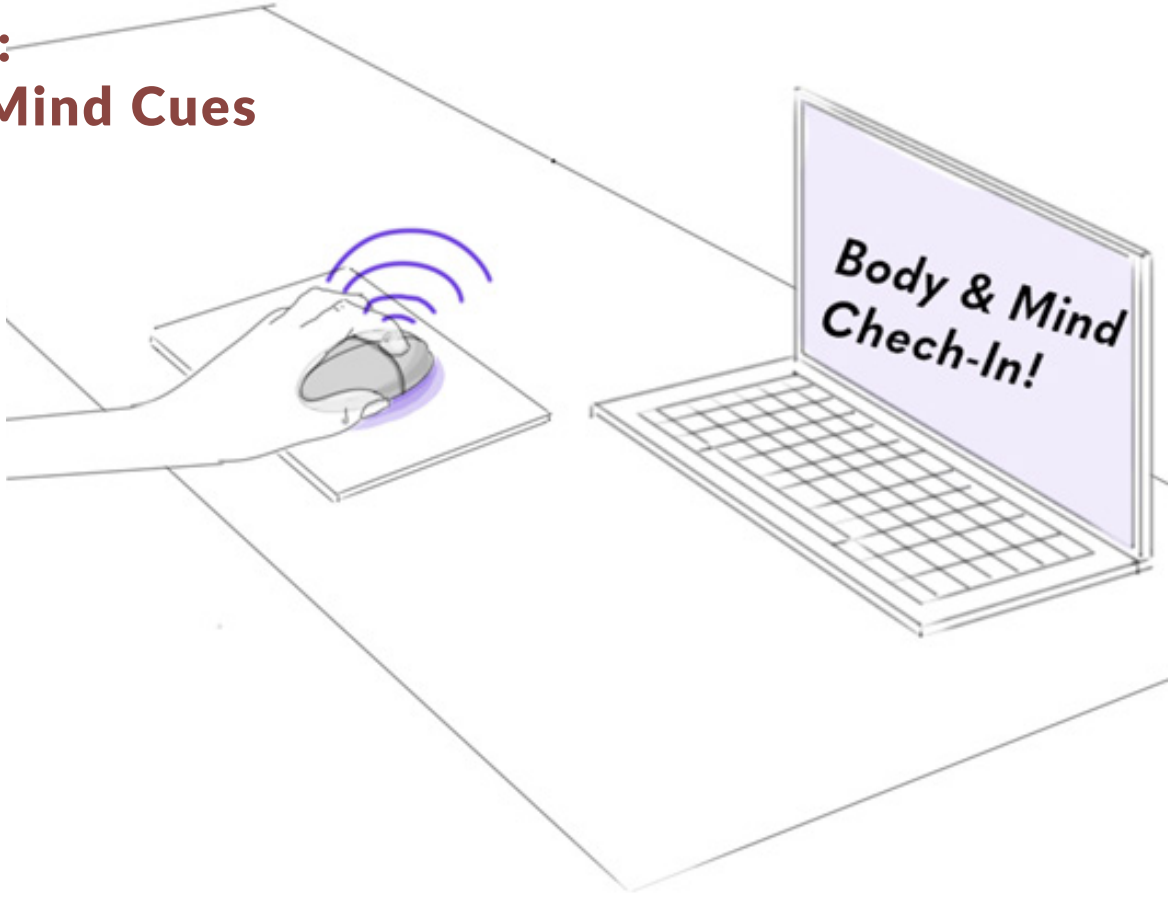
- “Integrating it in the company computer or coordinating it with a wearable device. “
- “I am more interested than the function of the table and not the application, so as not to feel distracted by the application.”
- ‘Probably in the long run, having different goals would be beneficial to avoid repetitiveness and annoyance.”
- ‘The simpler, the better as I do not want to spend a lot of time setting up the goal for the day.”
- ‘implementing it with members that work together would be easier.”
- ‘Potentially becoming automated, or have an actual prize to aim for e.g. discount on coffee”

4. **What do you think about keep the product and reminders digital?**

- “I tend to ignore the digital notifications and only the sound/vibrations catches my attention. Also, I don’t want to expand the attention to my mobile phone as it distracts me from working.”
- “I feel like the phone distracts me a lot. That is why I feel that it is better if the signal comes from the product itself. So if one is in a work flow, one can continue without a sudden change.”
- “I would believe that the best signal is a change of light.”
- “I want to be lazy and set-up everything without the need of taking out my phone”
- “Feels good sometime to press buttons, like starting up a rocket engine, and not be glued in front of my phone again.”



Idea 2
Body & Mind Mouse
Key Tool:
Body & Mind Cues



The Design

The Body & Mind Mouse combines a physical and digital product that takes advantage of classical conditioning to help the user become more aware of their body and mind to notice how they are feeling and then provides tips and tricks on how they can adjust their sit-stand desk to feel better. The product analyzes if the user is sitting or standing statically for a prolonged period or if they are adjusting in a way that indicates they are physically dis-comfortable. Once this occurs, a cue is sent to their mouse (e.g. vibration or lights), and a dialogue box will pop up on their screen asking them to indicate how they are feeling (both physically and mentally), it will then provide them with tips to alter their posture and desk position, so they can feel better. The goal is that over time the dialogue box will pop up less and less and the user will begin to associate the mouse cues with checking in on themselves and altering their position. The user can also track their answers over time to see the effect that altering their position has on both their body and mind.

The Key Tool

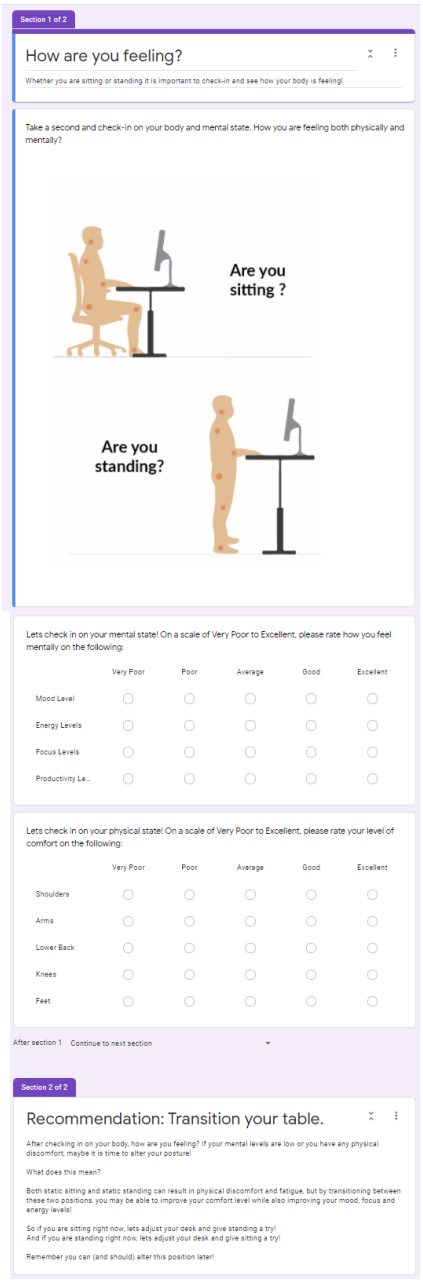
- Body & Mind Check-In/Cue
- Reminders

Key Features

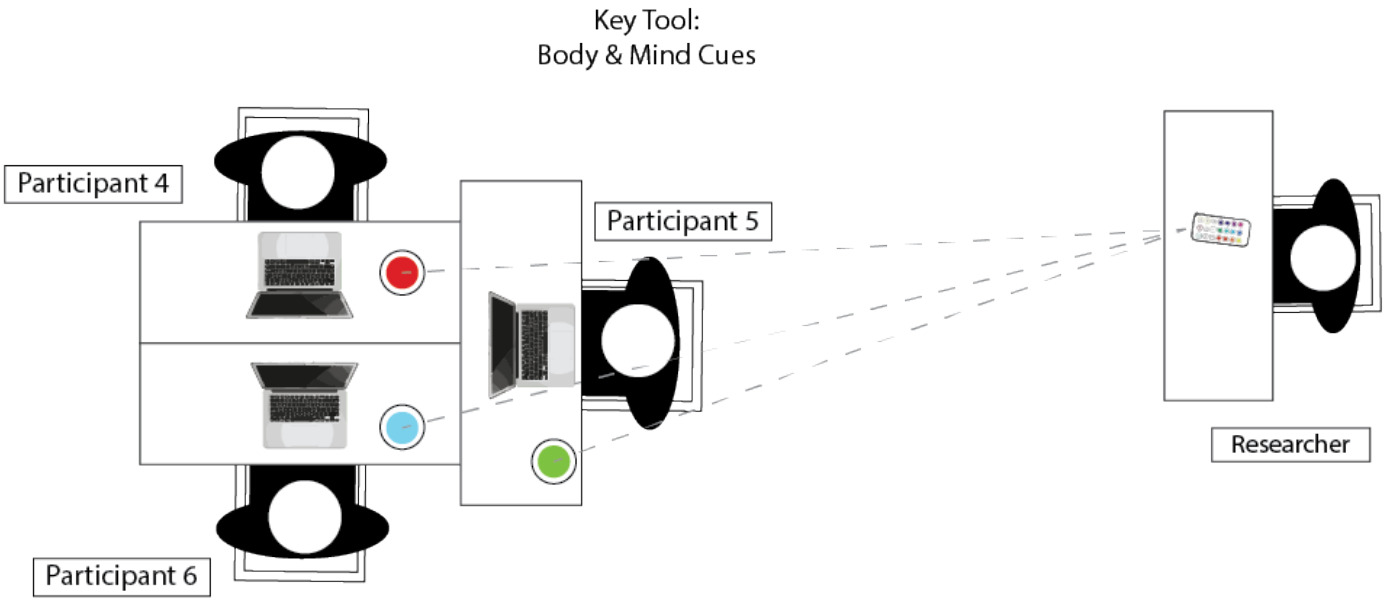
- Focuses on the physical and psychological indications for altering position.
- Only-at-the-office solution which user can sign-in to get their personal data.
- Uses AI to analyze user's sitting habits
- Computer Application to provide body & mind check-in, tips and tricks to feel better, and insights into progress.
- Takes advantage of a product which most working-adults already constantly use.
- Uses nudges to classical conditioning to help user start checking-in on themselves and altering according to their body's needs.

Method

Prototype



For the body & mind cues, the prototype consisted of three remote controlled lights (1 per participant), Body & Mind notifications followed by a link to a Google form spread sheet where users were prompted to do a body and mind scan and then were provided with a recommendation to alter their desk height.



Set-Up Check-List

Arrange the desks according to the figure on the previous page
Set up lights at each workstation
Put up participant place cards
Write down all user's telephone numbers

Procedure

Phase 1: The Key Tool

Once Group 2 has each taken their spot at their desks the following dialogue will be read to them:

"Today you will focus on altering their position according to body and mind cues. You have each received a lamp. At various times throughout the afternoon, the lamp will go off. At this point you will receive a notification in your WhatsApp asking you to fill out a quick survey. The survey will prompt you to check-in on yourself and evaluate how you are feeling, both mentally and physically. At the end of the survey you will be provided with a suggestion to alter your sit-stand position. Whether you alter it or not is up to you. "

Procedure Check-List:

Provide each participant with a lamp
Ensure participants have their WhatsApp on their computer with notifications on.

Throughout the work period, the researcher will use their remote to set off the participant's lamps. This will be done at random times or if the participant has remained in one position for a very long time.

Phase 2: Discussion

Following the schedule, a discussion session will be held with the participants in this group.

The following dialogue will be said followed by the listed questions.

"Your key tool is part of a concept that focuses on using classical conditioning to help the user become more aware of their body's needs and the need to alter position.

