OVERCOMING THE FEAR OF FALLING

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Summary & Description of Final Work

Up to 50% of individuals 65 years and older report a fear of falling. Within this group, 65% report that they restrict their physical activity as a result. This fear, however, is linked to higher incidence of falls. Individuals report slowing their gait to feel more in control, but research shows that this cautious gait results in overthinking and stride variation, making individuals less balanced and more likely to fall. Our study focuses on individuals who have low physical risk — individuals who may not have normally required a walking aid but due to their fear require a cane. Our research question asks, “How might we reduce the fear of falling for cane users?” Based on existing research on fear reduction, we discovered two primary ways to reduce fear. Physically, where we build trust in a person’s body and physical abilities, and cognitively, where we inspire confidence in a person’s environment, gait, and assistive support. We hypothesized that redesigning the cane to encourage confident gait and exercise can help reduce an individual’s fear of falling.

Thus, we introduce our personalized coach, CADY. Employing calm technology principles, CADY sends subtle vibrational cues through the handle of its walking aid to help guide gait. We gather walking data through CADY to encourage constructive conversations with physical therapists. Since medical professionals gather information about a person’s gait through laboratory settings, they often don’t have access to a patient’s true indoor or outdoor behaviors. This information will better equip professionals in determining goals with their patients and ensuring their patients are using the correct walking aid. Our product is part of a larger service that encourages virtual physical therapy sessions and for individuals to find a professional nearby. Since two-thirds of individuals self-prescribe a cane, most do not receive education on how to use it and almost half are misfitted for their cane.

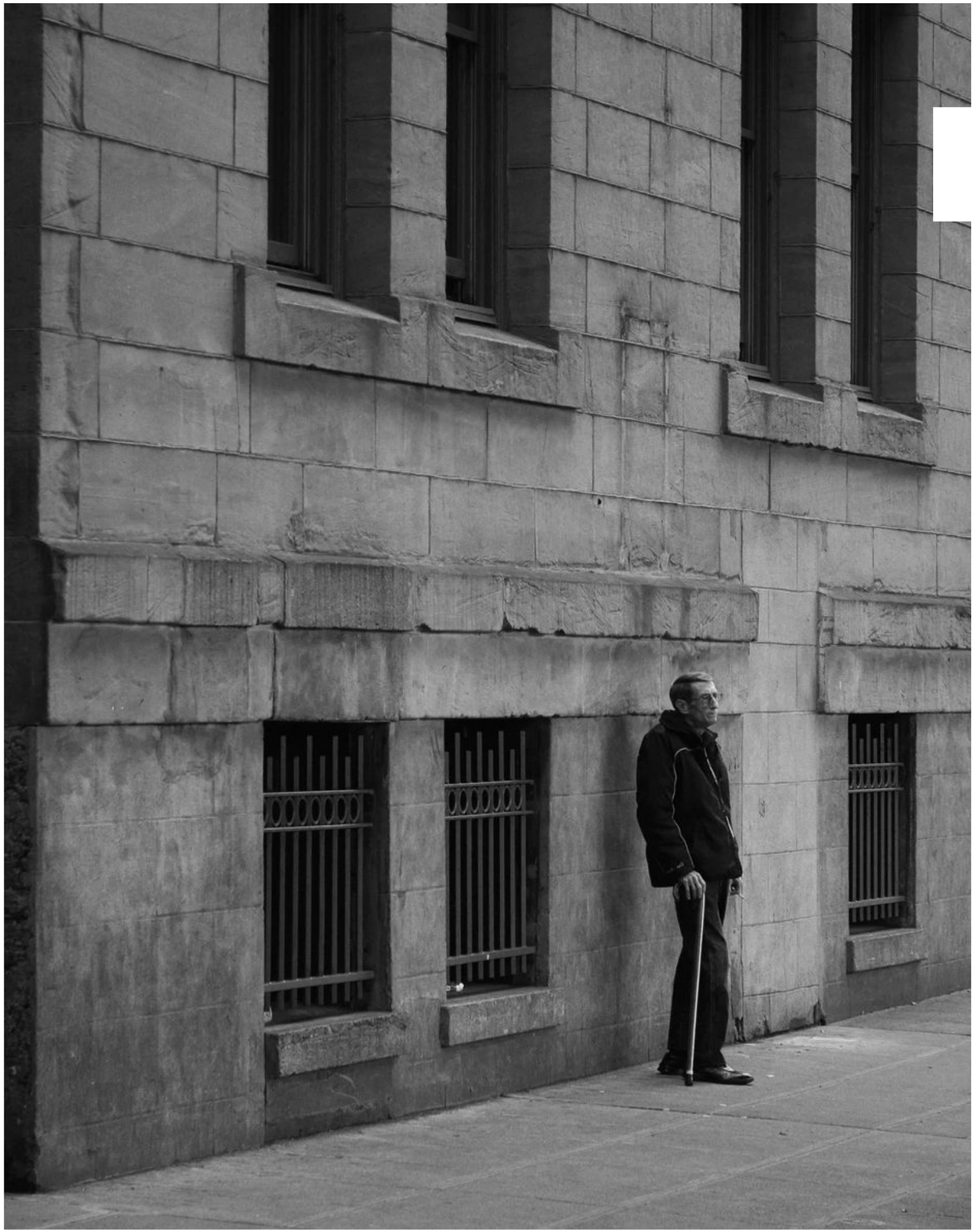
Part of our work in developing CADY is to begin destigmatizing the cane. During our interviews and our research, we learned about people’s hesitancy around using a cane and how they viewed the object as a symbol of aging and their demise. Our aspiration is to put CADY into the hands of users not only needing a cane, but a diversity of populations who need her rhythmic touch to guide them in whatever activity it is that they do — athletes keeping pace, musicians keeping beat, dancers keeping rhythm. This broader acceptance, we hope, could normalize the usage of a walking aid.

