Abstract

“Clothing is a language we wear on our bodies, telling the world our story, our values and our sense of self” Wheelchair User.

11.1% of the United States population has mobility difficulties and the number is expected to rise in the coming years (CDC) yet they are unable to find clothing that addresses their style and needs.

The study's focus is on understanding the clothing needs and preferences of people with seated ability, an important step towards inclusivity in the fashion industry. People with seated ability face challenges in finding clothing that addresses both their functional and personal fashion language, hence highlighting the need for tailored and customizable solutions.

The co-creation design approach, coupled with qualitative research methods, user journeys, and sharing pictures of ill-fitting clothing, proved to be a powerful and insightful process for designing a customizable clothing solution for people in wheelchairs. This led to Re-mend, a modular service model system for co-creation of customized clothing by leveraging community skills to make clothing functional, fashionable, and accessible. This approach has the potential to provide a more efficient and personalized service and to improve the quality of life of people in wheelchairs.

Keywords :

Adaptation, Wheelchair users, Customization, Clothing, measurements, co-creation model, modular system, style, fit, adaptive clothing

Re-mend: An accessible modular system for co-creation of customized clothing that caters to a wheelchair user's personal style and fit.

by

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Introduction

The term “adaptive clothing” refers to garments designed with medical function in mind for post-surgery patients, the disabled, elderly, rehabilitation patients, special needs children and adults, people with arthritis, stroke vitamins etc. (Richings) The purpose of the adaptive clothing is to have easy access to body parts without taking off the entire garment, as well as to make it easier for the people with disabilities to don and doff by themselves, promoting independency in dressing by oneself, performing personal care, as well as providing ease in the dressing process for the caregiver. (Buck)

Since adaptive clothing has been designed with medical function in mind, it often neglects the fundamental aspects of apparel design such as fit, function, and aesthetics, which can have a negative impact on the quality of life of people in wheelchairs. To address this problem, the study proposes a co-creation approach, working closely with individuals with seated ability to design a customizable clothing model that addresses their specific style and fit needs. The proposed Re-Mend service model allows users to customize their clothing by connecting them to tailors, thus providing a solution that addresses both functional and personal style. Overall, the study emphasizes the importance of considering all aspects of apparel design, to enhance the quality of life of people with seated ability.

Definitions

Donning and Doffing: Donning and doffing are the terms used to describe the process of putting on and taking off garments. Donning is the process of putting on garment, while doffing is the process of taking it off.

People with seated ability: Refers to people who are unable to stand or walk for extended periods of time. This could be due to a variety of factors, such as a physical disability, an injury, or an illness. People with seated ability may use assistive devices to help them get around, such as wheelchairs.

Customizations/alterations: Refers to the process of making something to meet the specific needs or requirements of an individual or group. This could involve changing the size, shape, color, or material of an object.
Alteration refers to the process of making changes to an existing object. This could involve resizing, repairing, or adding or removing features.

Fit: Refers to how well a garment conforms to the body of the wearer. A well-fitting garment will be comfortable and flattering, while a poorly fitting garment will be uncomfortable and may not look good.

Quality of life: Quality of life (QOL) is a broad term that refers to the overall well-being of an individual or group. It is a subjective measure that can be influenced by a variety of factors,

including physical health, mental health, social relationships, economic status, and environmental conditions.

People with seated ability face challenges in finding clothing that is comfortable, affordable, accessible, aesthetically pleasing, and expressive of their individual style. People with seated ability struggle to find comfortable, affordable, accessible, aesthetically pleasing clothing that can also accommodate their desire for self-expression. While the mainstream fashion industry has ignored the voices of this consumer, adaptive clothing is also primarily focused on the functionality of the garment or ease of the caregiver who assists the person. In addition, majority of fashion retailers target market has not included consumers whose bodies do not 'fit' the sizing norm either literally or metaphorically.

This study emphasizes that the style, fit, and functionality of clothing are inseparable parts of a whole, and neglecting any of these criteria can lead to a consumer's dissatisfaction with the clothing. By addressing this problem, the project aims to promote inclusivity and diversity in the fashion industry, as well as provide design solutions that meet the specific needs and preferences of people with seated ability.

Research Methodology

The outcomes of literature review informed my research methodology for the project. I proposed to work closely with the wheelchair users by following a co-creation strategy, which means the participants will be equal collaborators in the design process. The research was conducted through interviews, user journeys and understanding each participants adaptions for fit of the clothing. My research methodology comprised of three key stakeholders.

1. Wheelchair users
2. Caregivers/ family members of wheelchair users (who help in dressing/undressing)
3. Tailors

I divided my research process into three parts,

1. Defining research methodology that triangulates with the research goals and the needs of the end user (including tailors, caregivers and family members of the wheelchair users)
3. Carefully formulating interview questions that well relates to all the stakeholders experiences with each other
4. Crafting user journey for both instore and online shopping experience and returning of the items purchased (online and instore)

1. Conducting Interviews:

Conducting interviews was an important method to understand individual needs and requirements of people with seated ability when it comes to clothing. Interviews allowed me to gather qualitative data and insights from the perspective of the participants themselves, which

was valuable in understanding their personal style and functional needs. Through interviews, I was able to ask open-ended questions that allowed participants to share their experiences and opinions about the clothing options available to them, as well as their preferences and priorities. It was important to conduct interviews in a sensitive and respectful manner, considering the potential challenges that people in wheelchairs may face in their daily lives. For in-person interviews, I understood that I would need to make accommodations like choosing an accessible location, using appropriate language and tone, and allowing participants to take breaks or rest as needed.

2. Formulation of interview questions:

It was imperative to understand how to formulate questions to be asked that defined the design solution. I used the keywords or most used words derived from the literature review and laid them out to craft my interview questions. I divided this process into two parts

A. Assumptions:

It is common to make assumptions while crafting interview questions, as this can help ensure that the questions are relevant and useful for the research goals and methodology. However, it was important for me to keep in mind that these assumptions should be based on prior knowledge and research gathered from literature review and should be tested and refined as the data is gathered and analyzed.

B. Data to be gathered:

I proposed to ask open-ended questions that encourage conversation and exploration are often more effective at eliciting rich and detailed responses from participants. This helped in providing a more nuanced and comprehensive understanding of the topic being studied and can also help

uncover unexpected insights or perspectives. Additionally, it was important to ensure that the questions are clear, concise, and easy to understand, and that they are framed in a way that is relevant and meaningful to the participant's experiences and perspectives.

3. Understanding user journeys:

Using a user journey as a research method is a wonderful way to identify areas that may not be covered in existing literature, as well as to gain a deep understanding of individual user needs and requirements. By mapping out the steps that users take when shopping for clothes online or in-store, I was able to gain insights into the various touchpoints and interactions that users have with the product and the brand, as well as their goals, motivations, pain points, and successes at each stage.

These insights then be used to identify areas for improvement, such as addressing specific pain points that users may be experiencing. Additionally, by tailoring the research to individual user needs and requirements, I as a researcher can ensure that the insights, gathered are directly applicable to the target audience, which can lead to a more effective and successful product or service.

Defining research methods that aligned with research goals, I was able to gain more understanding about the problem, needs and requirements of the people with seated ability, caregivers and the tailors and develop a design process that is both inclusive and effective.

Literature Review

This literature review provides an analysis on the study of functional, adaptive clothing for people who use wheelchairs daily. The study is based on a larger body of knowledge that includes existing research on foundations of apparel design, FEA model, quality of life, balancing style and functional considerations, and the gap in the market for clothing customizations for people with seated ability as per their style and fit.

Adaptive clothing has a unique set of design requirements, as it must not only be easy to put on and take off, but also accommodate a range of body shapes and sizes. This requires careful attention to detail in terms of sizing, construction, and materials.
Research has shown that the principles of fit are especially important in adaptive clothing, as ill-fitting clothing can cause discomfort and interfere with mobility and independence (Boldt and Carvalho 1). To address this, many adaptive clothing manufacturers are using stretchy fabrics, adjustable closures, and other design features that can accommodate a range of body shapes and sizes.

In addition to functionality, functionality and fit of the garment are interlinked and these three criteria are meant to work together; they are “inseparable parts of a whole” (Orzada and Kallal 33). Many individuals with disabilities want to wear clothing that is fashionable and reflects their personal style but may have difficulty finding clothing that meets their needs. Therefore, the literature review examines the experiences and meanings of disability and functional fashion that have been evolved over the years.

History of disability and functional fashion

After post American war, perceptions towards disability have varied significantly in the country (Wright) . Though treatment and perceptions of disability have undergone many transformations since the 1900s but this happened largely because people with disabilities demanded and created those rights (Williamson, *A History of Disability and Design* 17).Like all the other civil rights, the disability rights movement has a long history. Organizations by and for the disabilities existed since 1800s however they exploded in popularity in 1900s during World War 11 (Meldon). Numerous events, laws and people have shaped this development. The historical relationship of disability and design framed with the aftermath of World War II,1945 when disabled veterans rallied around the poorly performing limbs they first received in military hospitals and articulated the problems of limbs cutting their clothes or fitting uncomfortably. Their statements about personal choice in prosthetics helped them lobby for more support, leading to specialized cars and houses being included in their veterans' benefits. While on the other hand, in Berkeley, the disability activists were fighting for the first sidewalk curb cuts in the nation. (Williamson, "Accessbile America" 113) Therefore, physical barriers in the environment were recognized as a significant hindrance to people with mobility impairments. As a result, barrier-free movement was established in 1950, which initiated the process of change in public policies and design practices. The movement was the result of the response to demands by disabled veterans and advocates for people with disabilities (Hamraie, *Universal Design and the Problem of "Post-Disability" Ideology* 216).

Aimi Hamraie, the author of Universal Design and the Politics of Disability discusses in her book chapter 'Before and After the Americans with Disability acts', in 1985, disabled architect Ronald Mace imagined "a way of designing a building or facility, at little or no extra cost, so that it is both attractive and functional for all people, disabled or not." Ronald called this idea as more inclusive, functional built environment and different from barrier-free design. This gave rise to the practice of using universal design in designing sidewalks and making accessible barrier free routes (Hamraie, *Building Access: Universal Design and Politics of Disability* 117). During 1967, accessible building products were initiated such as accessible teller machines, telephones, plumping fixtures, full size mirrors, drinking fountains. The lever on the front doors were a conceptual tool for the user and designed for all. Mace argued that designing for people with disabilities will also benefit the abled people (Koziar 23). However, these arguments are part of a broader discourse debating what Universal Design is and is not. It is undistinguishable if the universal design segregated disabled and able bodies: specialized usability features that marked differences in physical and cognitive abilities versus designs that included and accommodated people with disabilities and those without equally. I argue that portrayal of Universal design as a form of useful design and design for all simply distances itself from the civil right mandates of ADA and by the notion of disability itself. The needs and personal choices of people with disabilities came forcibly into the public eye as they never had before led to the establishment of ADA in 1990 (Bredberg 7). To date, the 1990 Americans with Disabilities Act (ADA) and the subsequent ADA Amendments Act (2008) are the movement's greatest legal achievements. The ADA is a major civil rights law that prohibits discrimination of people with disabilities in many aspects of public life such as design and architecture.