Among the participants who were actively using the sit-stand desks, they found that they no longer needed a reminder to change but were able to become more conscious of their body and minds and use these as cues to change. This meant that if they began to feel discomfort or fatigue, they knew that by altering their position they would be able to increase their alertness, energy levels, mood, and decrease the discomfort they were feeling in their bodies.

In this product, at first a cue (e.g. the light) will go off and a notification will be sent prompting the user to check-in on their bodies to become more aware on what is going on. Based on how the user responds, they will be provided with a tip to alter their position. Over time the light will continue to go off, but notifications will decrease. This aims to have the user associate the cue with check-in on their body and in turn alter their position based on their body's needs."

Questions:

1. How do you feel about this tool to help you limit the amount of time you spend sitting?
2. What are some limitations or threats that you think this approach could face in the future when attempting to help users stand-up more often?
3. To make this approach work better, what are things that you would added so that it better suits your needs?
4. What do you think about keep the product and reminders digital?

Results

The following results present quotes mentioned by the participants:

1. **How do you feel about this tool to help you limit the amount of time you spend sitting?**

- "Body and mind cues do help in taking a moment to be mindful about your

own body, I do use these a lot in my own studying but usually to find out if I need to go for a coffee break or a walk instead of switching working positions."

- "I think if I get used to this it will work quite well for me"
- "changing it like this might work for me but I would have to try it more often"
- "It made me more aware of how my body feels, usually I don't pay attention to it."
- "I think after a few times you don't even need the questionnaire anymore, a little reminder like the light would be enough to let me reflect how I feel and if I should change positions."
- "It makes me aware of discomfort in certain parts of my body."
- "I experienced the standing position positively, especially because of a stress release around my knees, which actually usually troubles me for a great part of the day."
- "I think it is very useful to check in with your body and mind regularly in general.
- The reminder of it definitely helped me remember to change my position and be conscious about this choice."
- "I think I could use some kind of extern motivation. A tool that reminds me to scan my body and mind and helps me to make a conscious decision would fit me well personally."

2. What are some limitations or threats that you think this approach could face in the future when attempting to help users stand-up more often?

- "The check in moments did however break my concentration so I wouldn't want them to be there often."
- "The noise the table makes when changing position puts the spotlight on people."
- "Same goes for the light/body check. It might force people into a position they don't enjoy themselves but just blindly following the light to change positions."
- "It is distracting when people keep switching and I feel pressure to change my position as well when others are doing it. Also you might feel observed when somebody is standing behind you."
- "Maybe I would start ignoring the light after a while and the questionnaire would def. annoy me after a few times."
- "I have to admit that I felt kind of eager to change to a standing position after the start but I was waiting for the light to turn on"
- "I did feel a bit awkward to change to a standing position. I think because I felt judged by my peers knowing that I did it because of the assignment, but in a real situation, nobody would know."
- "I can imagine that a nudge over time could degrade in effectiveness."

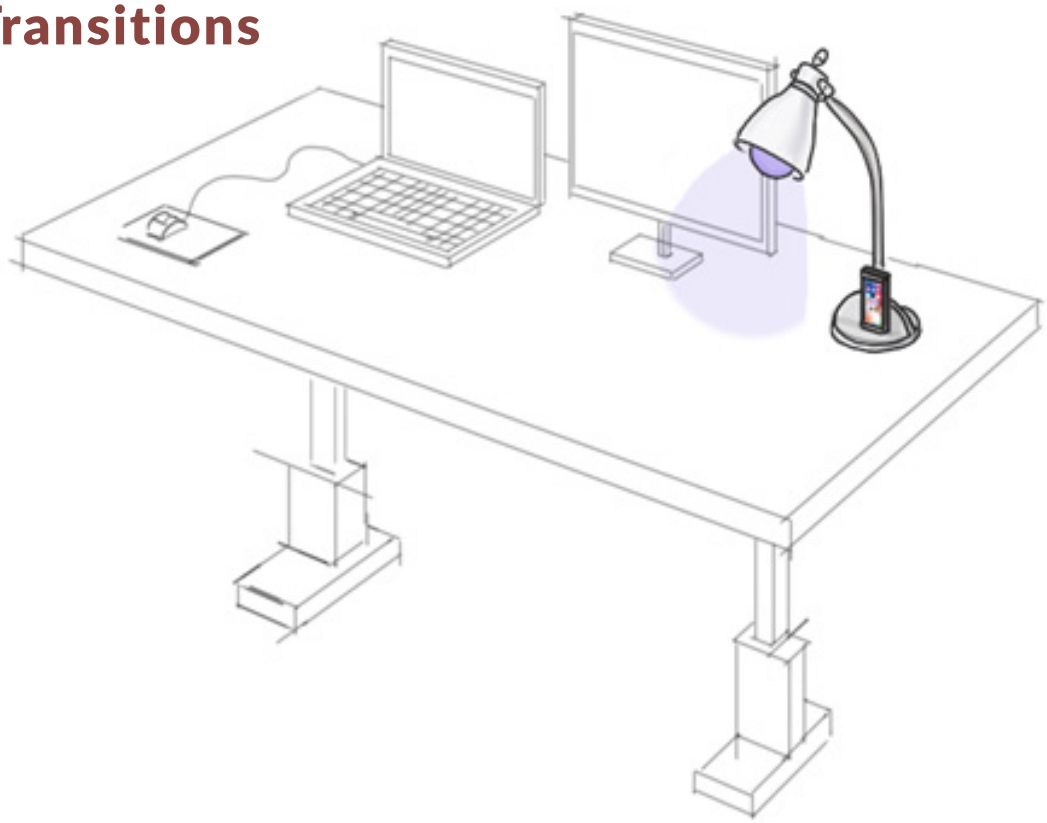
3. **To make this approach work better, what are things that you would added so that it better suits your needs?**

- “Change the physical queue and set a timer to the popup so people can’t just click through it and keep working but really need to take the time to think.”
- “Just do the questionnaire at the beginning and maybe alter the physical cue.”

4. **What do you think about keep the product and reminders digital?**

- “When I am working I don’t want to be distracted by my phone.”
- “I don’t like push notifications on my phone or computer and therefore I have them all turned off. Probably because I don’t want them to control my life and feel more at peace when I have them turned off.”
- “I think a physical device would fit me better, but taking this last personal need into account, it will be a challenge to find a form of a product that really feels like a helping hand to me rather than an intrusive object.”

Idea 3
My Sit-Stand Lamp
Key Tool:
Task-Based Transitions



The Design

The Self-Management lamp is a task-based digital/product combination that allows the user to insert their day's schedule with the tasks they need to accomplish and when they want to take breaks throughout the day on their phone. The app then asks the user to set a goal and indicate which tasks they want to try to do while standing. The goal starts small (e.g.stand up during their meeting) and gradually asks the user to indicate more and more times when they want to transition their posture until they reach their final goal. Users can also see the goals or tasks that their coworkers have set and choose to "buddy-up" (e.g. stand at the meeting together or alter desk position during each coffee break). Once the daily tasks and goals are set, the user places their phone on the lamp and the data is uploaded. The lamp has different color cues indicating to the user when it is time to change position, alter tasks, or take a break.

The Key Tool

- Task-Based / Self-Managment
- Reminders

Key Features

- Smartphone application for setting schedule, tasks, and goals for the day.
- Physical product to provide reminders and cues to desk transitions, tasks, and breaks (limits screen based cues)
- Uses task-based transitions to help user adopt sit-stand practices (Reduces obstruction to workflow)
- Provides gradual transition with users starting small (selected one task to stand during) and gradually increases the number of tasks during which the user stands / alters position.
- The user has control over when they stand.
- Possibility to "buddy up" and join another coworker's set goal/ standing task .
- Interaction with an app to upload schedule and tasks and gain insights on progress.

Method

Prototype

For the social support testing, a prototype was created using cardboard. Two cardboard circles were cut out and the second was additionally cut into 9 pieces (3 pieces per participant). Velcroe was added to allow for the nine pieces to be attached to the full circle as participants completed their sit-stand transitions. Three "challenge" cards were also created and laminated.

Set-Up Check-List

Arrange the desks following the figure below
Set up the kits at each workstation (plastic bag w/ schedule, Velcro, stand, whiteboard marker)
Put up participant place cards
Set up completed prototype example

Procedure

Phase 1: The Key Tool

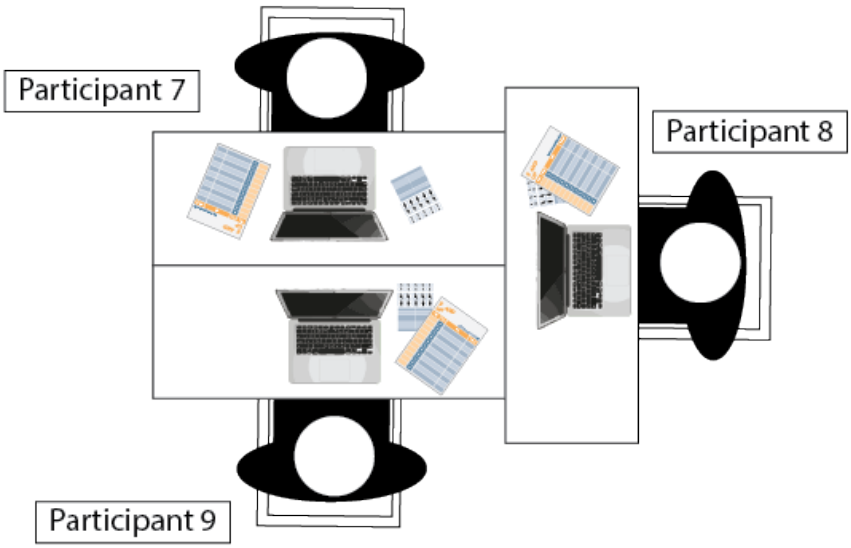
Once Group 3 has each taken their spot at their desks the following dialogue will be read to them:

"Today you will focus on time/task-management and adjusting your sitting and standing based on the tasks you are doing. First I am going to ask you to use the whiteboard markers and schedule to write down your tasks for the afternoon (if you have one thing you want to work on, try to break it up into smaller tasks).

Once this is done, using the Velcro icons, please indicate which tasks you would like to stand for and which tasks you want to sit for.

You can attach this to the stand. This will be your indicator for altering position."

Key Tool:
Social Support



Procedure Check-List:

Present the complete prototype to the group as an example
Have team write down their tasks for the afternoon and add it to the schedule
Have them indicate for which tasks they want to sit or stand by adding the indicators to the schedule next to the task.

Phase 2: Discussion

Following the schedule, a discussion session will be held with the participants in this group.

The following dialogue will be said followed by the listed questions.

"This tool is based off employees fear that transitioning their tables would interrupt their workflow and productivity. They thought that by altering it according to their tasks or break times then they wouldn't feel like they were being interrupted.

Your key tool is part of a concept where the employee is able to set-up their daily schedule and select during which tasks they would like to stand for. Once they complete their schedule, they will be able to upload it to a lamp that will alter colors when it is time for a break, time to stand, time to sit. This way they wont have to look back at their phone for reminders.."

Questions:

1. How do you feel about this tool to help you limit the amount of time you spend sitting?
2. What are some limitations or threats that you think this approach could face in the future when attempting to help users stand-up more often?
3. To make this approach work better, what are things that you would added so that it better suits your needs?
4. What do you think about keep the product and reminders digital?

Results

The following results present quotes mentioned by the participants:

1. **How do you feel about this tool to help you limit the amount of time you spend sitting?**

- "I tend to spend more times on a task than I put on my to-do list, and I tend to not plan breaks but I do take them. As a to-do list is for me already a semi-effective method to plan my workday it did not help much to let also my table position depend on it."
- "Sometimes I wanted to stand, where my task at that moment said 'sit'."
- "I only had one task today, so it was hard to break it down and link it to standing/sitting
- This concept specifically made me more conscious of taking longer than planned for some tasks - not in a good way."
- "When I was overdue with a task I felt some pressure to change position because my timeslot was over, while I wanted to work longer on it."
- "To start off the work session, it gave a sense of consciousness about the postures also some form of autonomy in transitioning from one posture to the other. "

2. **What are some limitations or threats that you think this approach could face in the future when attempting to help users stand-up more often?**

- "If we would sit at an island of desks, and everybody is sitting down, it would feel as a barrier to me to be the only one standing up, or disturbing them."