Aim & Background

According to one research[1], up to 50% of individuals 65 years and older report a fear of falling. Within this group, 65% report that they feel restriction in their physical activity as a result. Not just restriction, but this fear of falling can cause social isolation, muscular atrophy, depression, and worsened balance. Moreover, according to another research[2], fear of falling is not just restricted to people who are 65 years and older, but rather it is something that affects people across age, gender, education, medical condition, geography, and history of falling.

At first sight, fear of falling may seem harmless, because it doesn't instantly connect with the actual fall yet, however, according to Neuroscience Research Australia, worrying of falling actually is linked to higher incidence of falls. And once you fall, according to Centers of Disease Control and Prevention, it doubles the chance of falling again. Over 800,000 patients are hospitalized annually for fall-related injuries. Death rates related to falling have continued to increase by 30% in the last decade.

The overall risk of fall may be understood as a combination of actual risk of falling and the heightened risk due to fear of falling. The fear of falling increases the risk of physically falling, even for those with low actual risk. For this project, we are particularly going to focus on the with the anxious group who has a low physical risk but actually the total risk has been heightened significantly due to fear.



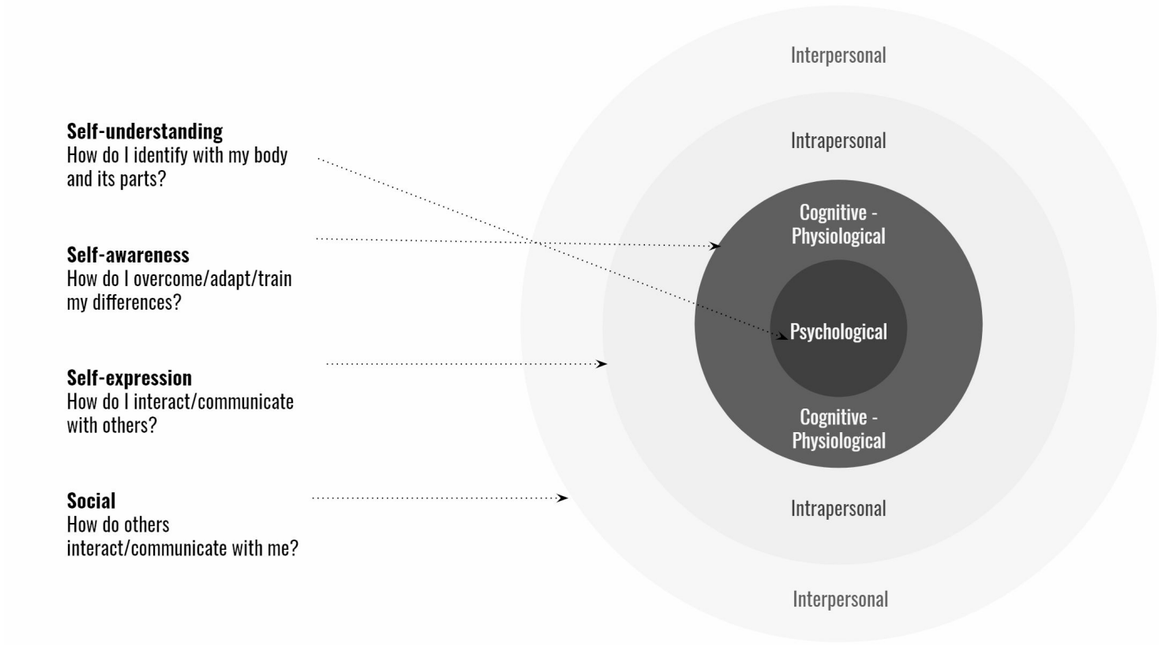
Significance & Impact to Culture and Society