In the United States after ADA, clothing began to be recognized and used as a rehabilitative tool in the 1930s. Mary Brown in 1950's laid the foundation of functional clothing for cerebral palsy patients with functional and fashion element. During 1958, a prominent fashion designer Helen Hookaman, who was also a researcher for physical medicine and rehabilitation, introduced functional fashion line along with other 30 designers (Wright 144). The key to this approach was to overcome the narrative of disability concealment and using clothing as a rehabilitation to lift the spirits of people with disability (Wright 151). Functional Fashions, as described here, played a crucial role in shaping the discourse around disability and its visibility in postwar American culture. By creating clothing designs that catered to disabled individuals and highlighting them through photography, functional fashions helped to challenge traditional ideas about what bodies should look like and what they were capable of. Additionally, by considering factors such as ability, class, race, and gender when determining the "ideal" functional fashions user, the creators of the brand helped to promote a more inclusive and intersectional understanding of disability. Later in 1961, Clarice Scott published 20 garments patterns for women leading to the formation of Fashion-able foundation. As the clothing options continued to increase in 1973 the Rehabilitation Act was passed and attention towards fashion and its relationship to the outward self-started(Caroll 151).

Through these efforts, functional fashions helped to promote the idea of total bodily autonomy, which is the belief that all individuals should have the freedom to make choices about their bodies and lives without interference or coercion from external forces. This idea was

particularly important for individuals with disabilities, who had long been subject to medicalization and institutionalization. By promoting the idea of bodily autonomy, functional fashions helped to empower individuals with disabilities and promote their independence and agency.

Despite decades of applied research, fashion solutions are not readily available for people with disabilities in a mass market fashion environment.

Fundamentals of apparel design and FEA model

Today, In United States up to 1 in 4 adults have some type of disability and around 11.1% of the United States population has mobility difficulties (CDC). The fashion industry has traditionally relied on a standard sizing system that often does not account for the diverse range of body shapes and sizes, including those of individuals with disabilities or mobility issues. This can make it difficult for these individuals to find clothing that fits properly and meets their specific needs. Lamb and Kallal laid out a framework that establishes a design methodology for apparel design considering the needs and requirements of every individual.

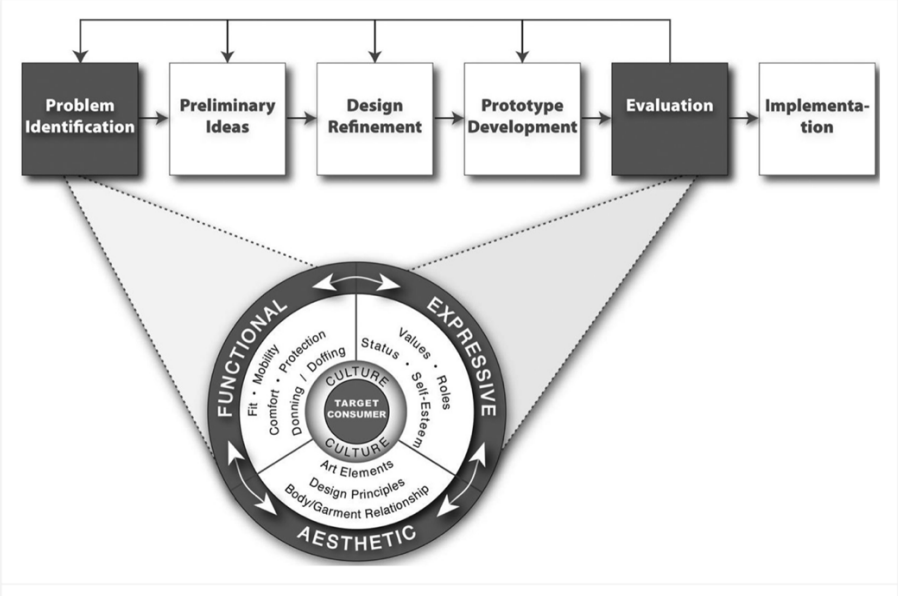


Figure 1: Apparel design framework incorporating functional, expressive, and aesthetic consumer needs model. (Orzada and Kallal 25)

The following study reviews the FEA consumer needs model and integrated Apparel design (AD) framework. The FEA (Functional, Expressive, Aesthetic) model is a conceptual framework for apparel design (AD) that aims to address the clothing needs and desires of non-traditional body types. Functional, Expressive, and Aesthetic criteria guide the development of apparel products that are inclusive and accessible to all users, regardless of their physical abilities. (Chang et al. 62) It was developed by Lamb and Kallal in 1992 as a problem-solving approach that does not differentiate between functional and fashion apparel design. The model emphasizes three key elements: functionality, expression, and aesthetics. (Wang et al. 551)

Functional aspects refer to the clothing's ability to meet the wearer's physical needs, such as mobility, comfort, and safety. Additionally, clothing should satisfy the donning and doffing requirements of the wearer.

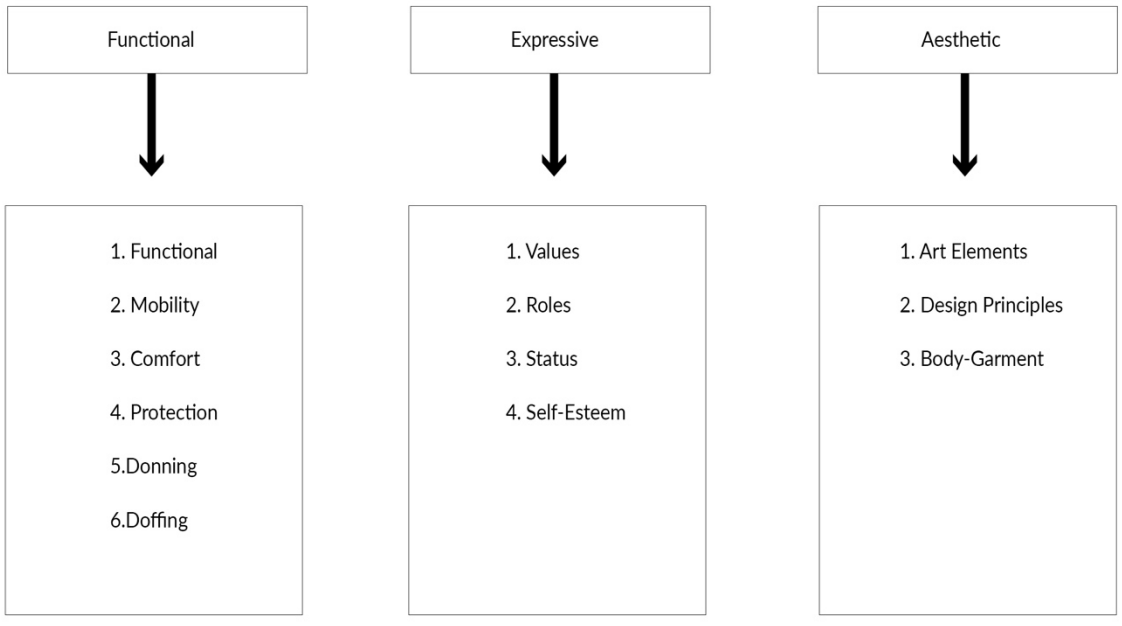


Figure 2: Sub elements of FEA Model based on (Orzada and Kallal)

Expressive elements refer to the clothing's ability to convey the wearer's personality, identity, or social status.

Finally, the aesthetic aspects refer to the clothing's design, style, and appearance and relation of the body with the garment.

The FEA model is a powerful tool for utilizing the consumer needs and wants. The FEA model recognizes that clothing is not just functional but also a means of self-expression and a reflection of personal style (Suri 9). Other researchers (Press) (Chang et al. 63) study highlights the significant role that clothing can play in improving different facets of a person's life, including physical health, psychological state, level of independence, social relationships, environments, and spiritual/personal beliefs. The facets of each can be improved by well thought and designed adaptive clothing, thus resulting in improved quality of life. (Carroll and Kincade 331)

Domain I	**Physical Capacity**
1	Pain and discomfort
2	Energy and fatigue
3	Sleep and rest
Domain II	**Psychological**
4	Positive feelings
5	Thinking, learning, memory and concentration
6	Self-esteem
7	Bodily image and appearance
8	Negative feelings
Domain III	**Level of Independence**
9	Mobility
10	Activities of daily living
11	Dependence on medication or treatments
12	Work capacity
Domain IV	**Social Relationships**
13	Personal relationships
14	Social support
15	Sexual activity
Domain V	**Environment**
16	Physical safety and security
17	Home environment
18	Financial resources
19	Health and social care: accessibility and quality
20	Opportunities for acquiring new information and skills
21	Participation in and opportunities for recreation/ leisure activities
22	Physical environment (pollution/noise/traffic/climate)
23	Transport
Domain VI	**Spirituality/Religion/ Personal Beliefs**
Overall quality of life and general health perceptions	

Figure 3: Quality of life demonstrated by (World Health Organization)

Researchers in literature highlight the importance of the functional application of clothing to reduce the physical burden on the wearer and the caregiver (Suri 13). In this study I attempted to analyze the previous studies and critiques regarding wheelchair users' clothing and the available clothing options for them. The study focuses on the following:

1) To understand the current apparel product design and the market for wheelchair users

2) To analyze the clothing needs for people and fit requirements of people with seated ability

Psychology of fashion and functional requirement of clothing

Adaptive clothing is a term used for a category designed to fulfill specific requirements of the wearer. Adaptive clothing can be designed to meet specific needs and challenges faced by individuals with disabilities or other limitations. For example, clothing with easy closures and adjustable features can improve independence and comfort for individuals with mobility limitations or dexterity issues. Clothing that is breathable, moisture-wicking, and antimicrobial can improve physical comfort and overall health for individuals with skin conditions or other health concerns (Meinander and Varheenmaa 11). In addition to addressing physical needs, adaptive clothing can also impact psychological well-being and social relationships. Clothing that is designed to be stylish, comfortable, and functional can boost confidence and self-esteem, leading to improved psychological health (Mair 35). Clothing that is easy to wear and maintain can also reduce stress and increase social participation, allowing individuals to engage more fully in their communities and relationships (Mair 36).