3. **To make this approach work better, what are things that you would added so that it better suits your needs?**

- "I think a small led light or something integrated in the desk would be better
- "Or maybe that you install something on your computer so that your screen loses brightness when it's time to stand up or something."
- "A friendly cue for a change could help"
- "Reduce sound on the sit stand desk,

maintain simplicity in the product, experiential triggers such as light and/or vibration cues(haptics)”

4. **What do you think about keep the product and reminders digital?**

- “I think a pop up on my computer would be preferred, because I don’t want to be looking at my phone more often than I already do. Physical changes would also work I guess, but nothing to distracting.”
- “I don’t have a smartphone, and try to kill notifications from every program on my laptop because it helps me stay focused. Physical cues are always preferable, if you ask me.”
- “The action required is a physical one and so an experiential cue would help better with the transfer of action. In the case of notification on a digital device, it’s more of a cognitive prompt which leads to a cognitive action on the screen, does not necessarily warrant a physical change or action.”

Observations Notes

Social Support

- Since the participants chose a challenge in which they are required to alter their sit-stand desks at the same time, it lowers the autonomous decision to make a change and may prevent users from altering on their own.
- This was the only group where participants did not take a break during the session.

Body & Mind Cues

- There were initial feelings of discomfort at being the first to make the sit-stand transition, but this transition appeared to get easier over time (as everyone was doing it and became more accustomed to it)
- Sometimes the lights were pushed out of the way, and were easier to ignore. Out-of-sight, out-of-mind
- After a time some participants began to alter their desk height on their own accord, with out the reminder. They seemed to become more aware of their bodies and used their bodies as a means to change.
- The light as a reminder was still a nice touch, as a reminder in case their forgot

Task-Based Transitions

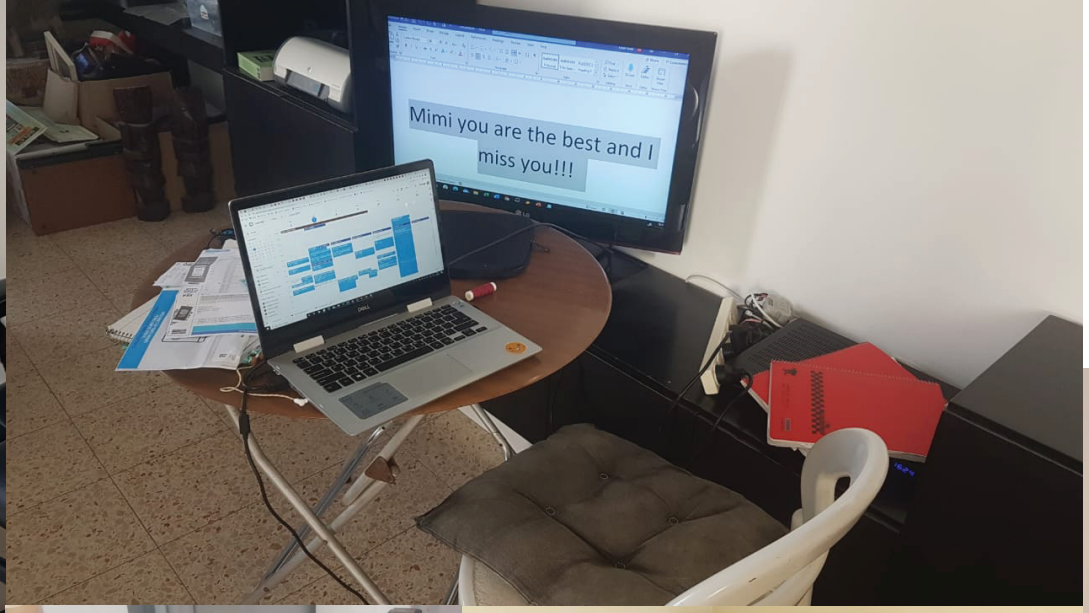
- This task was the hardest to explain/understand and took the longest set-up
- One user seemed to add his “sit-stand”stickers after the transition was done. He seemed to base it off his feelings
- There is definitely an influence of colleagues on each other
- This group took the most breaks
- The task-based transitions seemed to keep participants standing or sitting for the longest period of time.

Appendix VII: Whats on the Desk

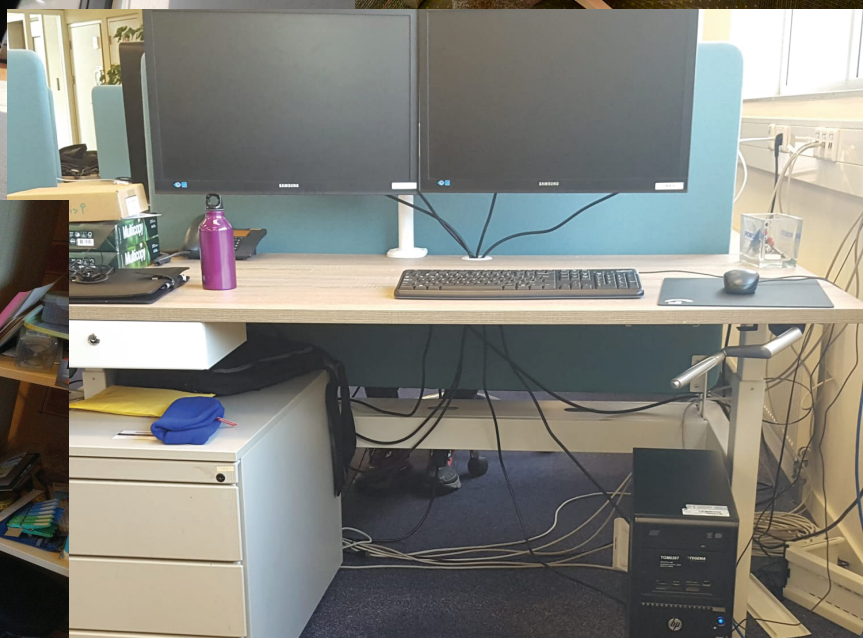








Mimi you are the best and I
miss you!!!



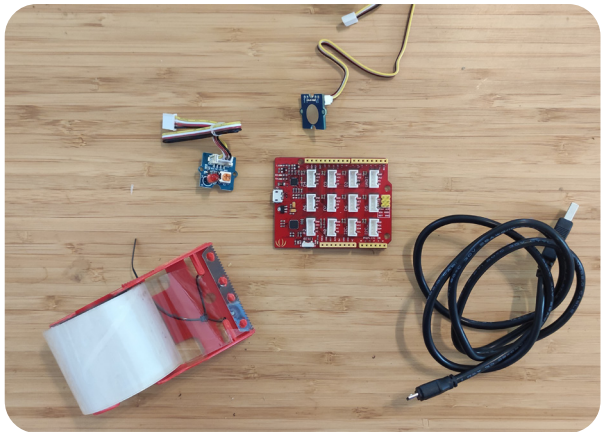

WHATS ON THE DESK?

Water Bottle	𝍸 𝍸	= 10
Pencil Case	𝍷	= 4
Pens	𝍸 𝍸	=10
Pencils	𝍷	= 4
Notebook	𝍸 𝍸 |	= 11
Laptop	𝍸 𝍸 𝍹	= 13
Backpack	𝍹	= 3
Floor	𝍸 𝍸 𝍸 ||	= 17
Chair	𝍸 𝍸 𝍸 |	= 16
Laptop Pad	||	= 2
Coffee Mug	𝍸 |	= 6
Pen/Pencil Holder	||	= 2
Mouse	𝍸 𝍸 ||	= 12
Laptop Charger	𝍸 𝍸 |	= 11
Desk	𝍸 𝍸 𝍷	= 14
Wall	𝍸 𝍸 𝍹	= 13
Keyboard (separate)	𝍸 𝍷	= 9
Monitor	𝍸 𝍷	=9
Double Monitor	𝍷	= 4
Sticky Note Pad	||	= 2
Hard drive	𝍷	=4
Headphones	𝍸 |	= 6
Lamp	𝍹	= 3
Snacks	|	= 1

Chapstick	|	= 1
Laptop Case	𝍹	= 3
Window	𝍸 ||	= 7
Coster	||	= 2
Mouse Pad	𝍸	= 5
Foot Rest	|	= 1
Computer Stand	𝍸	= 5
Cell Phone	||	= 2
Electric Coster	|	= 1
Plant	𝍹	= 3
Telephone	𝍷	= 4
Photos/Art	𝍹	= 3
Calculator	𝍹	= 3
Drawing Tablet	|	= 1

Appendix VIII: Selecting The Technology (Input & Output)

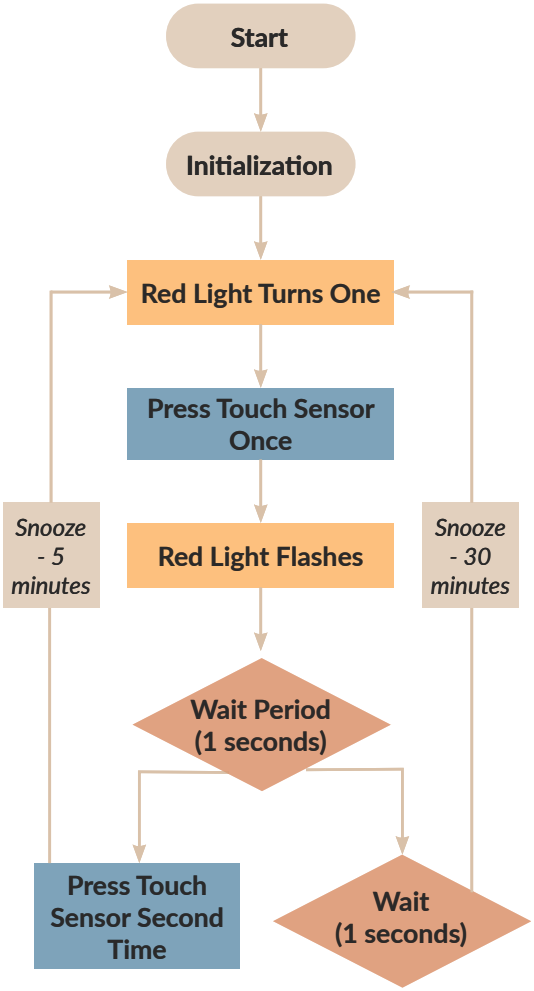
Tech Set-up 1: Light, Touch Sensor, Stick-On



Equipment

- Arduino Uno Board
- Grove - Red RGB Led
- Grove - Touch Sensor
- Tape
- Power Cable

Arduino Code



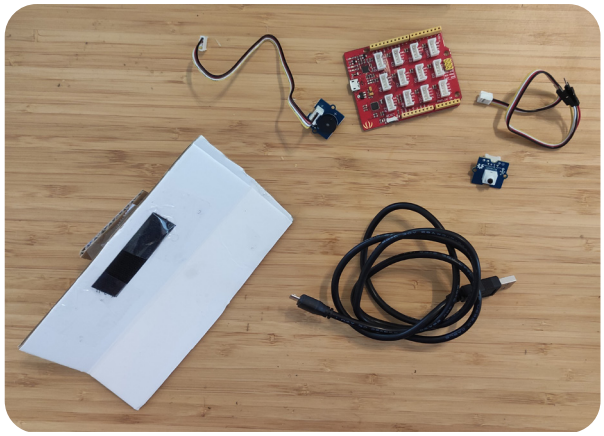
thesisC2 | Arduino 1.8.15 (Windows Store 1.8.49.0)