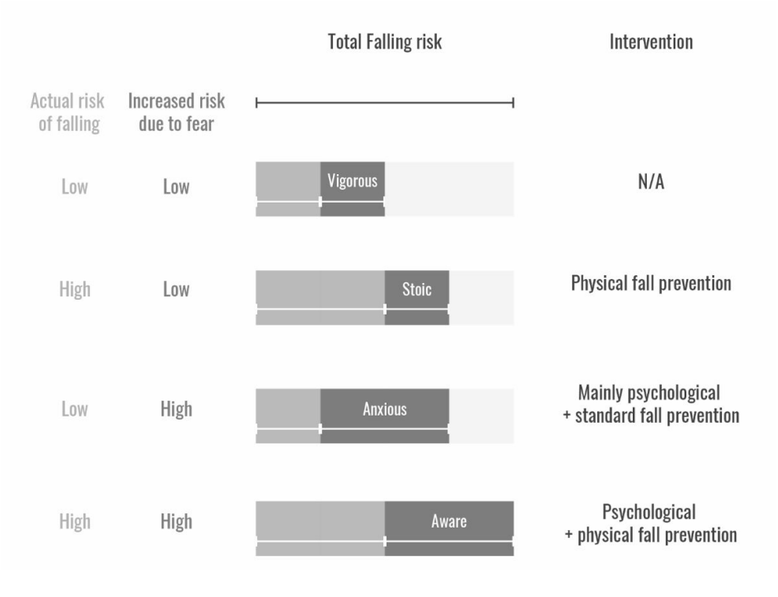
The fear of falling affects people across age, gender, education, medical condition, geography and history of falling. However, it does affect up to 50% of people over the age of 65, a relevant statistic given that populations are living longer and the baby boomer population is beginning to enter this age range. Developing interventions that consider both psychological and physical needs for this population is of utmost importance within the design community. At the same time, designers can be a part of destigmatizing the cane. Once a status symbol, the cane has now become a symbol of aging. While designing CADY, we constantly considered ergonomics and aesthetic, and began the destigmatization process by changing your relationship with your cane in your own home by transforming it into a lamp, as well as aspiring to universalize the experience of CADY by putting it into the hands of not only cane users, but anyone who might benefit from a training coach, baton, metronome, or calm technology, all of which describe facets of CADY.

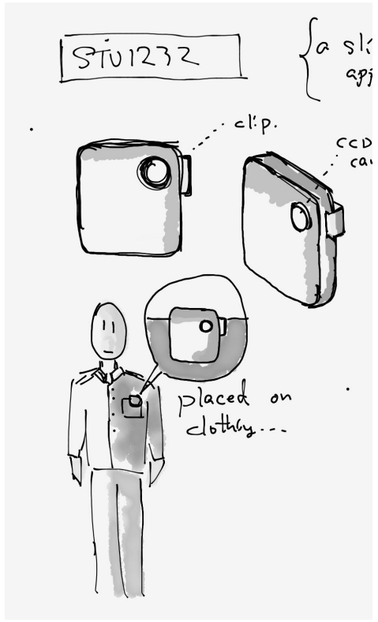
References:
The Inchianti Study
BMC Public Health 2009

Contribution to Mobility Theme

This project directly relates to the theme of mobility because it is aimed as a design intervention that helps alleviate the fear pertaining to walking and further empowering the user to become mobile.