Proper fit of the clothing boosts confidence. The fit of clothing is an issue that has often concerned researchers, retailers, and apparel designers but it is an integral part of functional clothing. Fit must consider the shape of the wearer, texture, drape and weight of the fabric when it comes to functional clothing. When it comes to functional clothing, fit is an important consideration that goes beyond just how the garment looks on the wearer. Therefore, a good fit in functional clothing must consider not only the shape of the wearer but also the range of motion required for the task and activity. (Boorady 345)

Following are the principles of fit in tandem with functional clothing:

1) Functional Ease

Functional ease of the garment is relevant to the functional ease of putting the garment on and off, the second type of is the ease chosen by the designer to create the silhouette designed, third type of the ease for the functional garment is which given to allow movement.

2) Movement Analysis

Mobility and motion are closely related to fit in functional garments. The fit of functional garment is essential for mobility and motion. A good fit allows individuals to move freely and without restrictions, which is important for safety, performance and comfort.

3) Adjustable and flexible fit

Adjustable and flexible fit of the garment is mandatory when thinking about functional garments. Fit must be determined for the body as it moves and changes positions. It must be considered that every individual has a unique set of body dimensions, and the clothing should have the flexibility to consider all the possible variations. Functional clothing has higher need of alterations and adjustability.

However,(Boorady) in the Principles of fit argues that it is difficult to balance the principles of fit and aesthetic of the garment together. Wang both identified in their research that based on a limited set of measurements available in the industry, it makes it difficult for the individuals with non-standard body to find suitable clothing (Wang et al. 550). The reason, as is accounted by Thoren, the researcher of System approach to clothing for disabled users (Thorén 392), is that most of the people with disability do not fit in the current sizes as their body dimensions differ from those represented in the sizing system. This is evident from the research that sizing systems caters to the specific group of people, while neglecting that fact that every

individual has unique sizes and body types. (Thorén 393) The lack of clothing options has affected the quality of life of the wearer and their relationship with clothing.

Carolyn mentions in the book Psychology of fashion and in her recent talk about clothing as “Our Second Skin”, and garments are often described in sensory terms such as vision and touch. (“Fashion Psychologist Carolyn Mair Speaks to Students”)

Helen Hookman, mentions in fashion for the physically handicapped: Postwar America that Clothing can be more than just a functional necessity for individuals with disability; it can also serve as a form of rehabilitation and a way to uplift the spirit (Wright 161). By considering both the functional and aesthetic needs of individuals, clothing can help to improve their physical and emotional well-being.

The fashion industry has traditionally been slow to embrace a full range of diverse body sizes and shapes (Russell 10). Hoffman mentions in his book that people with seated ability want to highlight desirable features and minimize limitations. Some of the styles of adaptive clothing are designed for medical purposes, promoting of functionality of the apparel but ignoring to eliminate the factors of stigmatizing and assuming people with disabilities to adapt to current adaptive apparel is debatable. Russell conducted a study to investigate clothing resource needs of people with disabilities. He examined three key elements of resources offering clothing for special needs, the use and adaptation of ready-to-wear and the effect of economic limitations on clothing resource alternatives. It is noted that alternative resources include both ready-to-wear clothing that has been modified or readily designed for people with disabilities (Russell 11). Most of the people with seated ability purchases ready-to-wear clothing desiring suitable styles and

alteration options but economic conditions limit the adaptation of customized unique clothing due to limited financial resources. (Chang et al. 62)

Market Analysis

Additionally, there are also a few independent designers and brands that specialize in creating clothing for individuals with disability. Tommy Hilfiger, Zappos, Every Human and many other brands are catering to the needs of wheelchair users. The story is well told by Mindy Schinder, the founder of Runway of dreams who started her consultancy for retail brands after her son was born with mobility issues (*How Adaptive Clothing Empowers People with Disabilities | Mindy Scheier*). Mindy has been continuously working on producing garments that can adapt according to the individual needs and requirements such as adding zippers, velcro and magnets for assisting in donning and doffing. She mentions in her talks that clothing modifications such as replacing buttons, closures, adjustable waistbands and altering the pants length are not only possible but can fit into the current sizing system (*Mindy Scheier's Mission To Create Adaptive Apparel For Son Inspired A Fashion Empire*).

Lucy Jones' collection for people in wheelchair focused on minimal and elegant clothes for wheelchair users, considering the need for them to be permanently seated and the challenges of wearing clothes in a seated position (Fernandaz). ABL jeans brand has created stylish yet practical jeans for those in wheelchairs. The waist bands are set high to facilitate people with seated ability. Izzy Camilleri founder of IZ adaptive clothing uses unique design techniques to make clothing without wrinkles when a person is seating in a wheelchair. Care and Wear has designed a line of Zip open shirts which have openings at strategic locations for access. While it's great that these companies are working towards making clothing accessible for people

in wheelchairs, it's important to also consider other factors such as affordability and variety in colors, styles, and prints.

Content Analysis

I did competitor analysis to analyze the strengths and weakness of existing companies. This information can be used to develop strategies for designing the solution.

Company Name	Ready-To-Wear Clothing	Target Market	Relevance and Conclusion
Stitches 	Maximum $55	Medically Minded Apparel	The clothes available on Stitches are designed keeping medical clothes in mind. The options available on the website does not have alot of options in style.
Unhidden 	Starting from 70 pounds	Adults and older people	The clothes available on Unhidden are available in mostly two design and two colours.
Kohl's 	Maximum $ 30	Kids, adults and older people	Kohl's provides adaptive clothing from different brands. There are fewer options available in terms of colour and style of the clothes
Zappos 	Maximum $ 89	Kids, adults and older people	Zappos is another company that provides options for adaptive clothing, similar to kohl's
Every Human 	Maximum $ 140	Kids, adults and older people	Every Human is a database website which provides collection of adaptive wear from different brands. The brand has options but fewer options in style or either they are very expensive.

Figure 4: Analysis of existing adaptive clothing brands in the market

Company Name	Ready-To-Wear Clothing	Target Market	Relevance and Conclusion
Tommy Hilfiger 	Maximum $130	Adults	Tommy Hilfiger clothes are stylish and has options in various colours however the price makes it less affordable for everyone
Seven 7 	Maximum $70	Kids and Adults	The clothes available on Unhidden are available in mostly two design and two colours.
Simplicity 	Maximum $ 30	Retailors	Simplicity patterns are very basic, and catered towards middle to older age population.
No Limits 	Maximum $ 120	Adults	No Limits is a chic adaptive clothing brand which is expensive and has fewer options in style and colours.
Silverts 	Maximum $ 140	Elderly population	Silverts is a brand targeting old age people which simple style and prints.

Figure 5: Analysis of existing adaptive clothing brands in the market

Company Name	Ready-To-Wear Clothing	Target Market	Relevance and Conclusion
Care + Wear 	Maximum $80	Healthcare	Care + Wear is brand focused on medical wear. The clothes are less stylish and focused on functionality of the garment
Reboundwear 	Maximum $95	Adults	The clothes available on Reboundwear are expensive and have fewer options in terms of style and colour. They are mostly in black and blue.
Buck & Buck 	Maximum $ 30	Elderly population	Buck and Buck is clothing collection that is focused on elderly population.

Figure 6: Analysis of existing adaptive clothing brands in the market

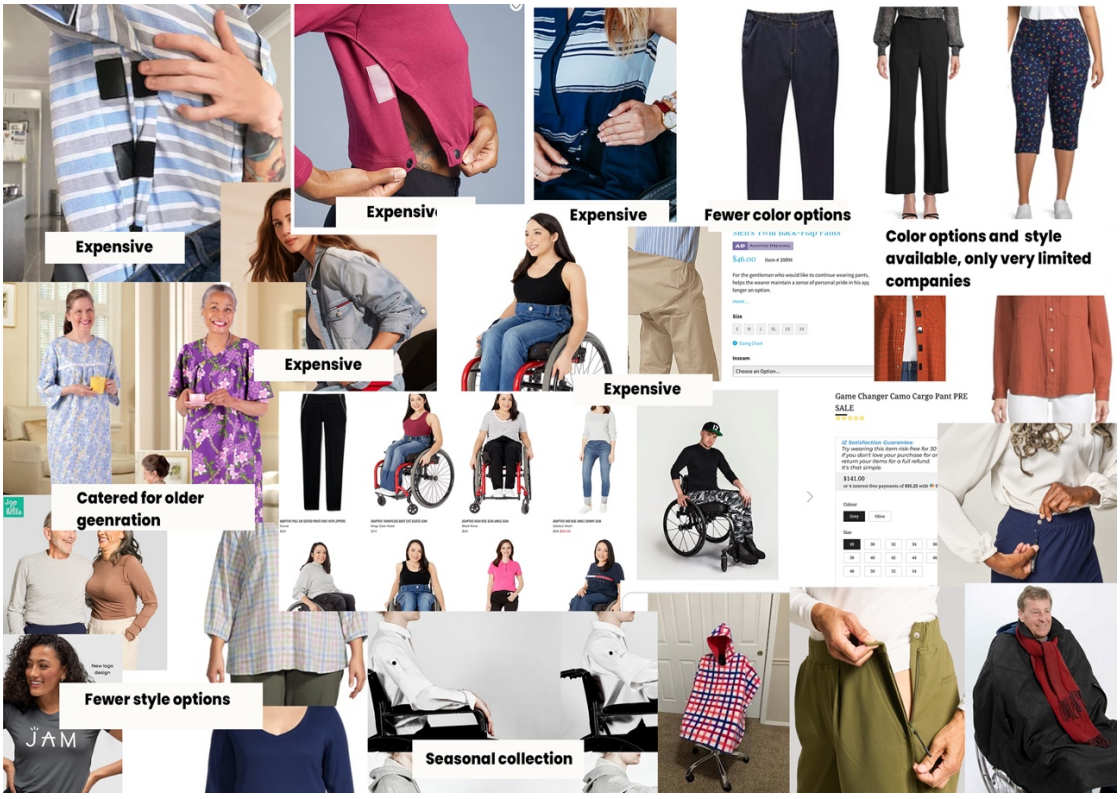


Figure 7: Product collage

Figure 8: Adaptations for the clothing available in the market

Existing companies primary focus for adaptive clothing is ease of donning and doffing, as shown in the content analysis there are fewer options in terms of style, color and print options.