File Edit Sketch Tools Help

thesisC2 §

```
int pinREDLED = 3;
int pinTOUCHSENSOR = 6;

unsigned long recordTime = 0;

unsigned long longSnoozeTime = 1800000; //Long break set at 30 minutes
boolean longSnoozeActive = 0;

unsigned long shortSnoozeTime = 600000; //short break set at ten minutes
boolean shortSnoozeActive = 0;

boolean touching = 0;
boolean touchedONE = 0;
boolean offtouchedONE = 0;
boolean touchedTWO = 0;
int waitfortwoTime = 1500; //Time window for looking for a second touch before deciding between long snooze and short snooze.


void setup() {
  // Start serial port
  Serial.begin(9600);

  pinMode(pinREDLED,OUTPUT);
  pinMode(pinTOUCHSENSOR, INPUT);

  Serial.println("Initializing...");
 // tone(pinREDLED, 20);
  digitalWrite(pinREDLED, 1);
  delay(100);
  digitalWrite(pinREDLED, 0);

  delay(waitfortwoTime+100);
  Serial.println('Now ready to start after ' + millis() + ' milliseconds');
  digitalWrite(pinREDLED, 1);
}



void loop() {

  if((millis() - recordTime)<waitfortwoTime){
    digitalWrite(pinREDLED, 1);
    delay(100);
    digitalWrite(pinREDLED, 0);
    delay(100);
  }


  touching = digitalRead(pinTOUCHSENSOR);

if(touching && !touchedONE){ //triggers during first touch event -> record the event
    touchedONE = 1;

    recordTime = millis();

    Serial.println(recordTime);

  } else if(touching && offtouchedONE && (millis() - recordTime)<waitfortwoTime){
    touchedTWO = 1;
  }

if(!touching && touchedONE && !touchedTWO){ //triggers after first touch event -> either sets up waiting for second touch event (within selection windo

    if((millis() - recordTime)<waitfortwoTime){
      offtouchedONE = 1;
    }else{
      longSnoozeActive = 1;

      //reset the variables
      touchedONE = 0;
      touchedTWO = 0;
      offtouchedONE = 0;
      recordTime = 0;
    }

  }

if(touchedONE && touchedTWO){ //triggers during/after second touch event -> Activate short snooze
    shortSnoozeActive = 1;

    //reset the variables
    touchedONE = 0;
    touchedTWO = 0;
    offtouchedONE = 0;
    recordTime = 0;

  }


  if(longSnoozeActive){

    Serial.println("LONG SNOOZE BEGIN");
    digitalWrite(pinREDLED, 0);//OFF
    delay(longSnoozeTime);
    longSnoozeActive = 0;

    Serial.println("SNOOZE OVER");
    digitalWrite(pinREDLED, 1);

  }

  if(shortSnoozeActive){
    digitalWrite(pinREDLED, 0);//OFF
    Serial.println("SHORT SNOOZE BEGIN");
    delay(shortSnoozeTime);
    shortSnoozeActive = 0;

    Serial.println("SNOOZE OVER");
    digitalWrite(pinREDLED, 1);

  }
}
```

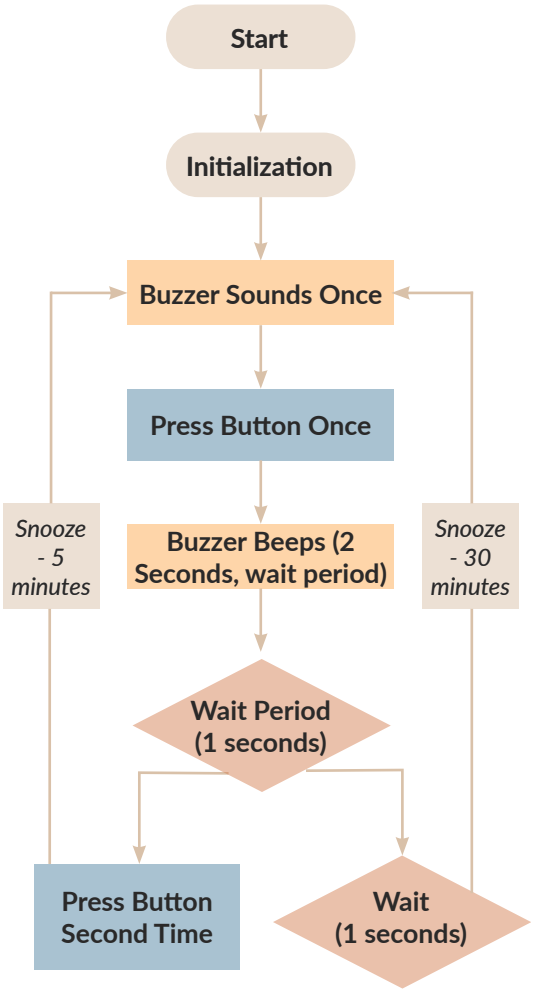
Tech Set-up 2: Button, Sound, Stand



Equipment

- Arduino Uno Board
- Grove - Buzzer
- Grove - Button (P)
- Cardboard Stand
- Power Cable

Arduino Code



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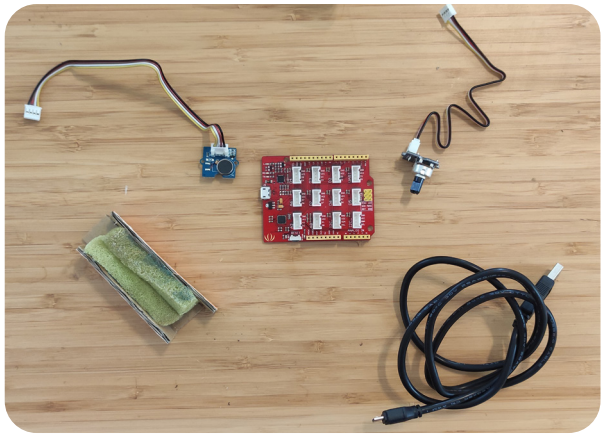
File Edit Sketch Tools Help

thesisC2 §

```
int pinBUZZER = 3;
int pinBUTTON = 6;

unsigned long recordTime = 0;

unsigned long longSnoozeTime = 1800000; //Long break set at 30 minutes
boolean longSnoozeActive = 0;

unsigned long shortSnoozeTime = 600000; //short break set at ten minutes
boolean shortSnoozeActive = 0;

boolean touching = 0;
boolean touchedONE = 0;
boolean offtouchedONE = 0;
boolean touchedTWO = 0;
int waitfortwoTime = 1500; //Time window for looking for a second touch before deciding between long snooze and short snooze.


void setup() {
  // Start serial port
  Serial.begin(9600);

  pinMode(pinBUZZER,OUTPUT);
  pinMode(pinBUTTON, INPUT);

  Serial.println("Initializing...");
 // tone(pinBUZZER, 20);
  digitalWrite(pinBUZZER, 1);
  delay(100);
  digitalWrite(pinBUZZER, 0);

  delay(waitfortwoTime+100);
  Serial.println('Now ready to start after ' + millis() + ' milliseconds');
  digitalWrite(pinBUZZER, 1);
}



void loop() {

  if((millis() - recordTime)<waitfortwoTime){
    digitalWrite(pinBUZZER, 1);
    delay(100);
    digitalWrite(pinBUZZER, 0);
    delay(100);
  }


  touching = digitalRead(pinBUTTON);

  if(touching && !touchedONE){ //triggers during first touch event -> record the event
    touchedONE = 1;

    recordTime = millis();

    Serial.println(recordTime);

  } else if(touching && offtouchedONE && (millis() - recordTime)<waitfortwoTime){
    touchedTWO = 1;
  }

  if(!touching && touchedONE && !touchedTWO){ //triggers after first touch event -> either sets up waiting for second touch event (within selection windo

    if((millis() - recordTime)<waitfortwoTime){
      offtouchedONE = 1;
    }else{
      longSnoozeActive = 1;

      //reset the variables
      touchedONE = 0;
      touchedTWO = 0;
      offtouchedONE = 0;
      recordTime = 0;
    }

  }

  if(touchedONE && touchedTWO){ //triggers during/after second touch event -> Activate short snooze
    shortSnoozeActive = 1;

    //reset the variables
    touchedONE = 0;
    touchedTWO = 0;
    offtouchedONE = 0;
    recordTime = 0;

  }


  if(longSnoozeActive){

    Serial.println("LONG SNOOZE BEGIN");
    digitalWrite(pinBUZZER, 0);//OFF
    delay(longSnoozeTime);
    longSnoozeActive = 0;

    Serial.println("SNOOZE OVER");
    digitalWrite(pinBUZZER, 1);

  }

  if(shortSnoozeActive){
    digitalWrite(pinBUZZER, 0);//OFF
    Serial.println("SHORT SNOOZE BEGIN");
    delay(shortSnoozeTime);
    shortSnoozeActive = 0;

    Serial.println("SNOOZE OVER");
    digitalWrite(pinBUZZER, 1);

  }
}
```

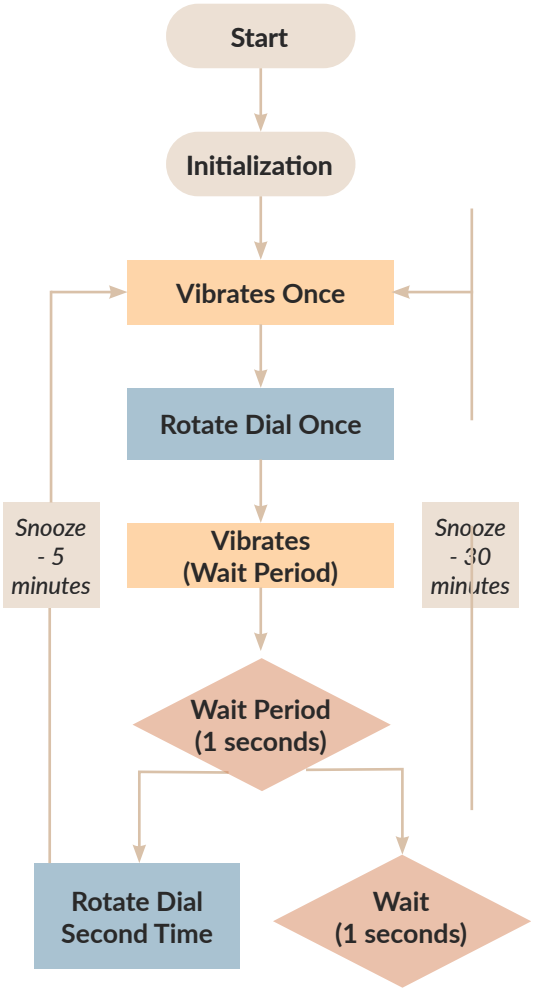
Tech Set-Up 3: Rotating Dial, Vibration, Slide-on



Equipment

- Arduino Uno Board
- Grove - Rotary Angle Sensor (P)
- Grove - Vibration Motor
- Cardboard Slide-On Prototype
- Power Cable