Detailed description of the work

Cady was the result of a design process, that included a blend of phases that develop parallelly.

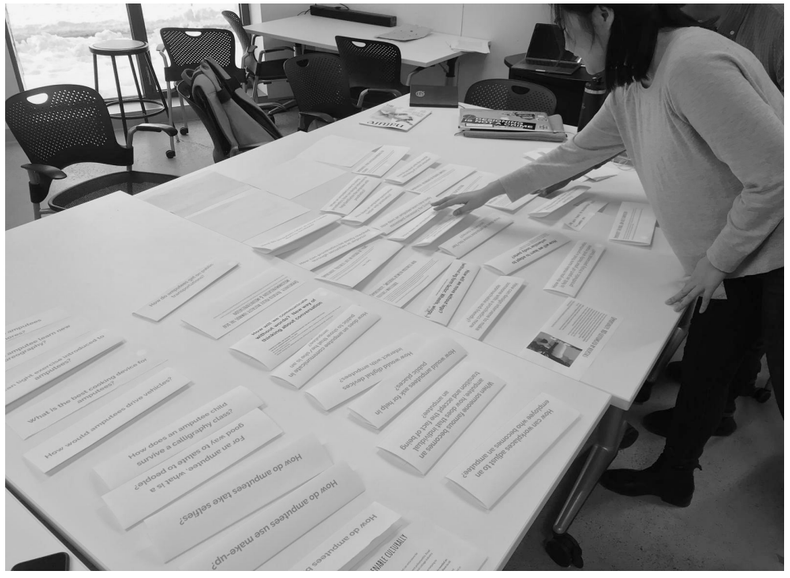
The project started with a **research phase** to find the right space for intervention. We did **desk research** around many **disabled-related topics** such as police violence against disabled people, neuroplasticity in phantom limbs, the association between mental health symptoms and mobility limitation, placebo and pain regulation, and sensory hypersensitivity.

After the research, we were able to **categorize the different users** into four types depending on the ability level and intention. We also **categorized the different levels of interaction** of our possible intervention. These were psychological, cognitive-physiological, interpersonal, and intrapersonal.

The desk research inspired over 50 **HMW question**s, that were discussed as a team to better identify overlapping opportunities and general topic interest. We decided to focus on walking disability. Through the description of multiple user types and interaction models, target users, context, problem phrasing through HMW questions and some envisioned design opportunities, we aimed to further define the problem.

Once we discussed the problem definition, we explored the **precedents** that could guide and inspire our ideation session and helped us to define the problem by identifying saturated solution spaces and existing gaps in overlooked areas.

This phase became a **mix of ideation and problem definition**. Exposure to problems and precedents generated many design ideas that we translated into sketches while we continued trying to find our right intervention. Going through these sketches as a team helped us realized which ideas required timeframes and resources outside of what was available for the project. It also helped to understand where the different member’s abilities, and their communication and collaboration styles.