Economic Considerations

Affordability is a key consideration when it comes to making clothing accessible for everyone. Past research has indicated that high cost of functional clothing is a concern for people with seated ability on daily basis because economically majority of people have lower incomes and higher health costs (Shin Na 100). It's important to ensure that the clothing is priced so that it can be accessible to people with seated ability. There are some organizations and initiatives that offer affordable adaptive clothing, such as the Open Style Lab and the Adaptive Clothing Showroom.

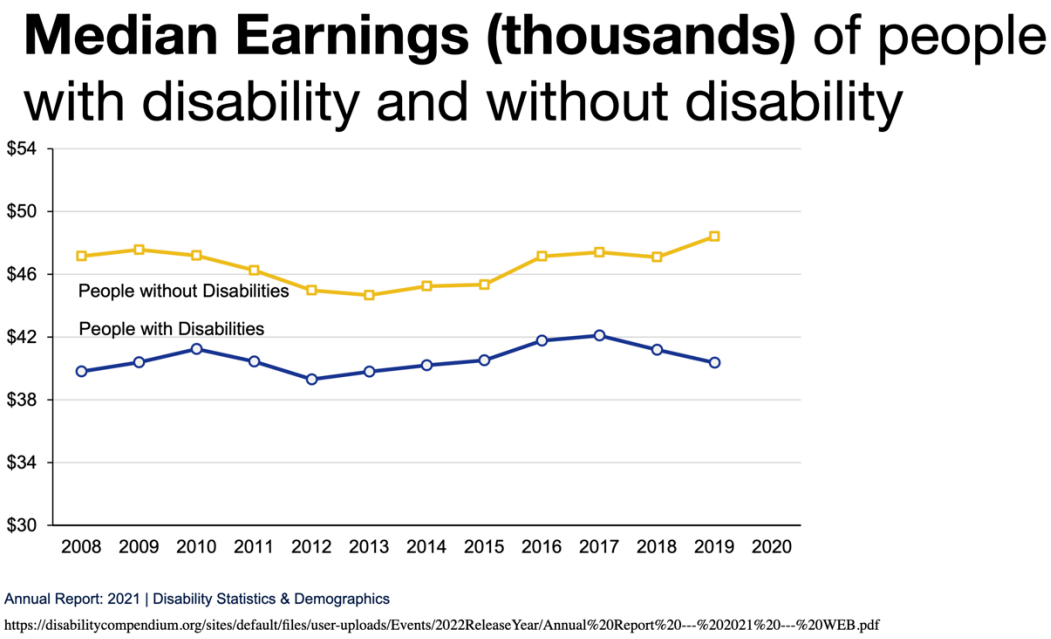


Figure 9: Median income of people with disability

In terms of variety in colors, styles, and prints, it's important for designers and manufacturers to consider the diverse needs and preferences of their customers. Though IZ adaptive used to have customizations available for their clients initially for few years, but they do not offer it anymore due to price considerations. Alterations can add a greater advantage for people with seated ability to tailor ready-to-wear garments instead of getting highly priced adaptive clothing.

There are 17,000 tailors in United States and tailoring industry which is expected to grow 1.7% market share in 2023 (United States) can provide support to alterations industry providing people with seated ability to alter the clothing as per their preference.

As mentioned by Camilleri personal communication 2016 customization in retail manufacturing is expensive and time consuming as the process involves in which the manufacturing is based on single ply cutting of fabrics for production and assembly of the garment (Caroll 162). Overall, it's

important to continue to push for more accessibility and inclusivity in the fashion industry, and to ensure that adaptive clothing is not only functional but also stylish and affordable.

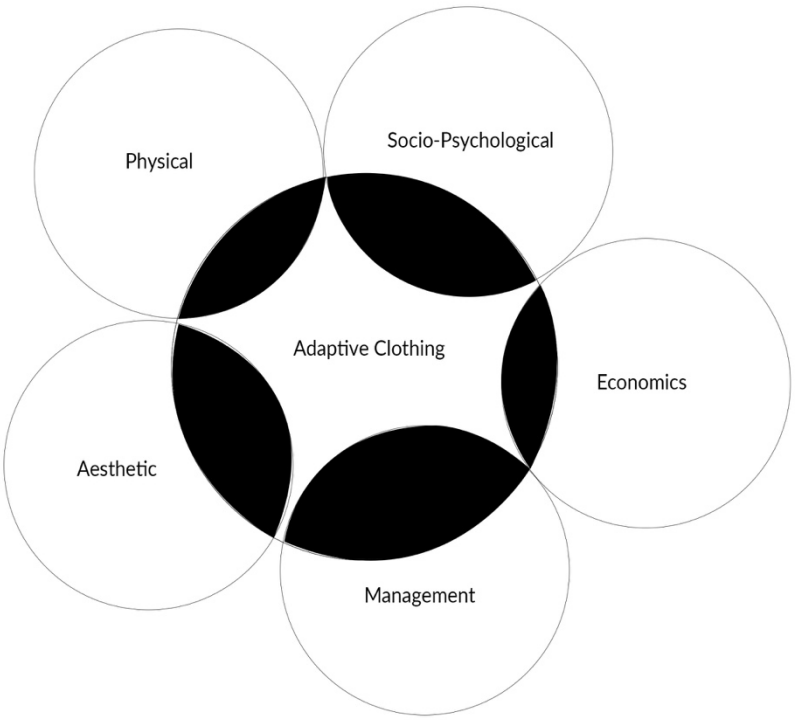


Figure 10: Factors effecting adaptive clothing (Shin Na)

Future technological Projections

While there have been significant advances in developing 3D scanning technologies for measuring and fitting standard body sizes for perfect fit and stylish clothing in standing or upright postures, there has been comparatively less progress in creating accessible, functional and fashionable clothing for people in wheelchair (Shcherbina et al. 191). This has resulted in a significant gap in the market for the availability of well-fitting clothes for people with disabilities and those without. The research indicates that creation of a sizing database can increase the demand for fashionable adaptive clothing and the lifecycle of the garments, as they can be worn

multiple times if they fit well. As the researcher Kidd mentioned in the study that emerging technologies can play a vital role in making the production process economical and more efficient through 3D scanning. 3D Scanners have the potential to map the dimensions of a person to create a custom fit and transform it into a CAD Software saving time and money in developing customized patterns (Spahiu et al. 7).

While these innovations have the potential to revolutionize the way we think about clothing design and accessibility, they can also be complex and expensive to implement.

A co-design approach that involves working directly with individuals with disabilities and incorporating their input and feedback into the design process can help to ensure that the resulting clothing is truly tailored to their specific needs and preferences. This approach can involve creating focus groups or consulting with disability advocacy organizations to gain insights into the needs and experiences of individuals with disabilities.

Following codesigning approach for functional fashion

In addition to co-design, it is also important for the fashion industry to prioritize accessibility and inclusivity in all aspects of their design and production processes. This can involve incorporating features such as adjustable closures, stretch fabrics, and removable inserts that can accommodate a range of body shapes and sizes, as well as ensuring that clothing is made from materials that are comfortable and easy to care for (Carroll and Kincade 304).

Overall, creating truly inclusive and accessible clothing options for individuals with disabilities will require a multifaceted approach that prioritizes co-design, accessibility, and inclusivity at all stages of the design and production process. By working collaboratively with individuals with

disabilities and incorporating their input and feedback, the fashion industry can help to create clothing that meets the unique needs and preferences of diverse consumers.

Research Question and Objectives

The purpose of the study is to understand how a customized clothing model can bridge the gap between functionality, personal style and comfort of a wheelchair user through a co-creation approach.

Research objectives:

1. Explores how to facilitate the availability of inclusive functional clothing and defining the intersection between fashion and comfort.

2. Understand how a co-creation approach allows users to adapt to their clothing to meet their functional needs and personal style.

3. Explore how adaptive tailoring can enhance the clothing experience for a wheelchair user by not only recognizing the wearers functionality but also their personal style and comfort.

Recruitment Process

Participants with seated ability aged 18-65, employed or unemployed were recruited through university connections and community advocates. By considering factors such as age, gender, and occupation, it helped me to ensure that the sample is diverse and includes a range of perspectives and experiences.

Caregivers were an integral part of the recruitment process. As the literature review mentions that most of the clothing available in the market is targeted towards the ease of the caregivers, so it was important to know their perspective related to clothing, dressing, and undressing. Participants helped in recruiting their caregivers and were able to answer questions related to each participant.

I was able to recruit tailors aged between 18-65 who have commercial presence in Syracuse, Downtown and seamstress who have home based business in Syracuse. This ensured that I gathered a diverse range of perspectives and experiences. Interviewing seamstress working from home was to understand the potential of alteration and customization industry in United States and their willingness to take up projects that related to simple piece of clothing. By involving professionals from diverse backgrounds and working environments, I was able to gain insights into the challenges and opportunities associated with designing clothing for wheelchair users in different contexts.

Outcome

Wheelchair Users

Six people were interviewed, which included a college student, a software engineer, a graphic designer, a PHD student, a former athlete, an industrial designer and a model. All participants were older than 18 years.

As literature review indicates that people in wheelchair prioritize functionality of the clothing over comfort while on the other hand participants stated:

"Cowboy boots take 30 mins to put them on and 30 mins to take them off. One hour is worth it because once you wear them, they look so good" Participant. Participants expressed that their clothing decisions involve both style and fit of the garment, comfort does not take priority over style.

Respondents were least satisfied with the attractiveness of the adaptive clothing available in the market and had to settle with whatever was available in the market hence, compromising their style.

It is important to recognize that clothing design can impact the comfort and confidence of people in wheelchairs. Many participants have expressed dissatisfaction with the necklines of their clothing, finding them to be too large or too small. This can create discomfort and restrict their ability to move freely.

Similarly, issues with sleeves and shirt length also created hindrances in their movement and lead to an untidy appearance. Shoulder seams that are too wide or poorly placed can give the impression of an oversized shirt which does not fit well with the participants style.

By considering the specific needs and preferences of wheelchair users, as a researcher I concluded the garments should include features such as adjustable necklines and sleeves, shorter hemlines, and shoulder seams that rests well with the shoulder. By addressing these concerns, clothing design could help boost the confidence and comfort of people in wheelchairs and ensure that they feel empowered to express their individual style.

People with seated ability also mentioned that they are not aware of any websites dealing with alterations or walk-in alterations shops to get the alterations. Moreover, the participants stated “I feel awkward when I tell them that one sleeve is longer than the other. I sometimes feel they do not understand our body dimensions as it does not fit the sizing system available”.