Arduino Code



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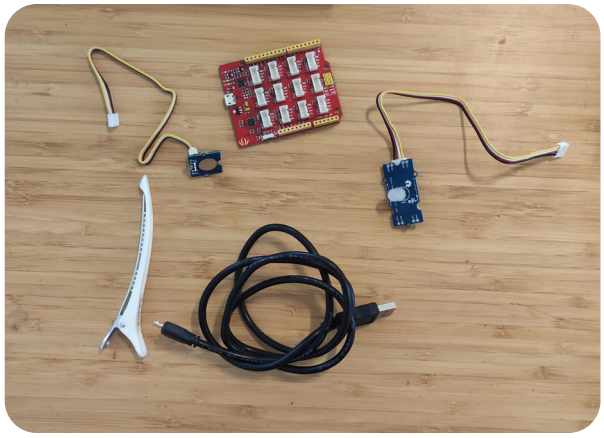
File Edit Sketch Tools Help

thesisC2 §

```
int pinVIBRATION = 3;
int pinROTARYDIAL = 6;

unsigned long recordTime = 0;

unsigned long longSnoozeTime = 1800000; //Long break set at 30 minutes
boolean longSnoozeActive = 0;

unsigned long shortSnoozeTime = 600000; //short break set at ten minutes
boolean shortSnoozeActive = 0;

boolean touching = 0;
boolean touchedONE = 0;
boolean offtouchedONE = 0;
boolean touchedTWO = 0;
int waitfortwoTime = 1500; //Time window for looking for a second touch before deciding between long snooze and short snooze.


void setup() {
  // Start serial port
  Serial.begin(9600);

  pinMode(pinVIBRATION,OUTPUT);
  pinMode(pinROTARYDIAL, INPUT);

  Serial.println("Initializing...");
 // tone(pinVIBRATION, 20);
  digitalWrite(pinVIBRATION, 1);
  delay(100);
  digitalWrite(pinVIBRATION, 0);

  delay(waitfortwoTime+100);
  Serial.println('Now ready to start after ' + millis() + ' milliseconds');
  digitalWrite(pinVIBRATION, 1);
}



void loop() {

  if((millis() - recordTime)<waitfortwoTime){
    digitalWrite(pinVIBRATION, 1);
    delay(100);
    digitalWrite(pinVIBRATION, 0);
    delay(100);
  }


  touching = digitalRead(pinROTARYDIAL);

  if(touching && !touchedONE){ //triggers during first touch event -> record the event
    touchedONE = 1;

    recordTime = millis();

    Serial.println(recordTime);

  } else if(touching && offtouchedONE && (millis() - recordTime)<waitfortwoTime){
    touchedTWO = 1;
  }

  if(!touching && touchedONE && !touchedTWO){ //triggers after first touch event -> either sets up waiting for second touch event (within selection windo

    if((millis() - recordTime)<waitfortwoTime){
      offtouchedONE = 1;
    }else{
      longSnoozeActive = 1;

      //reset the variables
      touchedONE = 0;
      touchedTWO = 0;
      offtouchedONE = 0;
      recordTime = 0;
    }

  }

  if(touchedONE && touchedTWO){ //triggers during/after second touch event -> Activate short snooze
    shortSnoozeActive = 1;

    //reset the variables
    touchedONE = 0;
    touchedTWO = 0;
    offtouchedONE = 0;
    recordTime = 0;

  }


  if(longSnoozeActive){

    Serial.println("LONG SNOOZE BEGIN");
    digitalWrite(pinVIBRATION, 0);//OFF
    delay(longSnoozeTime);
    longSnoozeActive = 0;

    Serial.println("SNOOZE OVER");
    digitalWrite(pinVIBRATION, 1);

  }

  if(shortSnoozeActive){
    digitalWrite(pinVIBRATION, 0);//OFF
    Serial.println("SHORT SNOOZE BEGIN");
    delay(shortSnoozeTime);
    shortSnoozeActive = 0;

    Serial.println("SNOOZE OVER");
    digitalWrite(pinVIBRATION, 1);

  }
}
```

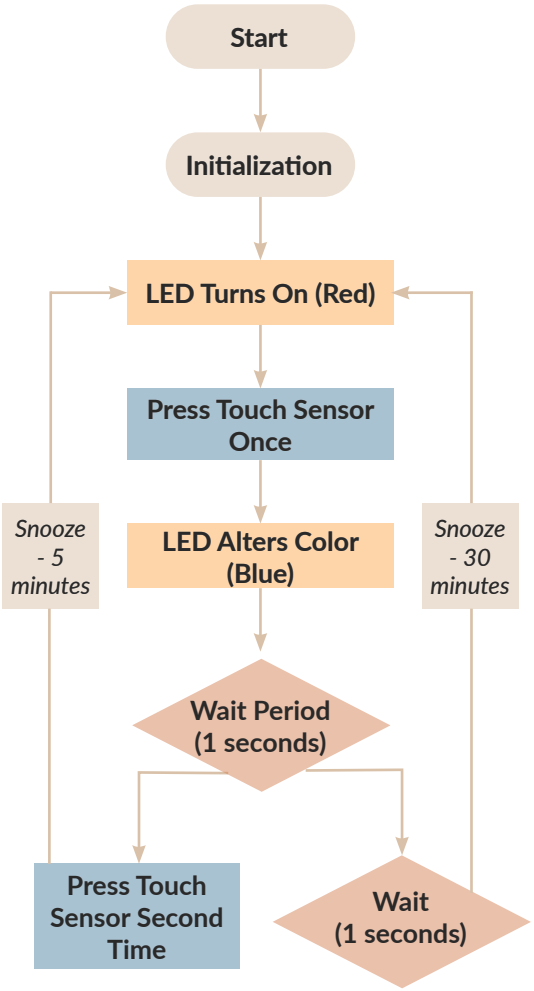
Tech Set-up 4: Touch Sensor, Gradual Light Change, and Clip

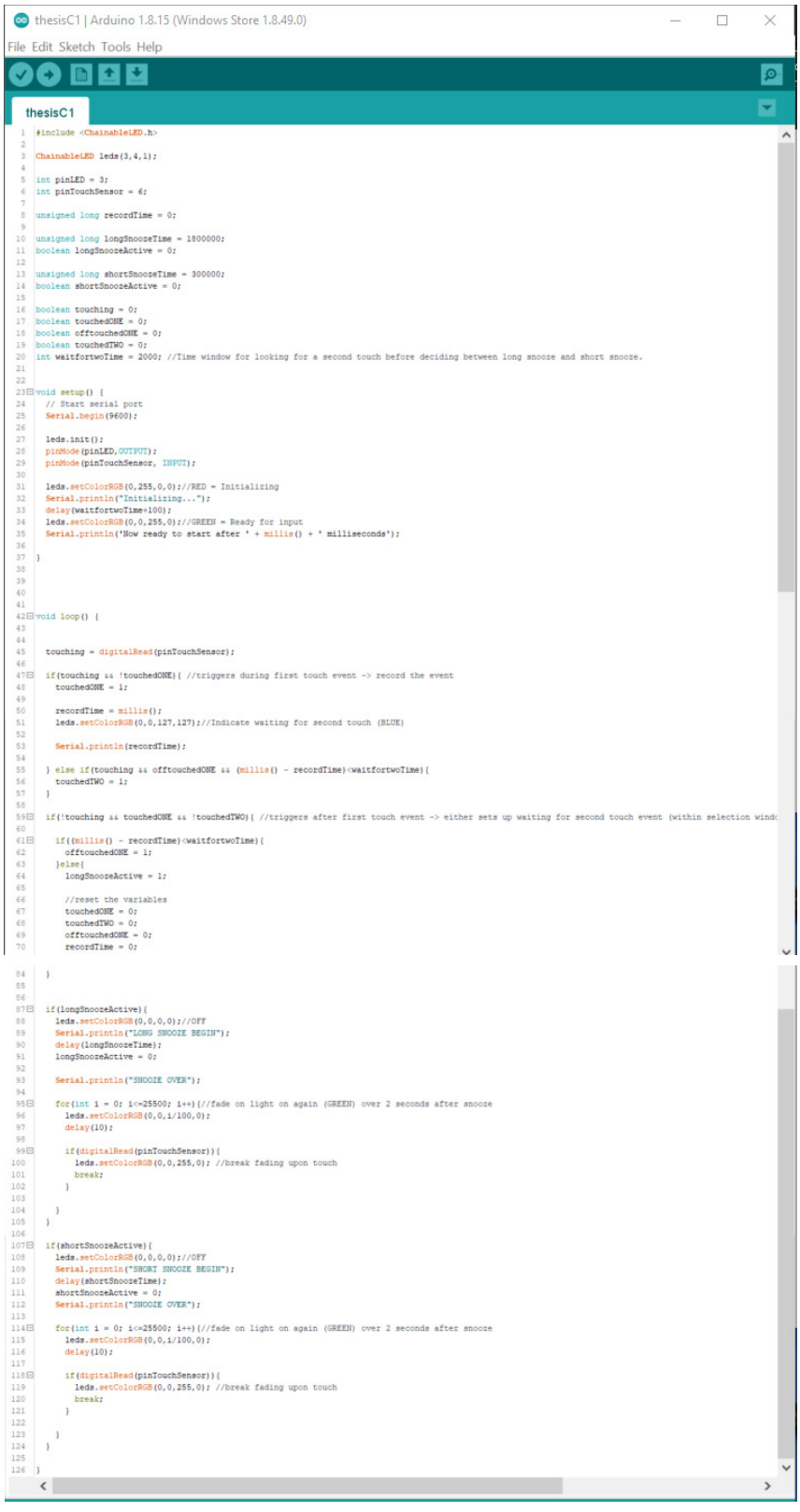


Equipment

- Arduino Uno Board
- Grove - RBG Chainable LED
- Grove - Touch Sensor
- Clip
- Power Cable

Arduino Code





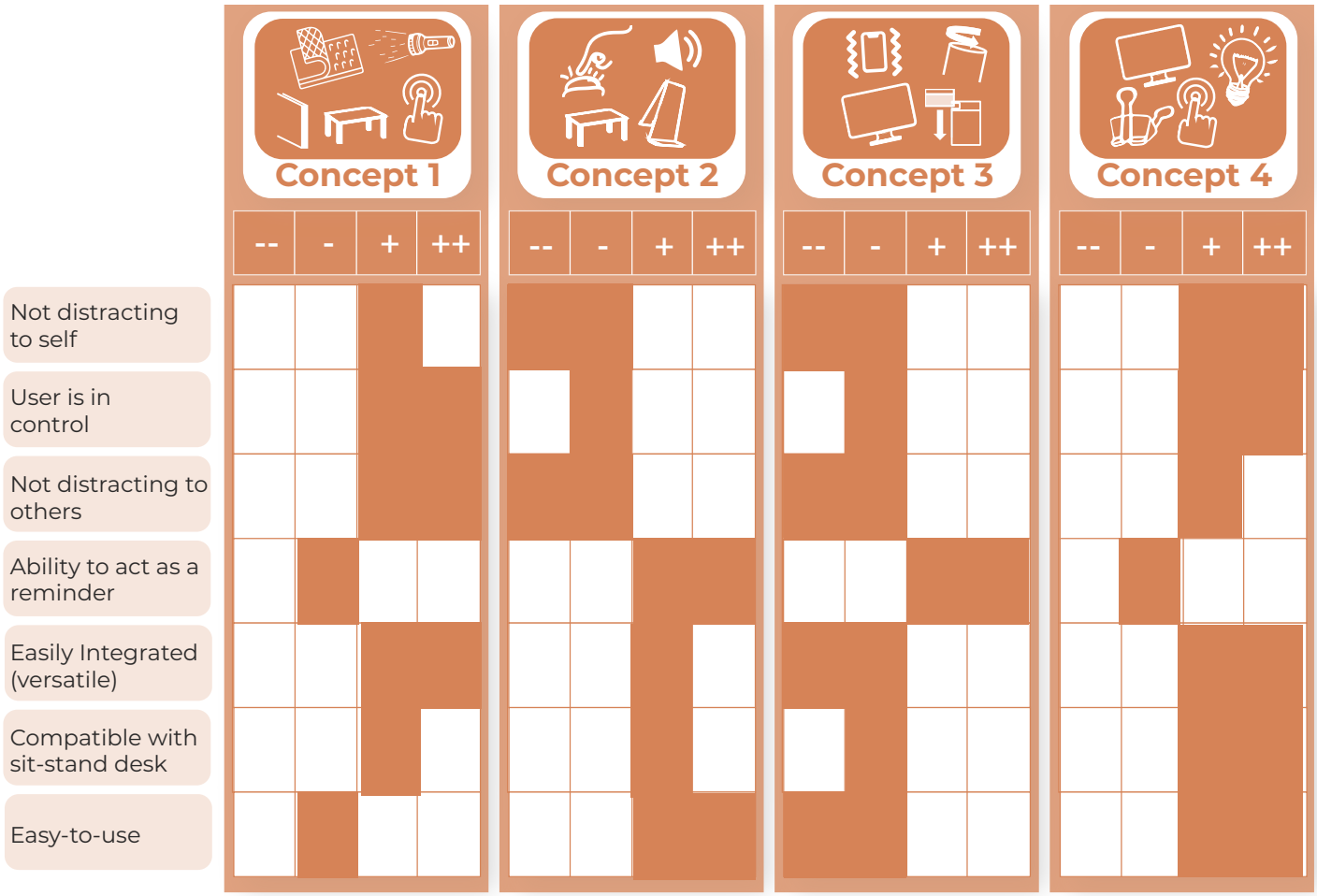
thesisC1 | Arduino 1.8.15 (Windows Store 1.8.49.0)