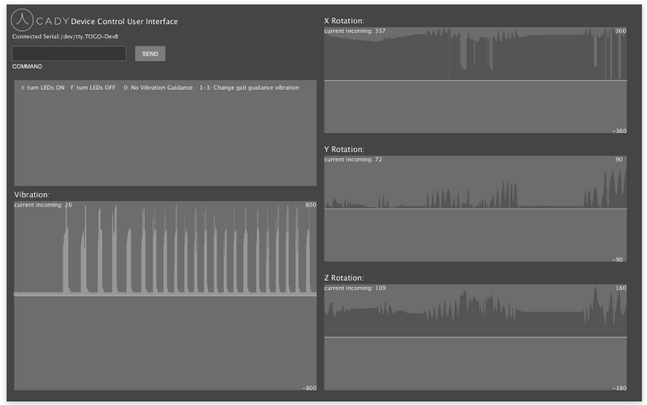


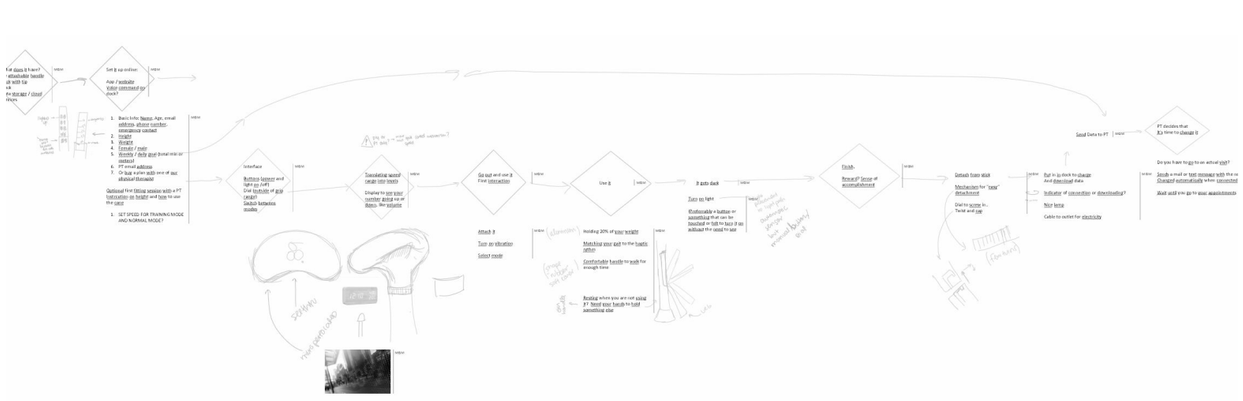
Detailed description of the work

At this moment we started conducting **interviews** with professionals. We interviewed Dr. Friedman, Anesthesiologist @ UM Health Center, Vascular Surgery Unit and Dr. Sheth, Pediatric Heme Oncologist @ Children's Hospital of Los Angeles. Their comments showed us a huge opportunity area in the **cognitive-physiological relation** for walking disability, especially around **walking motivation for walking-aid users**.

Once settled in the walking aid topic. We did more **desk research** about some crucial concepts to **understand different walking aids**, like the Berg Score, the issue with the correct fitting and size, and the different walking assistive tools. We also researched some **precedents in cane design** to map the **existing solution approaches**. These were aesthetics, ergonomics, added functionalities, and safety. We included a study around the **history of cane** and different precedents that explore other types of walking aids, walking motivation, and walking objects. At the same time, we continued developing ideas through sketches.

The gathered information was continuously analyzed, and this helped realize the importance of the cognitive-physiological relationship. Walking, a physical activity, is hugely impacted by motivation, a psychological activity, in individuals with diverse mobility abilities. This **insight** guided us in our research across that relationship and we found that **fear of falling** is a major problem that none of the existing cane designs addressed beyond a physiological safety way. They all overlooked the cognitive side of the problem.





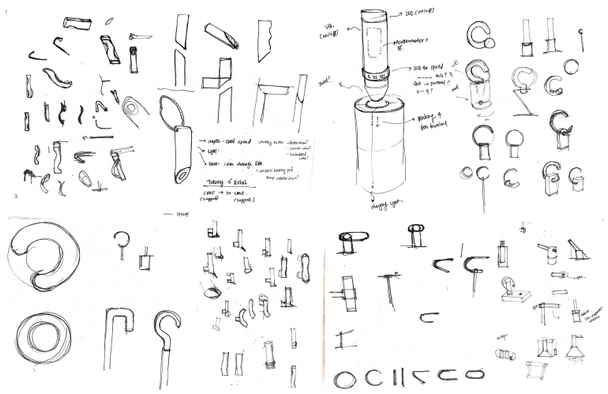
Detailed description of the work

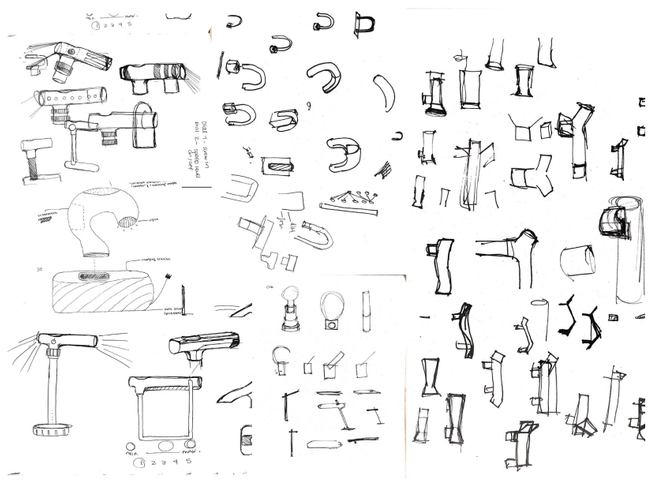
By this phase, our **research question** was getting more refined: How might we encourage a safer and more motivating walking experience for those who are less ambulatory? To answer that question, we researched how fear of falling induced gait adaptations, the cognitive-behavioral approach to solving the basophobia (fear of falling problem), and the stigma around canes. We also performed **interviews with users** with fear of walking and **physical therapists** to understand their perspective of the problem and gathered more insights around their cane-related behavior.