Caregivers

I carried out interview with two caregivers of the participants. The caregivers in the interviews emphasized the importance of functionality and ease of use in clothing for people in wheelchairs. One of the caregivers mentioned “If the adjustable elastic can be added to the shirts, it will save so much time in dressing and undressing.” They highlighted the need for alterations and adaptations on ready to wear clothing such as magnetic closures, snap buttons on the side seam and zippers on T-shirt and on the pants.

Tailors

Tailors working commercially expressed that they hardly find people with seated ability looking for alterations. One of the participants mentioned “We usually don’t see wheelchair users here

at the store often but only when they need suit customization. We would happily alter garments if we were communicated with the changes thoroughly. Adaptive clothing is not different, as tailors we understand construction of every garment, therefore this makes it easier for us to make any type of alteration."

Seamstress mentioned that making alterations to a shirt doesn't necessarily require specialized training or education in adaptive clothing. A skilled tailor should have a good understanding of how garments are constructed and how different fabrics behave, which enables them to make the necessary adjustments to a shirt based on a customer's specific needs and preferences. Tailors showed their interest in doing alterations if they are communicated digitally or both if they would meet in person to understand the changes in the stitched garment.

After gathering data through interviews. Each participant was asked to share their experiences while shopping instore and online.

User journey and Pictures of clothing worn by people in wheelchair.

The participants were asked about who they go shopping with, as this can provide insights into the social and psychological factors that influence clothing choices. Additionally, understanding challenges related to online and in-store shopping as well as returning clothes if they don't fit well.

I used thematic and narrative analysis to analyze data captured through pictures, interviews and user journeys. This allowed me to identify patterns and trends in the data, and to group together similar information. By using affinity diagramming method, I identified the keywords as below.

Commonly used keywords were fit issues, no style, less options, ease of donning and doffing, clothing for ease of wearing, customization, tailoring needs with style, sleeves alteration, necklines and length of the shirt.

Figure 11: Themes from literature review and content analysis

Matching the keywords from the literature review to the responses from the participants is an effective way to identify common themes and areas of concern related to clothing and shopping behavior.

For example, as mentioned above many participants talked about the importance of customizing and tailoring clothing to fit their individual needs, this could suggest that there is a demand for more personalized clothing options. Alternatively, many participants mentioned that they struggle with standard sizing and finding clothes that fit well, this could suggest that there is a need for more inclusive sizing options that cater to a wider range of body types.

By identifying these patterns and themes, I was able to develop design solutions that could address the specific needs and concerns of consumers. I concluded designing a modular system that allows the user to customize their clothing as their style and fit. This model will involve digitally recording the measurements, uploading it on the digital web application and connecting to the nearest tailors through database of tailors available on the digital application for alterations or customization. The following design process explains what led me to the design solutions channeling the ideation process.

Design Process

Ideation:

After creating themes by patterns and trends in the data. I sketched 60 possible design solutions that linked to each identified category. This, therefore, helped me to ensure that I was considering a diverse range of options and not overlooking any potential opportunities.

After analyzing the priority, implementation timeline, and feasibility of the ideas, I was able to shortlist five ideas that directly addressed the identified problem. Five design solutions hinted towards a 3D body scanner for measurements, Customization service model, Online shopping clothing database, pattern making for adaptive clothing and non-stitch adaptation possibilities.

I started researching and testing different options for taking measurements, such as Apple Xcode tools and Spark AR to use augmented reality for virtual fitting and taking measurements online. However, I recognized the fact that this solution may not be feasible or practical within the constraints of the project and it required far more knowledge about 3D mapping and points in

space to gather 3D measurements in a sitting position. In this case, I also found out that 3D scanning, and measurement tools may not be the best fit for addressing the needs of the target audience.

By recognizing this limitation, I was able to pivot to other design solutions that may be more effective at addressing the needs and preferences of the target audience.

Customization model involved sketching out various scenarios explained by the participants during user journeys. I designed the service model around the scenarios expressed by individuals and how each factor in the potential service model solved the problems mentioned by the participants.

As I continued to develop the design solutions, it was important to keep the needs of the target audience at the forefront of the thinking process and to test and iterate your ideas based on their feedback and insights. I realized that shopping experience may be a design solution for scenarios like unavailable fitting rooms but to address the needs of fit and style this may not develop into a solution that directly solves the problem of finding clothes that fulfills the need of people in wheelchair. By staying focused on the needs and preferences of my target audience, I negated the idea of considering shopping experience as the design solution.

Pattern making for adaptive clothing was a great start. My prototype was to understand the simplicity pattern and how those existing patterns can be adjusted to make clothing for people with seated ability which is both functional and stylish.

However, it's important to recognize that the success of this approach will depend on the willingness of the retail industry to adopt and use these patterns. While there may be some

challenges in convincing retailers to adopt new patterns and designs, there are also opportunities to work with retailers to demonstrate the value and potential of these designs. Overall, while there may be challenges in convincing the retail industry to adopt new patterns and designs for adaptive clothing, there are also opportunities to work with retailers to create innovative solutions that meet the needs and preferences of people with seated ability. Therefore, after iteration and learning about the proposed design solutions outcomes I understood that there is a need of customizing existing ready to wear clothes to cater to the needs of the people in wheelchair.

Content analysis

I did content analysis on the existing companies providing clothes customization to understand the gap in the current industry. There are limited companies providing alterations/customizations.

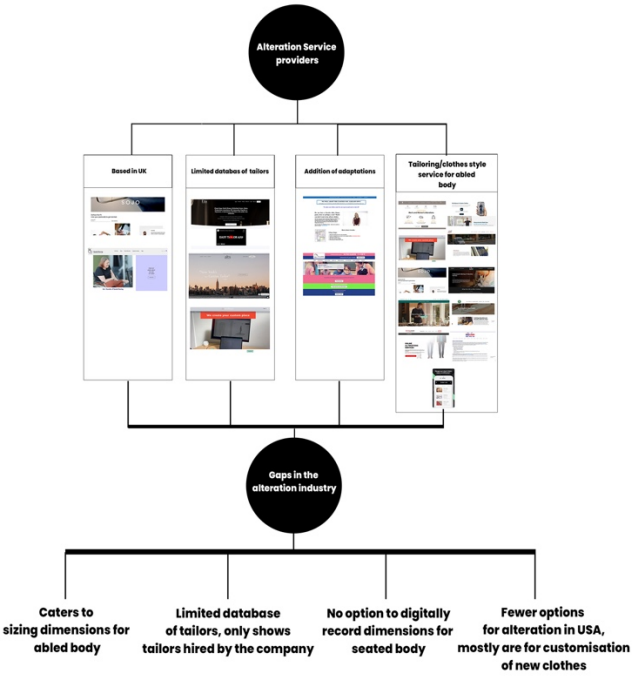


Figure 12: Content Analysis of existing alteration brand

Prototyping

Prototype 1:

Prototype phase one was about understanding about how to take measurements through stitched garments and record them digitally for a digital sizing database. Crew neck T-shirt was selected for prototyping and testing for a customized model. T shirts are commonly worn pieces of garment which are both suited for professional and casual situations. The initial prototype was delivered to one of the participants. The shirt was handed over safety pins. Participant was asked to pin the areas where they would need the alterations.

The T-shirt was received with the marking of the safety pins, but it was unclear which areas required alterations and which areas did not. For instance, as shown in the figure 12 it was hard to understand if the participant wants the front to be altered, leaving the back as it is. Moreso, understanding the measurements of shirt width was unclear as well.

Figure 14: Prototype 1

At this point I consulted the tailor, and faculty expert who provided more guidance on how to take measurements for alterations in the shirt.

Prototype 2:

After the first prototype, I realized that there should be a grid on the T-shirt that provides a realistic scale of alterations based on the specific margins for each T-shirt size.

By investigating each size and considering it with tailors, I gained a better understanding of the specific margins for alterations that each garment has as shown in the figure 15. This was useful in ensuring that the customization process is accurate and efficient, as it allows for adjustments to be made within the margins of the garment.

It's also helpful to note that if a person requires more alterations than the garment has margins for, then changing the size of the T-shirt may be a better option. This highlighted the importance of having a range of sizes available for customers to choose from, in order to accommodate their individual body types and preferences.

Figure 15: Prototype of shirt with grid

Testing Prototype 2:

Each participant was delivered a T-shirt with a grid marked on it, default size of the shirt along with a set of instructions on how to put the safety pins for accurate measurements. The instructions included if the person is taking the measurements themselves or someone else was taking the measurements for them, for instance their caregivers.

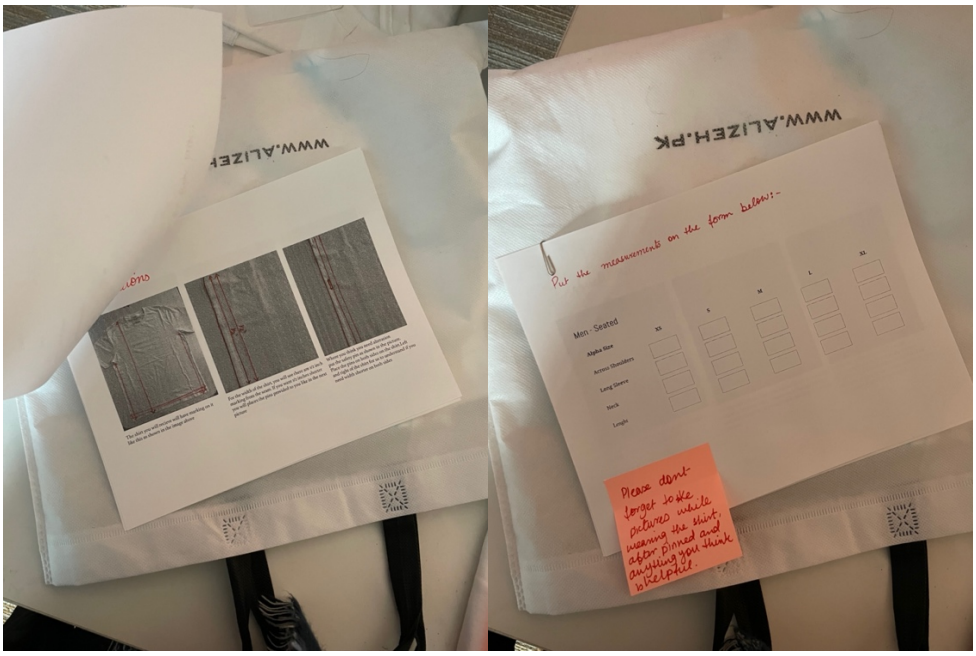


Figure 16: Instructions were added on how to take the measurements.