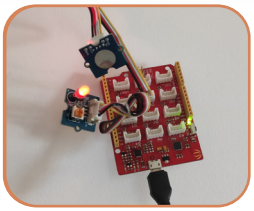
File Edit Sketch Tools Help

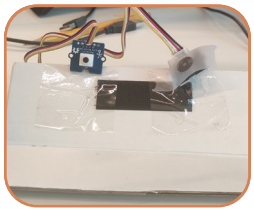
thesisC1

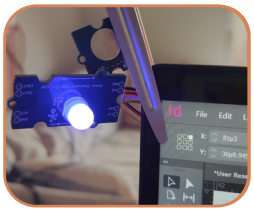
```
#include <ChainableLED.h>

ChainableLED leds(3,4,1);

int pinLED = 3;
int pinTouchSensor = 6;

unsigned long recordTime = 0;

unsigned long longSnoozeTime = 1800000;
boolean longSnoozeActive = 0;

unsigned long shortSnoozeTime = 300000;
boolean shortSnoozeActive = 0;

boolean touching = 0;
boolean touchedONE = 0;
boolean offtouchedONE = 0;
boolean touchedTWO = 0;
int waitfortwoTime = 2000; //Time window for looking for a second touch before deciding between long snooze and short snooze.


void setup() {
  // Start serial port
  Serial.begin(9600);

  leds.init();
  pinMode(pinLED,OUTPUT);
  pinMode(pinTouchSensor, INPUT);

  leds.setColorRGB(0,255,0,0);//RED = Initializing
  Serial.println("Initializing...");
  delay(waitfortwoTime+100);
  leds.setColorRGB(0,0,255,0);//GREEN = Ready for input
  Serial.println('Now ready to start after ' + millis() + ' milliseconds');
}



void loop() {


  touching = digitalRead(pinTouchSensor);

  if(touching && !touchedONE){ //triggers during first touch event -> record the event
    touchedONE = 1;

    recordTime = millis();
    leds.setColorRGB(0,0,127,127);//Indicate waiting for second touch (BLUE)

    Serial.println(recordTime);

  } else if(touching && offtouchedONE && (millis() - recordTime)<waitfortwoTime){
    touchedTWO = 1;
  }

  if(!touching && touchedONE && !touchedTWO){ //triggers after first touch event -> either sets up waiting for second touch event (within selection windo

    if((millis() - recordTime)<waitfortwoTime){
      offtouchedONE = 1;
    }else{
      longSnoozeActive = 1;

      //reset the variables
      touchedONE = 0;
      touchedTWO = 0;
      offtouchedONE = 0;
      recordTime = 0;
    }


  if(longSnoozeActive){
    leds.setColorRGB(0,0,0,0);//OFF
    Serial.println("LONG SNOOZE BEGIN");
    delay(longSnoozeTime);
    longSnoozeActive = 0;

    Serial.println("SNOOZE OVER");

    for(int i = 0; i<=25500; i++){//fade on light on again (GREEN) over 2 seconds after snooze
      leds.setColorRGB(0,0,i/100,0);
      delay(10);

      if(digitalRead(pinTouchSensor)){
        leds.setColorRGB(0,0,255,0); //break fading upon touch
        break;
      }

    }
  }

  if(shortSnoozeActive){
    leds.setColorRGB(0,0,0,0);//OFF
    Serial.println("SHORT SNOOZE BEGIN");
    delay(shortSnoozeTime);
    shortSnoozeActive = 0;
    Serial.println("SNOOZE OVER");

    for(int i = 0; i<=25500; i++){//fade on light on again (GREEN) over 2 seconds after snooze
      leds.setColorRGB(0,0,i/100,0);
      delay(10);

      if(digitalRead(pinTouchSensor)){
        leds.setColorRGB(0,0,255,0); //break fading upon touch
        break;
      }

    }
  }
}
```

Evaluation: Harris Profile









- \+ Not too distracting for coworkers (since it is small and in my own area)
- \+ Easy-to-use (sensor)
- \+ Could be placed where ever I want on screen
- − If stuck to wall, not easy-to-use since it is out of reach
- − If stuck on desk, easy to use, but also easier to ignore/cover with papers
- − Quick light-on and flash was a bit distracting

- \+ Hard to ignore
- \+ Stand was easily integrated to desk
- \+ Button was easy-to-use (common element in electronics)
- − Extremely distracting for myself and for coworkers
- − Resulted in a break in concentration
- − Got annoying after a time
- − Since it is annoying, I turned it off quickly and then forgot about it(could not make my own decision when to notice it)
- − With a lot of things, stand could be push out of the way

- \+ Hard to Ignore
- − Rotating dial did not work properly
- − Extremely distracting for myself and for coworkers
- − Resulted in a break in concentration
- − Got annoying after a time
- − Since it is annoying, I turned it off quickly and then forgot about it(could not make my own decision when to notice it)
- − Slide-On element is not versatile and it is not adjustable for different screen widths

- \+ Gradual change in color was not distracting to work
- \+ I could notice light when I was ready
- \+ Clip can be adjust to different screen widths
- \+ Easily reachable to press sensor
- \+ Easy-to-use (sensor)
- \+ Could be placed where ever I want on screen
- − Easy to ignore

Limitations

This study was done as a self-testing procedure due to limited time and Covid restrictions which could have an effect on the outcome.

Appendix XI:
The Final Prototype

THE ARDUINO CODE

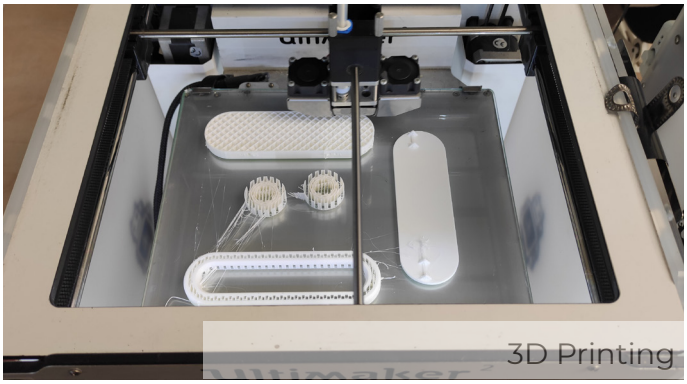
```
#include <FadeChainableLed.h>
#include <Bounce2.h>
#include <Adafruit_VL53L0X.h>

// LED pins
const byte NUM_LEDS = 1;
const byte CLK_PIN = 7;
const byte DATA_PIN = 8;

// Button pins
const byte SNOOZE_PIN = 5;
const byte CHECK_IN_PIN = 6;

// Distance sensor settings
const byte LOX_SHUTDOWN_PIN = 2; // Reset pin of distance sensor
const byte LOX_I2C_ADDR = 0x30; // I2C address of distance sensor
const byte LOX_SAMPLE_SIZE = 1; // Samples to take for one reading
const unsigned int DISTANCE_TIMER = 10000; // Time between readings (millis)

// Timings (millis)
const unsigned int SHORT_SNOOZE_TIME = 1; // Snooze time after snoozing (seconds)
const unsigned int LONG_SNOOZE_TIME = 3; // Snooze time after checking in (seconds)

// Sit/Stand settings
const unsigned int SIT_STAND_THRESHOLD = 300; // Minimum difference between sitting and standing (millimeters)
const unsigned int SIT_STAND_SNOOZE_TIME = 6; // Snooze time after changing between sitting and standing (seconds)

ChainableLED *leds;
FadeChainableLed *fade;
Bounce2::Button *checkInButton;
Bounce2::Button *snoozeButton;
Adafruit_VL53L0X *distanceSensor;

bool snoozing = false;
unsigned long snoozeStart = 0;
unsigned int snoozeTime = 0;
unsigned int startingDistance = 0;
unsigned int distance = 0;
unsigned long lastMeasuredAt = 0;

void setup()
{
```

```
  // Start serial port
  Serial.begin(250000);
  // wait until serial port opens for native USB devices
  while (!Serial)
  {
    delay(1);
  }
  Serial.println("Initializing...");
  leds = new ChainableLED(CLK_PIN, DATA_PIN, NUM_LEDS);
  leds->setColorRGB(0, 255, 0, 0);
  fade = new FadeChainableLed(leds, NUM_LEDS);
  distanceSensor = new Adafruit_VL53L0X();
  if (!initLox(distanceSensor))
  {
    while(1);
  }
  initButtons();
  delay (1000);
  Serial.print("Now ready to start after ");
  Serial.print(millis());
  Serial.println(" milliseconds");
  fade->set(0, 0, 255, 0);
}

void initButtons()
{
  checkInButton = new Bounce2::Button();
  checkInButton->attach(CHECK_IN_PIN, INPUT);
  checkInButton->interval(25);
  checkInButton->setPressedState(HIGH);
  snoozeButton = new Bounce2::Button();
  snoozeButton->attach(SNOOZE_PIN, INPUT);
  snoozeButton->interval(25);
  snoozeButton->setPressedState(HIGH);
}

bool initLox(Adafruit_VL53L0X *lox)
{
  pinMode(LOX_SHUTDOWN_PIN, OUTPUT);
  digitalWrite(LOX_SHUTDOWN_PIN, LOW);
  delay(10);
  digitalWrite(LOX_SHUTDOWN_PIN, HIGH);
  if (!lox->begin(LOX_I2C_ADDR, false, &Wire, Adafruit_VL53L0X::VL53L0X_SENSE_LONG_RANGE))
  {
    Serial.println("Failed to boot VL53L0X");
    return false;
  }
  startingDistance = measureDistance(lox);
  distance = startingDistance;
  Serial.print("Starting position: ");
  Serial.println(startingDistance);
  return true;
}

void loop()
{
  updateButtons();
  fade->update();
```