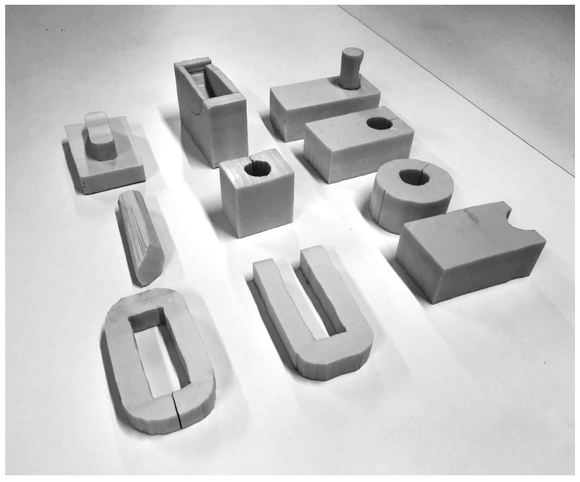
During the next step, we researched about gait definitions, and common measurements used by PTs. With this information, we decided to use a **simple feedback mechanism** to positively impact cognitive behavior as our design approach, rather than a complex set of multiple features. Through more research we found out the best approach for this was **haptic feedback, and visual indicators** because they followed the principles of calm technology, where the interaction can be done without a major effort. This built our case for tactile interaction.

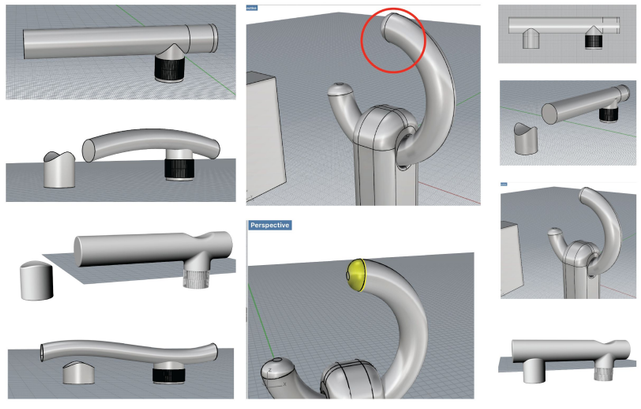
We split tasks. A part of the team focused on **cane design** creating more sketches and building different fidelities prototypes. We used different mediums such as PVC pipes, blue foam, 3D CAD design, life-size paper models, and 3D prints. Jumping from one medium to another helped us to quickly understand flaws and evaluate the form, size, and feel of each prototype. Another part of the team concentrated on **building the electronics**, both the code and the assembly of the components. Prototyping with the electronic components as they progressed aided to understand the haptic feedback better. During this **“design & build” phase** we researched more around **cane design specifications** such as FDA requirements, Material selection, weight and force resistance, special medical conditions of target users, safety and risks, and handle ergonomics. We continued trying different materials for our final 3D printed prototype and made a bigger scale model to fit all the electronics in.

As this phase advanced, we worked on our **storytelling and data curation** to better communicate the case of fear of falling. Through this exercise, we observed some gaps our design approach had left unanswered, that were not the focus but were still relevant. We attempted to answer these through designing a **comprehensive user experience** that we illustrated as a flow diagram; making sure the user had enough freedom without compromising its safety. We **designed a UI** to communicate this experience.