Each participant returned the T-shirts with the marking on it. One of the participants was satisfied with the actual fitting of the T-shirt while others required alteration as per their fit. The shirts were then taken to the tailor based in to make the adjustments on the T-shirt.

Figure 17: Tailor making adjustments through markings on the T-shirt

During the alteration process I realized experienced tailors and seamstresses have knowledge and skill when it comes to making alterations to garments. However, they do need

clear guidelines and instructions to follow to ensure that the alterations are done correctly and to the wearer's satisfaction.

The shirts were then returned to the participants to check if the altered garment fits them well. The shirt fitting worked well on each participant and the measurements were recorded. During this testing phase, I realized that participants were not aware of their sizes because they mentioned that they never had tailors do their alterations or would not find anyone who would it do it for them professionally.

Before moving on to designing a digital product I did a thorough research on the existing tailoring companies in the industry.

Development of digital product:

Created a digital application that can record measurements digitally and share them with tailors for alterations which can streamline the tailoring process and enhance customer experience. Similarly, leveraging the recorded measurements to generate a tailored shopping experience based on body size can provide personalized recommendations and improve the overall shopping experience.

The figure 17 shows the ordering process of the grid shirt for capturing measurements to be later added in the database, tutorials on how to take the measurements and send it to the tailors for alterations.

Figure 17: Shows low fidelity interface to select the garment type in the wardrobe.

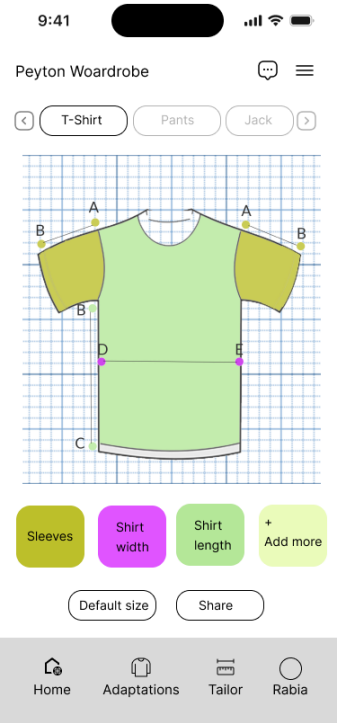


Figure 18: Shows low fidelity interface of the measurement interface.

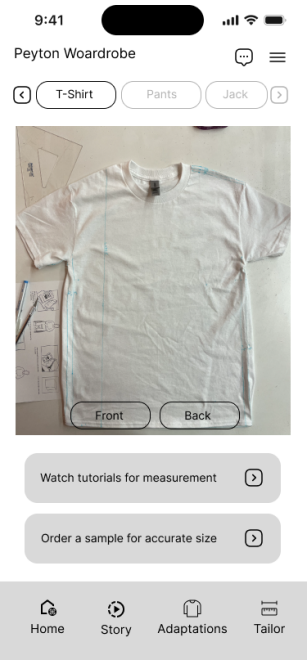


Figure 19: Shows low fidelity interface to order the grid shirt and tutorials on how to take measurements.

This allows users to order a sample T-shirt with a grid on it to obtain accurate dimensions for shopping online or communicating dimensions to tailors. This feature is useful as it can help users to ensure that the clothes, they purchase fit them well, thereby reducing the likelihood of returns or exchanges. By ordering the sample T-shirt with the grid on it, users can measure the dimensions of the T-shirt (Figure 18)and use these measurements to choose the right size when shopping online (Figure 20) or to communicate the correct measurements to tailors.

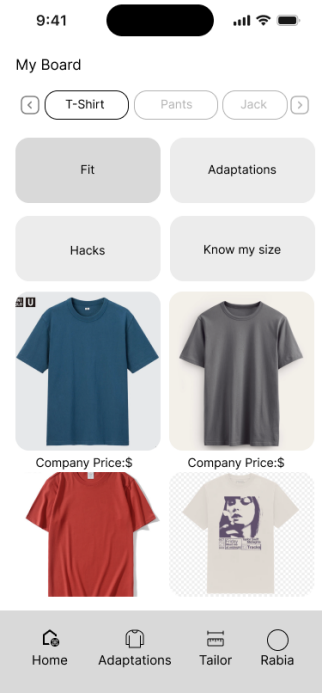


Figure 20: Tailored shopping experience for the user as per it fetches the data added by the user.

The Figure 21. shows the screen that gives relevant information about the tailors such as address, base charges and ability to connect via phone. The purpose of this interface was to test the connection of the users with the tailors and how tailors would respond on what features they would like on the digital app to understand the alterations.

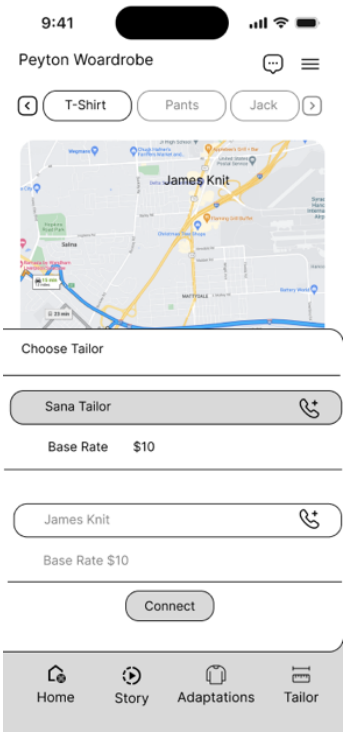


Figure 21: Interface showing tailors tab and related information.

Following are the potential benefit of the physical interface that works in tandem with a companionvdigital interface:

Efficiency: Sharing measurements digitally with tailors can streamline the alteration process by eliminating the need for people in wheelchair to visit tailoring shops multiple times for fittings. This can lead to faster turnaround times and improved efficiency in the tailoring process.

Personalization: Utilizing the recorded measurements to generate a tailored shopping experience can provide personalized recommendations for clothing options that are likely to fit well based on the individual's body size. This can enhance the overall shopping experience and increase customer satisfaction.

Data-driven insights: The digital application can collect data on customers' body measurements, alteration preferences, and shopping behavior, which can provide valuable insights for tailors

and retailers to make data-driven decisions in terms of inventory management, product offerings, and marketing strategies.

The adaptation screen provides multiple adaptations available to add on the T-shirt for ease of dressing and undressing such as zippers, Velcro and elastic. This interface also allows the users to add any other adaption element they would to add on the T-shirt apart from the ones mentioned on the interface.

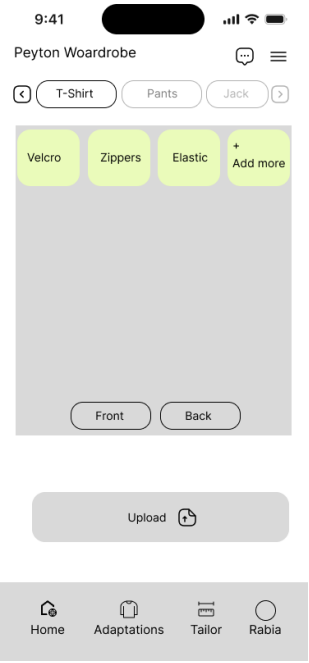


Figure 22: Adaptations low fidelity interface

User Testing

The images below (Figure 23) shows that the app was tested with one of the participants and the tailors. (Figure 24)

Users in wheelchairs expressed satisfaction with the digital interface's features and flexibility for adaptations. This feedback was encouraging and suggested that the interface is meeting the needs of people in wheelchair by providing them with the tools and resources they need to communicate their adaptations to tailors and customize their clothing accordingly.

However, the buttons on the home page of the digital interface that corresponds to the T-shirt measurements were small for the participants with less dexterity. Participants suggested they want the buttons to be bigger and they should be positioned in a way that is easy for them to interact and navigate.

Some users have expressed confusion about the graphical chart (Figure 22) on the back of the T-shirt in the interface. It seems that the chart may have given the impression that users were expected to create their own shirt from scratch based on the provided dimensions. During the interview and testing process of the prototype, participants mentioned that they need some assistance or help to go to the postal service for delivering the items for tailors, and that would create hinderance in the usability of the app.

Overall, the positive feedback from people in wheelchairs underscores the importance of designing digital interfaces with accessibility in mind. By prioritizing accessibility and incorporating feedback from users, I moved on to the next step of creating a digital experience that are more inclusive, user-friendly, and effective for all users.

Figure 23. Participant testing the user interface and core interactions.

Figure 24: Tailor testing the interface.

Iteration Phase 1:

Changes were made to the digital application based on user feedback, including moving the dimensions button to the center of the interface and increasing the surface area of the button for easier access. These changes are likely to improve the usability and accessibility of the

interface for users, making it easier for them to access and use the dimensions button to obtain accurate sizing information.

The graphical chart was removed from the background to simplify complex visual elements and reduce distractions that can make it difficult for users to understand the information being presented. (Figure 25)

By incorporating USPS pickup service as an option for participants to schedule the delivery of items to the tailors, this addressed the concern of dependency on someone for delivering the items. This can provide more flexibility and convenience for users, allowing them to choose a pickup location and schedule time that works best for them. (Figure 27)

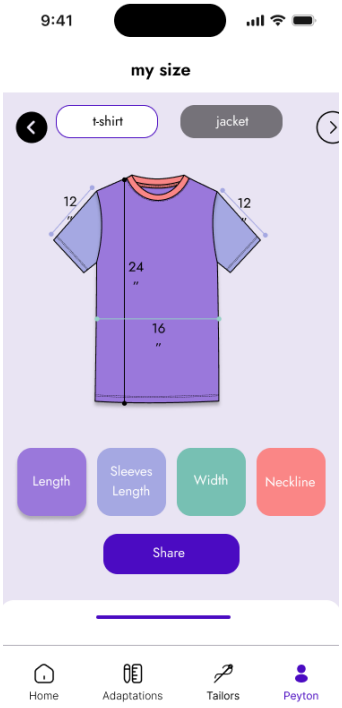
I added a useful feature to the adaptation process, by including the price of each item. This provided users with important information about the cost of each adaptation, which can help them make more informed decisions about what adaptations they want to make and how much they are willing to spend. (Figure 26)

Addition of a scheduling feature for “tailor visit at home” was a great way to further improve the adaptation process. By offering this option, I was able to address the needs of users who may have difficulty taking their own measurements or require more complex adaptations. (Figure 27)

Scheduling a tailor visit can ensure that the measurements are taken correctly and that the adaptations are tailored to the user's specific needs. This can lead to a more personalized and comfortable fit, which can be especially important for individuals using wheelchairs. Incorporating this feature into the digital interface can also make the scheduling process more streamlined and convenient for users. They can easily select a date and time that works for

them, and the tailor can arrive at their location to take measurements and discuss the adaptation options.