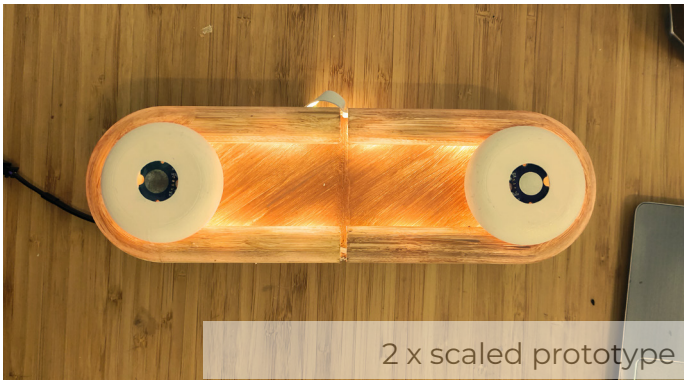
```
  if ((unsigned long)(millis() - lastMeasuredAt) > DISTANCE_TIMER)
  {
    updateDistance();
    Serial.print("Distance: ");
    Serial.println(distance);
    if (abs(distance - (long)startingDistance) > SIT_STAND_THRESHOLD)
    {
      startingDistance = distance;
      snoozing = true;
      snoozeStart = millis();
      snoozeTime = SIT_STAND_SNOOZE_TIME * 1000;
      fade->stop(0);
      Serial.println("Changed between sitting and standing");
      Serial.print("Sleep for ");
      Serial.print(snoozeTime / 1000);
      Serial.println(" seconds");
    }
  }
  if (checkInButton->pressed())
  {
    snoozing = true;
    snoozeStart = millis();
    snoozeTime = LONG_SNOOZE_TIME * 1000;
    fade->stop(0);
    Serial.println("Long snooze!");
    Serial.print("Sleep for ");
    Serial.print(snoozeTime / 1000);
    Serial.println(" seconds");
  }
  if (snoozeButton->pressed())
  {
    snoozing = true;
    snoozeStart = millis();
    snoozeTime = SHORT_SNOOZE_TIME * 1000;
    fade->stop(0);
    Serial.println("Short snooze!");
    Serial.print("Sleep for ");
    Serial.print(snoozeTime / 1000);
    Serial.println(" seconds");
  }
  if (snoozing && (unsigned long)(millis() - snoozeStart) >= snoozeTime)
  {
    Serial.println("Waking up! Snooze is over!");
    snoozing = false;
    fade->set(0, 0, 255, 0);
  }
}

void updateButtons()
{
  checkInButton->update();
  snoozeButton->update();
}

void updateDistance()
{
  lastMeasuredAt = millis();
  unsigned int dist = measureDistance(distanceSensor);
```

```
  if (dist > 0)
  {
    distance = dist;
  }
}

unsigned int measureDistance(Adafruit_VL53L0X *lox)
{
  unsigned long x = millis();
  VL53L0X_RangingMeasurementData_t measure;
  byte failCount = 0;
  unsigned int dist = 0;
  for (byte i = 1; i <= LOX_SAMPLE_SIZE; i++)
  {
    lox->rangingTest(&measure, false);
    if (measure.RangeStatus != 4)  // phase failures have incorrect data
    {
      dist += measure.RangeMilliMeter;
    }
    else
    {
      Serial.println("Invalid measurement");
      i--;
      failCount++;
      if (failCount > LOX_SAMPLE_SIZE)
      {
        return 0;
      }
    }
  }
  Serial.print("Measuring distance took ");
  Serial.print(millis() - x);
  Serial.println(" milliseconds");
  return dist / LOX_SAMPLE_SIZE;
}
```

THE PROTOTYPES



3D Printing



2 x scaled prototype

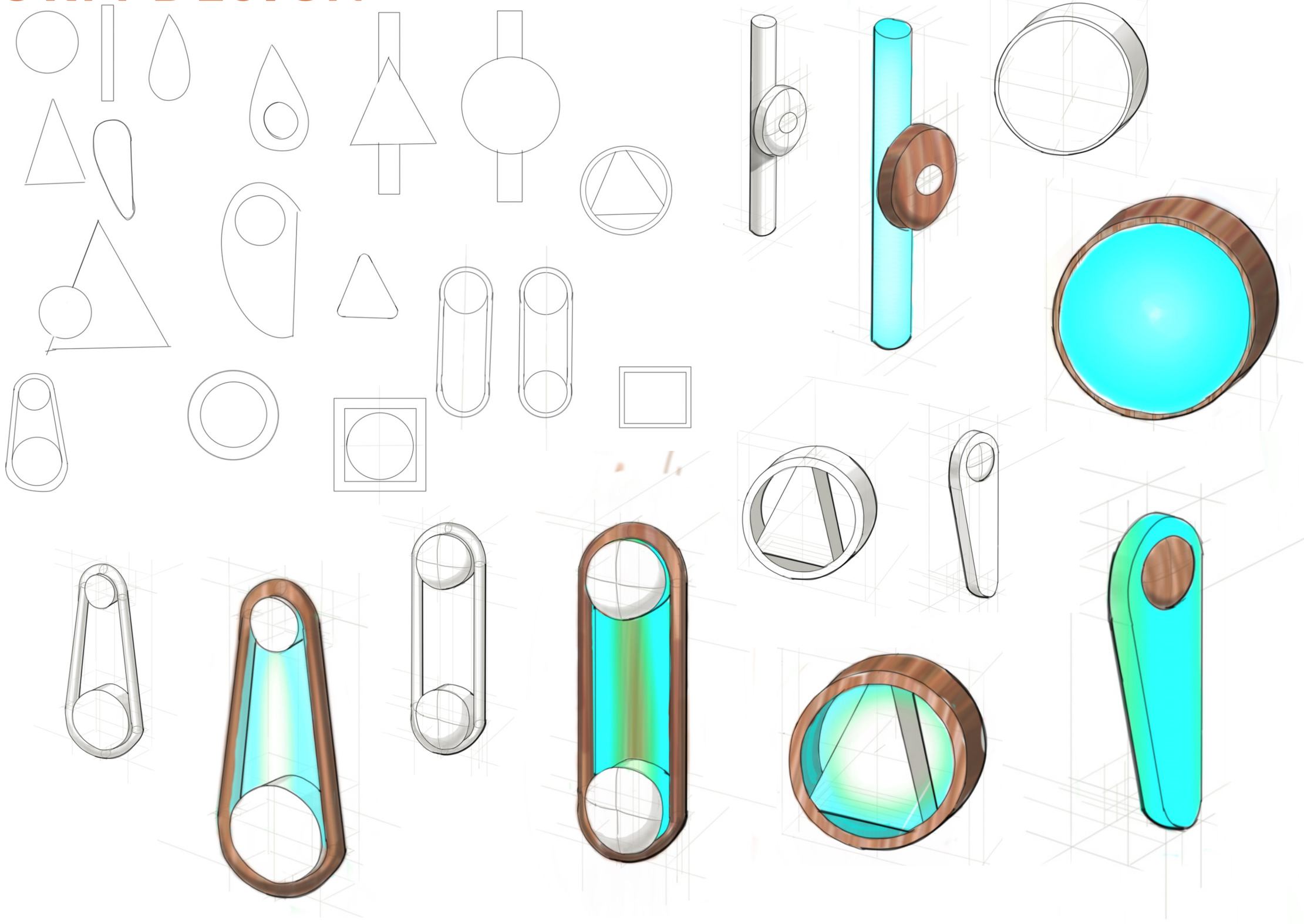
Building & Painting the Prototypes

1 x scaled prototype

Appendix X: Form Design


Simple,
Peaceful,
Elegant

FORM DESIGN



HOW IT WILL LOOK

Appendix XI:
The Final Prototype

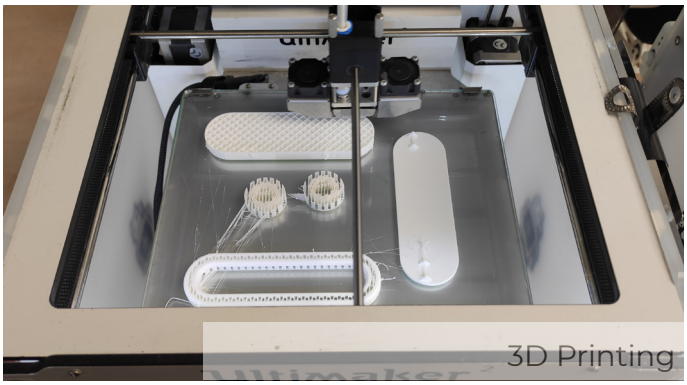
THE ARDUINO CODE

```
#include <FadeChainableLed.h>
#include <Bounce2.h>
#include <Adafruit_VL53L0X.h>

// LED pins
const byte NUM_LEDS = 1;
const byte CLK_PIN = 7;
const byte DATA_PIN = 8;

// Button pins
const byte SNOOZE_PIN = 5;
const byte CHECK_IN_PIN = 6;

// Distance sensor settings
const byte LOX_SHUTDOWN_PIN = 2; // Reset pin of distance sensor
const byte LOX_I2C_ADDR = 0x30; // I2C address of distance sensor
const byte LOX_SAMPLE_SIZE = 1; // Samples to take for one reading
const unsigned int DISTANCE_TIMER = 10000; // Time between readings (millis)

// Timings (millis)
const unsigned int SHORT_SNOOZE_TIME = 1; // Snooze time after snoozing (seconds)
const unsigned int LONG_SNOOZE_TIME = 3; // Snooze time after checking in (seconds)

// Sit/Stand settings
const unsigned int SIT_STAND_THRESHOLD = 300; // Minimum difference between sitting and standing (millimeters)
const unsigned int SIT_STAND_SNOOZE_TIME = 6; // Snooze time after changing between sitting and standing (seconds)

ChainableLED *leds;
FadeChainableLed *fade;
Bounce2::Button *checkInButton;
Bounce2::Button *snoozeButton;
Adafruit_VL53L0X *distanceSensor;

bool snoozing = false;
unsigned long snoozeStart = 0;
unsigned int snoozeTime = 0;
unsigned int startingDistance = 0;
unsigned int distance = 0;
unsigned long lastMeasuredAt = 0;

void setup()
{
```

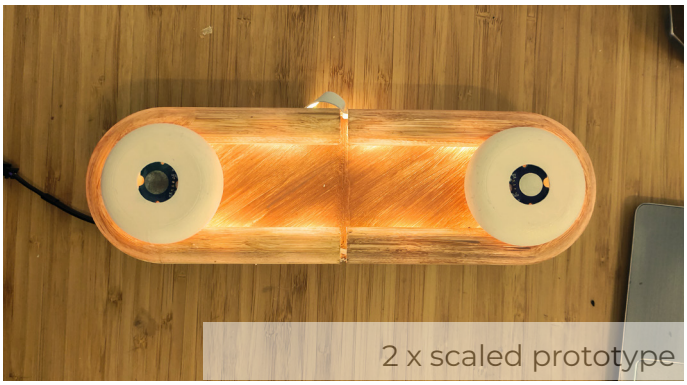
```
  // Start serial port
  Serial.begin(250000);
  // wait until serial port opens for native USB devices
  while (!Serial)
  {
    delay(1);
  }
  Serial.println("Initializing...");
  leds = new ChainableLED(CLK_PIN, DATA_PIN, NUM_LEDS);
  leds->setColorRGB(0, 255, 0, 0);
  fade = new FadeChainableLed(leds, NUM_LEDS);
  distanceSensor = new Adafruit_VL53L0X();
  if (!initLox(distanceSensor))
  {
    while(1);
  }
  initButtons();
  delay (1000);
  Serial.print("Now ready to start after ");
  Serial.print(millis());
  Serial.println(" milliseconds");
  fade->set(0, 0, 255, 0);
}

void initButtons()
{
  checkInButton = new Bounce2::Button();
  checkInButton->attach(CHECK_IN_PIN, INPUT);
  checkInButton->interval(25);
  checkInButton->setPressedState(HIGH);
  snoozeButton = new Bounce2::Button();
  snoozeButton->attach(SNOOZE_PIN, INPUT);
  snoozeButton->interval(25);
  snoozeButton->setPressedState(HIGH);
}

bool initLox(Adafruit_VL53L0X *lox)
{
  pinMode(LOX_SHUTDOWN_PIN, OUTPUT);
  digitalWrite(LOX_SHUTDOWN_PIN, LOW);
  delay(10);
  digitalWrite(LOX_SHUTDOWN_PIN, HIGH);
  if (!lox->begin(LOX_I2C_ADDR, false, &Wire, Adafruit_VL53L0X::VL53L0X_SENSE_LONG_RANGE))
  {
    Serial.println("Failed to boot VL53L0X");
    return false;
  }
  startingDistance = measureDistance(lox);
  distance = startingDistance;
  Serial.print("Starting position: ");
  Serial.println(startingDistance);
  return true;
}

void loop()
{
  updateButtons();
  fade->update();
```

```
  if ((unsigned long)(millis() - lastMeasuredAt) > DISTANCE_TIMER)
  {
    updateDistance();
    Serial.print("Distance: ");
    Serial.println(distance);
    if (abs(distance - (long)startingDistance) > SIT_STAND_THRESHOLD)
    {
      startingDistance = distance;
      snoozing = true;
      snoozeStart = millis();
      snoozeTime = SIT_STAND_SNOOZE_TIME * 1000;
      fade->stop(0);
      Serial.println("Changed between sitting and standing");
      Serial.print("Sleep for ");
      Serial.print(snoozeTime / 1000);
      Serial.println(" seconds");
    }
  }
  if (checkInButton->pressed())
  {
    snoozing = true;
    snoozeStart = millis();
    snoozeTime = LONG_SNOOZE_TIME * 1000;
    fade->stop(0);
    Serial.println("Long snooze!");
    Serial.print("Sleep for ");
    Serial.print(snoozeTime / 1000);
    Serial.println(" seconds");
  }
  if (snoozeButton->pressed())
  {
    snoozing = true;
    snoozeStart = millis();
    snoozeTime = SHORT_SNOOZE_TIME * 1000;
    fade->stop(0);
    Serial.println("Short snooze!");
    Serial.print("Sleep for ");
    Serial.print(snoozeTime / 1000);
    Serial.println(" seconds");
  }
  if (snoozing && (unsigned long)(millis() - snoozeStart) >= snoozeTime)
  {
    Serial.println("Waking up! Snooze is over!");
    snoozing = false;
    fade->set(0, 0, 255, 0);
  }
}

void updateButtons()
{
  checkInButton->update();
  snoozeButton->update();
}

void updateDistance()
{
  lastMeasuredAt = millis();
  unsigned int dist = measureDistance(distanceSensor);
```

```
  if (dist > 0)
  {
    distance = dist;
  }
}

unsigned int measureDistance(Adafruit_VL53L0X *lox)
{
  unsigned long x = millis();
  VL53L0X_RangingMeasurementData_t measure;
  byte failCount = 0;
  unsigned int dist = 0;
  for (byte i = 1; i <= LOX_SAMPLE_SIZE; i++)
  {
    lox->rangingTest(&measure, false);
    if (measure.RangeStatus != 4)  // phase failures have incorrect data
    {
      dist += measure.RangeMilliMeter;
    }
    else
    {
      Serial.println("Invalid measurement");
      i--;
      failCount++;
      if (failCount > LOX_SAMPLE_SIZE)
      {
        return 0;
      }
    }
  }
  Serial.print("Measuring distance took ");
  Serial.print(millis() - x);
  Serial.println(" milliseconds");
  return dist / LOX_SAMPLE_SIZE;
}
```