Design Process

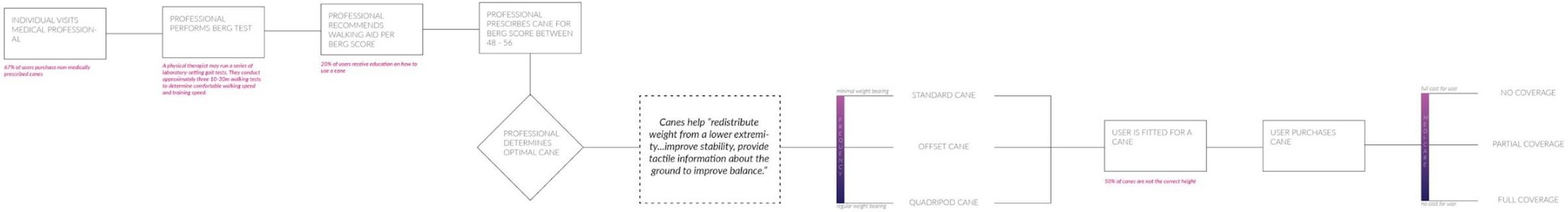
Concept Ideation

Sketching

Rapid Prototyping

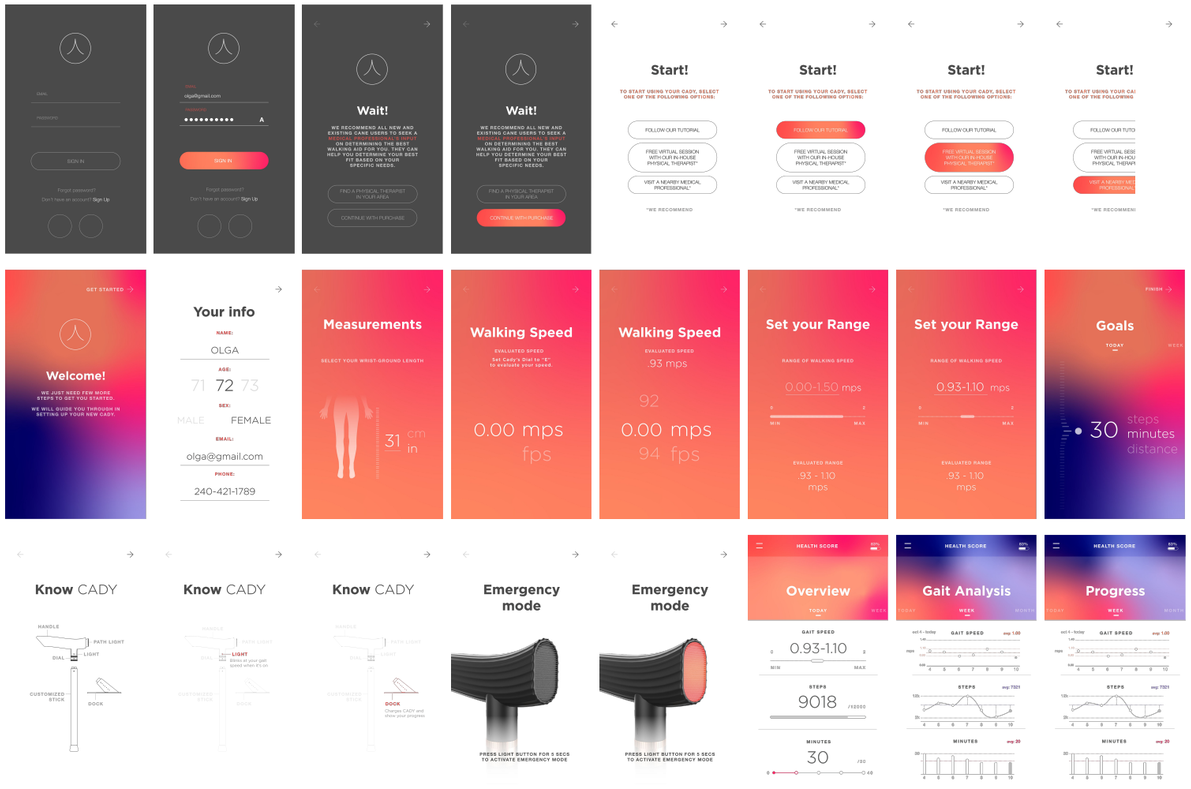
3D Modeling

Fabrication



Design Process

Based on our research and interviews with our users and stakeholders, we identified three phases of user pain point in their experiences with cane: 1. Acquisition, 2.Identity, 3.Walking. Each pain point shaped our design principles of both our product and service design.