During the discovery process, I found out that Medicaid has funding that covers the cost of alterations and clothing under disability funding through New York state law. Additional information was added in the profile tab of the application where the user can request about available funding which can cover their additional costs for alterations. (Figure 28)



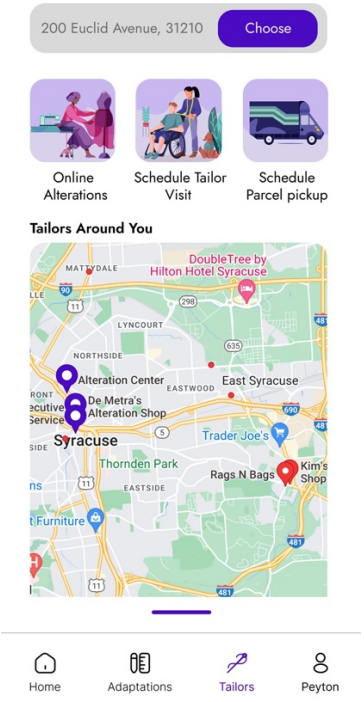


Figure 25: T-shirt interface Figure 26: Chose Parcel pickup Figure 27: Adaptations screen

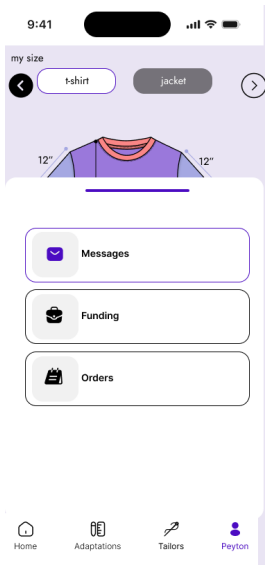


Figure 28: Adaptations screen

Accessibility considerations:

When designing an app with accessibility in mind, it's was important to consider color contrast to ensure that the app is usable by people with visual impairments or color vision deficiencies. The app color pallet was checked through Web Content Accessibility Guidelines (WCAG). Additionally, color coding method was used in designing the measurement interface to make it clear for the user which areas of the shirt are they viewing and what are the changes they are making.

I used color coding in the measurement interface to convey information to users, but it was important to ensure that the color coding is designed with accessibility considerations in mind.

I used distinguishable colors: colors that have a clear contrast to ensure that users with color vision deficiencies can differentiate between different areas or changes in the interface and avoided using colors that are too similar or that may blend for users with visual impairments.

Moreover, provided alternative cues: Used additional cues, such as labels, text descriptions, icons, to complement the color coding. This ensures that users who may not perceive colors can still understand the information being conveyed.

Prototype Phase 2 testing:

In prototype phase 2 I carried out user testing with a female participant over a zoom call. The access to the application was shared with her and she was asked to give feedback on the interactions of the application as well as the core functionality of it.

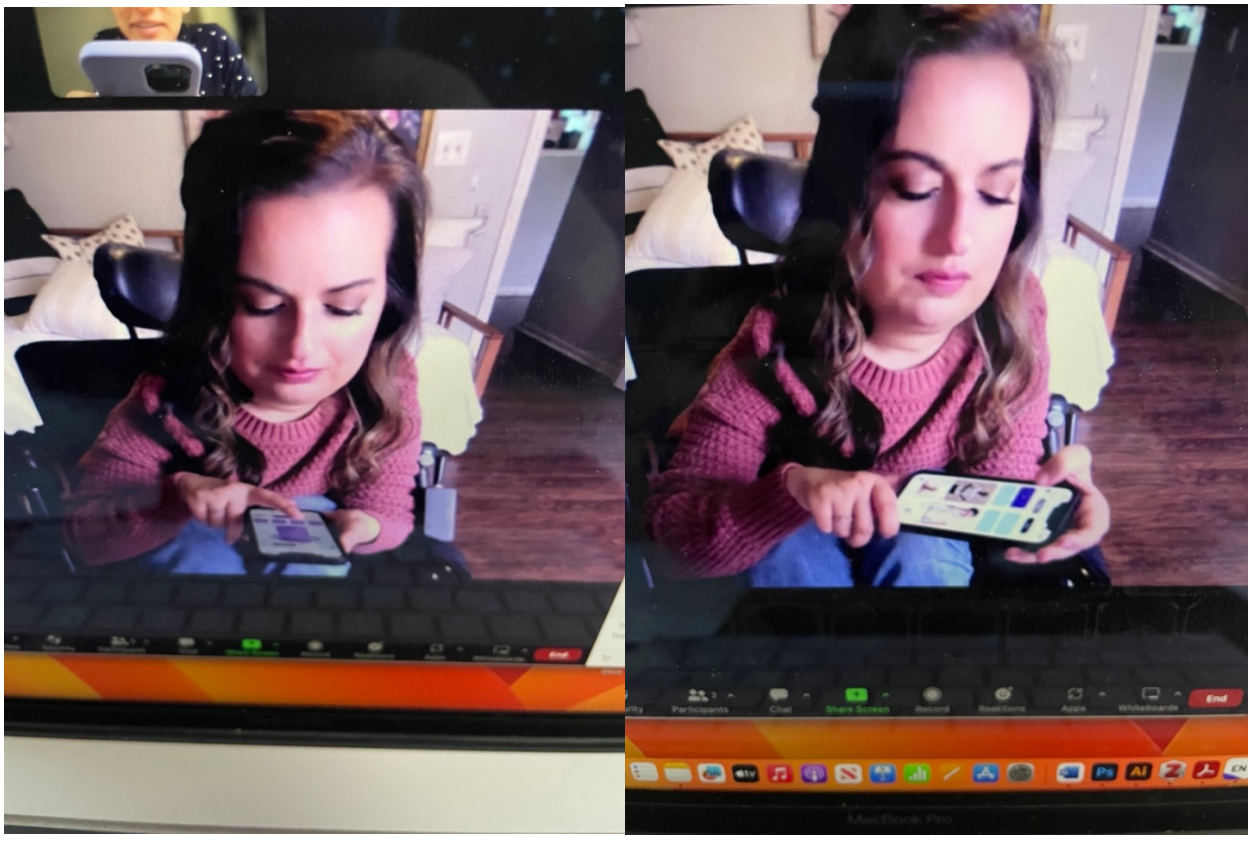


Figure 29: shows the snapshots taken while testing.

Feedback after prototype phase 2:

Participant was satisfied with the interactions of the application as well as the size of the buttons were easily clickable. However, she expressed the color contrast of actionable buttons could be increased.

Final Design:

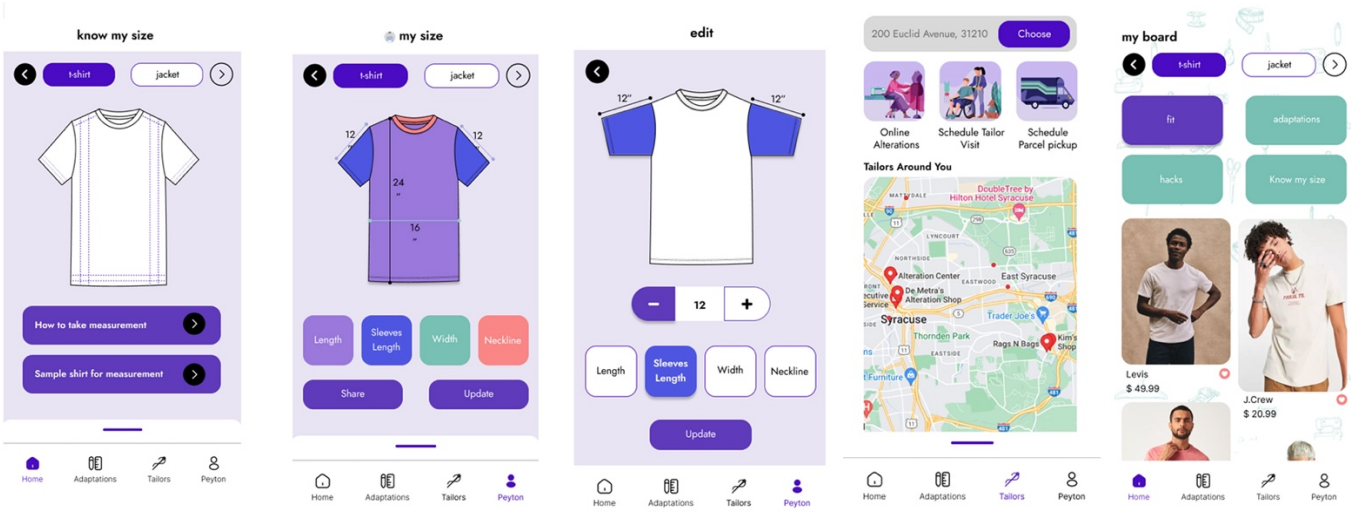


Figure 30: Shows the final design with the changes from the testing phase 2

Reflections

Designing a physical measurement interface with a companion app was indeed a challenging process, and determining the standard size and style of the T-shirt was a crucial step. Using popular brands' sizes and styles as a starting point was a practical approach however while standard size charts and measurement guidelines used in the fashion industry were only limited to XS,S,M,L sizes it lead to a time-consuming process.

My research involved participants from different cities, utilizing remote testing with participants who are in different cities was a practical and effective way to gather feedback on

the measurement interface and sizing options though longer lead times for prototype delivery and potential delays in gathering feedback dragged the research process longer than expected. However, it is still a valuable approach to gather feedback from participants located in different cities, as it allowed me to reach a diverse user base and obtain insights from a wider range of perspectives.

By the end of the design process, I concluded that designing a 3D adaptable suit that can directly take body measurements and transfer the data to a sizing system can be a great way to address the back-and-forth of sizing alterations in a more efficient and accurate manner. However, setting up a foundation of measurement database was important, and it directly speaks to the needs of the wheelchair user. If I had more time, I would have prototyped a suit with solenoid attached to gather data by snapping connecting points on the grid to directly capture the measurements from the shirt without pinning them for alterations.