3D Printing



2 x scaled prototype

Building & Painting the Prototypes

1 x scaled prototype

Appendix XII: Testing the User Experience

TESTING THE USER EXPERIENCE

Research Objective

The goal of the final user evaluation is to evaluate the final concept based on desirability, viability, and user experience.

Method

The evaluation is broken up into two different methods. The first method involves a focus group where participants were able to interact with both the digital and non-digital prototypes to evaluate them based on their experience. The second method involves an Online questionnaire that was sent out to all of the initial participants who participated in the first questionnaire. This way, a wide range of users will be able to evaluate the product and provide insights. The following sections will provide a more in-depth explanation of the methods used.

Focus Group

Focus groups are often used to test a product or service concept in order to gather recommendations for the future. This type of method is quite insightful in an agile design process as it provides an overview of consumer's opinions about the product. As the focus group allows for a free-flowing discussion, many unexpected findings can arise.

Location

The focus group took place in Studio 6 at the IO Faculty over the course of 1.5 hours. This location was selected as it provided enough space as well as access to sit-stand desks. Due to the closing time of the faculty, 17:45, selecting 13:45 as the starting time, ensure there was enough time to hold the full evaluation.

Participants

The participants included a mix of 5 students and working adults, all whom had access to the IO faculty. Due to the current Covid Regulation set in place, participants must be able to sign into the faculty with a TU Delft card.

Participants were asked to bring in their own computers.

Equipment

The following equipment was used in this evaluation:

- Video Recorder
- Voice Recorder
- 1-by-1 scaled prototype
- 1-by-2 scaled working prototype
- Laminated photo of rendered image
- Laminated photo of use scenario
- Figma digital application prototype
- Research laptop & charging cable
- Sit-stand desks

Procedure

Step 1: Introduction to the Project
Participants will enter the evaluation room and will be asked to sit at a specific sit-stand desk, take out their laptops, and place their laptops to their side. The desks will be arrange so that all participants are able to easily talk to one another.

Once participants are set up they will be provided with the following introduction to the project:

(Start Recording)

"Welcome and thank you for participating in this concept evaluation!

Today, humans are spending increasing amounts of time in environments that not only limit access to physical activity but also promote sedentary behavior (e.g. prolonged periods of sitting, reclining, or lying posture). Whether it is at work, at home, in transportation, or in our communities, all of these environments have been (re)engineered in a way that minimizes human movement and muscular activity. This phenomenon is growing on a global scale and has become a great area for concern, as research has proven that prolonged sedentary behavior is linked to an increase in all-cause mortality as well as adverse health effects such as cardiovascular diseases and musculoskeletal discomfort.

With the average working-age adult in high-income countries sitting about 9.3 hours per day, these individuals are proposed to be at greater risks for the poor health outcomes associated with sedentary behavior. As jobs are becoming less and less active, and the workforce is spending almost a third of their lives in the office, with a majority of that time spent sitting behind their desks, this time is only expected to increase.

This topic has become even more relevant due to the Covid-19 pandemic, as working adults' are often trading in their commute times with more hours spent sitting behind their desks working.

Over the past six months, the goal of my thesis was to design a solution aimed at reducing the sedentary behavior of working adults within the workplace. For this project, there was a specific focus on sit-stand desks as they are the most commonly implemented tactic used by employers to reduce sedentary behavior and improve the physical wellbeing of their employees. But studies showed that even though many working adults have access to sit-stand desks, they do not actually use the desk in the standing position and instead remain in a static sitting position for more than they initially intended. The initial research carried out in this project analyzed why this lack of sit-stand desk use might occur and how working adults' who are active users of sit-stand desks were able to develop and maintain this behavior.

It is important to note that sitting itself is not a problem, but it is the static and prolonged periods of sitting that harm the human body. Therefore it was essential to design a solution that

promotes the transition between the sitting and standing positions, rather than just focusing on getting working adults to stand."

At the end of the introduction, participants are asked the following question:

1. How would you each describe your typical workday when it comes to your sedentary behavior? Were you aware that it was such an issue?

Step 2: Introduction to the Concept
Before providing the users with the product, they are given a brief introduction to the concept. This is done to ensure they are listening to the descriptions rather than focusing on the concept itself. They are provided with the following explanation:

"The BMDesk presents a solution that combines a digital application with a controller to aid working adults in using their own body and mind as indicators for transitioning between sitting and standing. The product consists of a controller that can be attached to the user's monitor and uses light as a cue to prompt the user to do self check-ins. Once the light turns on, the user can choose whether to check in or snooze by pressing the correlated button. When the user chooses to check-in, the digital app will open up on their screen to provide step-by-step directions for a body and mind scan. The user is then provided with tips on how to adjust their posture or make a transition between sitting or standing, based on their self-evaluation. If the user decides to transition their position from sitting to standing, or vice versa, the controller will note the change and automatically send it to the app where it will be recorded so that the user can track their progress. As the users becomes more competent in using their body & mind as a prompt to alter between sitting and standing and is able to automatically associate the light with their self check-ins, the digital app step-by-step body & mind check-ins will pop-up less often."

After the explanation is complete, participants are given the box containing the 1-1 scaled prototype and a render of the final device. As each participant is provided with some time to interact with the prototype, they will be asked the following questions:

1. Based on the explanation provided before, how do you think the product will work (eg. snooze, check-in, etc.)
2. Where on your workstation would you place the prototype? Why?

Before moving on, ask the participants if they have any questions.

Step 3: Controller/Digital Application Walk Through
Each participant will be provided with a page presented the use scenario of the product. With the research, the scenario will be explained and users will be able to see how the product will work in real life using the 1-2 scaled prototype.

Step 3.1 : The 1-2 prototype will be introduced to the users. As the light gradually fades on, users will be asked to "check-in." Once they press the button on the prototype, the light will switch off and they will be sent a link to the Figma digital prototype.
Step 3-2 : Users will be provided with about 5-10 minutes to go through the digital application.

Once this is complete, the following questions are asked:

1. How did you feel about your interaction with the product? Was it easy to understand how it is supposed to be used?
2. In what use scenarios would you not use the product?
3. How would you alter the product to improve upon it so that it better suits your needs? One thought is to alter the appearance of the product so that it looks more medical, what would you prefer?
4. What kind of feedback information do you think would improve the interaction? (eg. adding

something to keep interest going, indication when goal is complete, welcoming/start-up, closing/end of work)

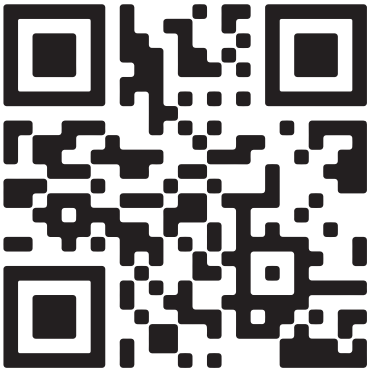
Step 4: Conclusion
Ask the participants if they have any further comments or questions before closing the session.

Thank the participants for coming and providing relevant feedback.

Data Analysis

The recorded data is transcribed and the findings are analyzed and reported by indicating the main opinions and range in opinions for each question.

Scan or Click to get to the questionnaire



Appendix XII: Testing the User Experience

TESTING THE USER EXPERIENCE

Research Objective

The goal of the final user evaluation is to evaluate the final concept based on desirability, viability, and user experience.

Method

The evaluation is broken up into two different methods. The first method involves a focus group where participants were able to interact with both the digital and non-digital prototypes to evaluate them based on their experience. The second method involves an Online questionnaire that was sent out to all of the initial participants who participated in the first questionnaire. This way, a wide range of users will be able to evaluate the product and provide insights. The following sections will provide a more in-depth explanation of the methods used.

Focus Group

Focus groups are often used to test a product or service concept in order to gather recommendations for the future. This type of method is quite insightful in an agile design process as it provides an overview of consumer's opinions about the product. As the focus group allows for a free-flowing discussion, many unexpected findings can arise.

Location

The focus group took place in Studio 6 at the IO Faculty over the course of 1.5 hours. This location was selected as it provided enough space as well as access to sit-stand desks. Due to the closing time of the faculty, 17:45, selecting 13:45 as the starting time, ensure there was enough time to hold the full evaluation.

Participants

The participants included a mix of 5 students and working adults, all whom had access to the IO faculty. Due to the current Covid Regulation set in place, participants must be able to sign into the faculty with a TU Delft card.

Participants were asked to bring in their own computers.

Equipment

The following equipment was used in this evaluation:

- Video Recorder
- Voice Recorder
- 1-by-1 scaled prototype
- 1-by-2 scaled working prototype
- Laminated photo of rendered image
- Laminated photo of use scenario
- Figma digital application prototype
- Research laptop & charging cable
- Sit-stand desks

Procedure

Step 1: Introduction to the Project
Participants will enter the evaluation room and will be asked to sit at a specific sit-stand desk, take out their laptops, and place their laptops to their side. The desks will be arrange so that all participants are able to easily talk to one another.

Once participants are set up they will be provided with the following introduction to the project:

(Start Recording)

"Welcome and thank you for participating in this concept evaluation!

Today, humans are spending increasing amounts of time in environments that not only limit access to physical activity but also promote sedentary behavior (e.g. prolonged periods of sitting, reclining, or lying posture). Whether it is at work, at home, in transportation, or in our communities, all of these environments have been (re)engineered in a way that minimizes human movement and muscular activity. This phenomenon is growing on a global scale and has become a great area for concern, as research has proven that prolonged sedentary behavior is linked to an increase in all-cause mortality as well as adverse health effects such as cardiovascular diseases and musculoskeletal discomfort.

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