Service Design: Acquisition

For acquiring a cane, we found many people purchase non-medically prescribed canes, receive no cane education and do not use the appropriate cane height.
Across our service, we offer multiple touchpoints to visit a physical therapist to address these problems. The service begins by offering an individual a free virtual session with an in-house therapist or to pop out of the interface and visit a nearby professional. This is to encourage individuals to be educated on how to use their cane. Then it asks for for wrist-ground length measurement to send the appropriately sized cane for the individual. Finally, it enable users to set goals and track their progress with their PT. This data will help the PT make better recommendations and accurate evaluations over time instead of their laboratory results.

Product Design: Grip & Ergonomics

During our secondary research, we discovered that the ergonomics of handles are critical because cane users press upto 20% of their body weight onto the cane. Through prototyping and testing ergonomics we designed the slight curvature on the handle to reduce the stress on the wrist along with the texture of the grip to prevent from slippage. The soft rubber material also secures from slippage while being useful when resting the cane against the wall.

Product Design: Sensory Experience

To address stride variability and the overthinking of gait, we wanted to find a way to subconsciously guide your walk so it becomes more consistent. We wanted to do that without making it feel like punishment, correction, and drawing attention to walking. We discovered, through our research, that sensory experiences can help subconsciously guide body rhythm and movement. We considered a number of sensory experiences to help create a consistent pace – audio, light, heat, and haptics - and then evaluated each on five metrics - Guidance, Cost-efficiency, immediacy of feedback, simplicity, and non distracting. Ultimately, haptics scored the highest across our metrics. We embedded vibration motors in the handle to send consistent vibrations at a steady speed to help to guide a person's walking speed.

Product Design: Data Collection

In order to determine the best metrics to share with medical professionals, we spoke to gait labs on how they consider gait, balance, and load on the cane. We discovered that across the board, speed of walking was most consistently used to understand a person’s gait and any issues they might have. This was confirmed in several studies we looked at that compared other metrics around gait such as stride length, load, and foot angle, but every time, gait speed proved most useful to understand how a person might walk. They also use this in a clinic setting, which makes sense since gait speed is an inexpensive, quick, and easy measurement to gather in a clinic, and it’s a strong proxy to understand balance and load.

Thus, we wanted to collect the same type of information. We embedded an accelerometer on the cane handle which gathers data points including distance, time, and speed traveled whenever you use your handle to walk. The data are transferred to the system while it charges in the hub, and the hub will also light up daily achievement of goals.

Product Design: Identity

In our research, canes have been stigmatized since the 1800s. They were once a status symbol before they became a sign of aging. Some people we spoke to didn’t want to get a cane because they felt like she was losing her independence.

Thus, we created a new identity for a cane when it lives inside of your home. Instead of seeing something that’s medicalized all the time, you see a lamp at your bedside table. More importantly, the light is also used as a cane itselt, to light up dim corridors or when it is late at night outside, which is one of the major factors of falling.



Future Developments & Industry Implementation

Before CADY can be launched, it must undergo a series of iterations in development and be user tested by our primary stakeholders, including cane users, physicians, and physical therapists.

Our initial implementation strategy consists of three phases.

The first phase is to iterate on the current design by microtizing electronics and developing a working dial on the handle of the cane. We would then gather user feedback on the materiality, ergonomics, and initial features of the handle.

We would then begin to develop a full cane design, evaluating the body and adjustability of it, plus the adaptability of its tip.

We would also consider developing new features to build confidence after a fall has occurred. Building confidence in your walking aid means feeling confidence before, during, and after a fall. We consider GPS and Emergency Call functionality as possible options.

Once these features are completed, we would need to continue working on the materiality of the prototype and stress test it to determine how much weight it can hold from a user.

Though these are some of our initial steps before launch, we view this product aspirationally. CADY doesn’t only have to live in the hands of cane users or people afraid of falling. CADY can be a universally embraced coach, from athletes keeping track of their speed and motions to musicians looking to replace their metronomes.

Credits

We would like to thank the professionals and users that kindly offered their time for an interview: Lauren Baker, Inocencia Ibarra, Lucas Ogura, Dr. Friedman, and Dr. Sheth

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