Conclusion

Re-mend is a prototype that uses a T-shirt (the most worn garment) to help users understand their measurements and facilitate the process of tailoring. The prototype showed that when a garment fits well according to one's own style, it boosts the wearer's confidence. However, additional features can be incorporated into the application to allow users to stylize their garments through alterations and customization, including color and accessories selection. This is a steppingstone for providing people with the seated ability to tailor their wardrobe according to their choice. Furthermore, this can be taken further to add additional pieces of wardrobe that are essential for the wearer's look, such as jackets, pants, etc.

Here are some additional thoughts on how Re-mend could be improved:

- The application could be expanded to include measurements for other garments, such as pants, shirts, and dresses.
- The application could also include a library of pre-made alterations and customizations that users could choose from.
- The application can also give users the option to stylize their outfit by selecting garments from different companies. This would allow users to create unique and stylish looks that are not limited to the garments that they own. The application could also provide users with recommendations for garments that would complement their existing wardrobe.

Re-mend is an innovative modular service model that provides customization of garments based on individual style and fit preferences. By leveraging digital communication, customers can easily convey their alteration requirements to tailors, enabling a convenient and adaptable service experience. This approach has the potential to revolutionize the traditional garment alteration process by making it more efficient, customer-centric, and accessible to a wider range of individuals. Moreover, Re-mend's model also aligns with sustainability principles by promoting garment re-styling and re-purposing. Many garments end up sitting in closets unused because they don't fit well or meet the wearer's preferences. By offering customization and alteration services, Re-mend encourages the reuse and repurposing of garments, reducing waste and promoting a more sustainable approach to fashion consumption because sustainability must include accessibility.

Indeed, Re-mend's modular service model has the potential to create employment opportunities and promote skill development within the alteration and tailoring industry. By connecting customers with skilled seamstresses/tailors who work from home, Re-mend can create a platform for individuals to utilize their tailoring skills and provide services to customers.
Re-mend can have multiple positive impacts. it can create job opportunities for individuals who may have limitations in terms of mobility, transportation, or other factors that prevent them from being employed in a traditional work setting. This can include individuals who are part of shelter homes, people with disabilities, or those who prefer working from home for various reasons.

Re-mend can provide them with a platform to generate income and improve their quality of life by utilizing their skills and providing alteration services.
There are a few limitations related to the project, prototyping other garments in the wardrobe such as jackets. In order to develop the database for every garment this will be a time-consuming process; however, 3D scanning suits can serve as the catalyst in the development of the project.

In future, the Re-mend platform can contribute to skill development within the tailoring industry by fostering training, learning, and professional development opportunities for seamstresses/tailors about adaptive clothing that can also provide services to retail industry. This can include providing access to resources, training programs, and mentorship opportunities, thereby empowering them to enhance their skills, expand their knowledge, and improve the quality of life for both the service providers and the customers.

Further research will involve connecting with retailors and manufactures to understand their limitations when designing clothing for people in wheelchairs and the future considerations of adding adaptations features into ready-to-wear clothing.

Appendix

Interview Questions

Questions for people in wheelchair:

Q1) Are you satisfied with current ready to wear clothing attributes? (Such as style, color and usability?)

Q2) Do you shop with your friends/family/or you prefer to go for shopping alone?

Q3) While shopping for clothes what are the factors you keep in mind that resonated with your style?

Q4) If you are invited to a special event, would you be prompted to buy new clothes?

Q5) Can you describe what your preference for shopping would be? For instance, would you shop for fashionable clothing or comfort?

Q6) How much you need special alterations to your ready-to-made clothing to accommodate your style or comfort?

Q7) What are the challenges you face in getting your clothes customized?

Q8) From pieces of clothing that you currently own which are you most dissatisfied with?

Q9) How far you would be willing to travel to be fitted to have customized clothing?

Q10) If you ever have gotten your clothes altered, how were you able to/arrange this

Q11) How do you prefer explaining customization Online/In-person?

Q12) Do you stylize your outfit when going for an event or you are more inclined towards whatever comfortable is in the wardrobe?

Q13) Are you aware of any brands/designers specializing in adaptive clothing for seated ability?

Q14) Do you work? Do you feel the need of adaptable clothing for a professional workplace

situation? Q3

Q15) Any suggestions on how to make clothing fashionable and functional?

Questions for Caregiver:

Q1) What are the challenges when you take (insert name of the participant on wheelchair) for shopping? OR shopping Online?

Q2) Do you help (Participant name) in taking the decision of which apparels to buy?

Q3) What are the factors that influence your and (insert name of the participant) while making choices for clothing?

Q4) Do you assist in donning and doffing with the (participant name)?

Q5) What are the challenges when you must get the clothes customized for (insert name of the participant)?

Q6) Can you describe what (participants) preference for shopping would be? For instance, would you shop for fashionable clothing or comfort?

Q7) How far you would be willing to travel to be fitted to have customized clothing for the participant if they cannot get it done themselves?

Questions for tailors:

Q1) Can you please describe you experience of working with people in wheelchair?

Q2) How often do you alter/customize clothes for people in wheelchair?

Q3) Have you ever been altering garments that do not fit the standard sizing, please elaborate?

Q4) What is your take on alterations, if you are asked to alter garment which does not fall under specific size?

Q5) Are you aware of adaptive clothing?

Q6) Do you think for alterations one should have enough knowledge about adaptive clothing?

Q7) Can tailors with 3-4 years of experience can alter garments if the measurements are communicated digitally?

Q8) Would you be interested in using a digital platform for increasing your market share?

Q9) If the measurements are communicated digitally or via video call, does that information help in tailoring? Please elaborate other forms of communication can help in understanding measurements.

Q10) After covid do you do home visits for measurements?

Q11) What are the specific information you would need for measurements; how will you be able to take measurements for a person in a seated position?

IRB Approval

Syracuse University

INSTITUTIONAL REVIEW BOARD
MEMORANDUM

TO: James Fathers
DATE: October 18, 2022
SUBJECT: **Exempt Protocol Review - Modifications Required**
IRB #: 22-314
TITLE: *Fashion-able Co-Creation Model How Clothing Can Bridge the Gap between Functionality and Personal Style for a Wheelchair User through a Co-Creation Model?*

The above referenced application, submitted for consideration as exempt from federal regulations as defined in 45 C.F.R. 46, has been evaluated by the Institutional Review Board (IRB) for the following:

1. determination that it falls within the one or more of the eight exempt categories allowed by the organization;
2. determination that the research meets the organization's ethical standards.

It has been determined by the IRB that authorization of your protocol is deferred until you respond to the modifications required or issues raised below:

1. **Focus groups are indicated in Sections 1-A, 4-B, and 4-C of the IRB exempt application. However, focus group discussion questions and a consent document describing focus groups was not submitted. If you will conduct focus groups at this time, submit the focus group questions and the consent document for focus groups. If you will add focus groups at a later time, remove focus groups from all sections of the application, then submit the questions and consent form for focus groups with an IRB amendment request form at the time they will be added to the protocol.**
2. **In-person interviews should use a written consent process, remote/telephone interviews should use an oral consent process, and electronic/online surveys should use an electronic consent process. Per the protocol description in Section 4-C, an electronic survey will not be used. Please remove the electronic consent from the application. There should be two consent documents submitted, one for oral consent (zoom/phone) and one for written consent (in-person). The consent submitted with the application is labeled Oral consent form but is in a written/in-person consent format including signature lines on the form. Please revise accordingly using the oral and written exempt consent templates (Oral: https://researchintegrity.syr.edu/wp-content/uploads/2021/10/Template-Exempt-Oral-Consent-Rev.-3-16-21.docx ; Written: https://researchintegrity.syr.edu/wp-content/uploads/2021/10/Template-Exempt-Written-Consent-Rev.-3-16-21.docx).**

All changes/modifications must be incorporated into your application and/or supplemental documents as requested. Copies of all requested documents must be provided.

The revised documents should be carefully reviewed by the Principal Investigator prior to resubmission and sent via e-mail to: orip@syr.edu within ONE MONTH of the date of this letter.

As a reminder, you may not initiate any activities related to this research project, including recruitment, consent, data collection, and/or data analysis until the protocol receives IRB approval.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Tracy Cromp, M.S.W.
Director

DEPT: VPA – School of Design, Rm-101E, The Design Warehouse, 350 W Fayette St, Syracuse, 13202 **STUDENT:** Rabia Razzaq

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Images of participants wearing sample and altered sample T-shirt :

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Resume

Rabia Razzaq
Interaction and Product designer

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I'm a Product designer, compelled by co-design processes.
I am passionate about conveying storytelling with an emphasis on **research, diversity and inclusion** in my practice.

Projects

Amble / Product designer
Syracuse University September 2021-December 2022
Creating an assistive walking methodology to prevent older adults from falling through machine learning, aurdunio; encompassing the use of mechanical devices.Strategized ways to make quick wearable prototype, through adaptive design techniques.

Detector Pro/ Product designer
Syracuse University September 2021-December 2022
A qualitative research to develop ways to control infestation. Designed an autonomous device working in tandem with an application. Designed and prototyped using sketch, photoshop, figma.Understanding the usibility of the product, and design process.

Experience

Design Researcher/ Syracuse University
September 2021-Ongoing
Understanding the perspectives and demographics for designing women wellness centers in New York by working with researchers and demonstrating the data graphically.

Graphic Designer/ Republicwomenswear
August 2017-August,2021
Lead the design team, drafting and executing ideas for women in the fashion industry. Developing and adopting new technological aspects in the field of art and design; through set design, photography and graphical campaigns.

UI/UX Designer/ Uninama
May 2017-May 2018
Lead designer for education-based startup. Designed and user tested the application and website with the students in Pakistan. Formulated the design plan for marketing the website that gave an access to students to explore the schools and education facilities available.

Honours

September 2021-Ongoing
Fellowship at Syracuse University for Masters in Design.

Education

Syracuse University/ MFADesign
May 2021-May 2023
Initiated and part of several experimental projects involving web usibility, tangible interactions and natural user interfaces. Along with product development starting from qualitative reserach towards testing.

Skills

Design: Illustration & UI Graphics• Strategy and vision presentations •User flows• Concept sketches •Wireframes & mockups with sketch & Illustrator •Style guide & Pattern Library

Research: Data analysis •Task Analysis & Personna hypothesis•

Collaboration: Self starter•Detailed Oriented •Flexible•Communicative•

Softwares: Adobe-Photoshop, Illustrator, Aftereffects•Figma•Sketch

Research & Exhibitions

- Social and cultural impact of design and development in the third world countries
- Understanding how technology can contribute in development
- Build a Nation, teach a child at a young age
- Dissertation used in Punjab University Library, Lahore Pakistan
- Art in the presence of social media The Aurat March and Female Youth activism in Pakistan through art and design