"THE JOLLY TROLLEY" - ENHANCING THE SHOPPING EXPERIENCE FOR SENIORS

A creative work submitted to the faculty of
San Francisco State University
In partial fulfillment of
the requirements for
the Degree

Master of Arts in Industial Arts

by

Yilun Zhang San Francisco, California May 2016

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Certification of Approval

I certify that I have read "The Jolly Trolley" - Enhancing the Shopping Experience for Seniors by Yilun Zhang, and that in my opinion this work meets the criteria for approving a written creative work submitted in partial fulfillment of the requirements for the degree: Master of Arts in Industrial Arts at San Francisco State University.

Ricardo Gomes Professor

Design & Industry

Silvan Linn Assistant Professor Design & Industry

Abstract

In this research-based design project, the author deals with the problems entailed ambulatory disabilities in terms of navigating through the store with shopping can home. This creative work aims to generate a new design for a shopping cart that of seniors and is more attractive in appearance based on human-centered design will be easy to use, lightweight, and foldable, and will be able to carry sufficient which will help the senior citizens aging in place to have a happier shopping expense.	arts and transporting heavy groceries at can better accommodate the needs gn and universal design principles. It groceries for two people for a week,
lives.	
Key Words: grocery shopping; seniors; ambulatory disability; aging in place; sho	opping carts; human-centered design;
I certify that the Abstract is a correct representation of the content of this written	creative work.
Ricardo Gomes, Professor, Design & Industry	Date
Chair, Written Creative Work Committee	

Acknowledgements

I would first like to thank my mom and my dad for their unfailing dedication to my education, for their unconditional love and for supporting my dream of pursuing my future overseas. They have not only supported me financially, but are also my strongest spiritual support.

To my thesis committee chair, Professor Ricardo Gomes, I am sincerely grateful for your brilliant instruction and constant assistance throughout the two-year study program. I could not have achieved this accomplishment without your grounded support and practical insights. To my thesis committee member, Professor Silvan Linn, thank you for helping me with all the difficulties and obstacles throughout the development of my research and design processes. To the DAI laboratory assistants, Richard and Jim, thank you for all your help in setting up machines and giving instructions throughout my prototype development.

To my community partners, Jane Winslow, Sue Siegel, and Dr. June Fisher, thank you for sharing all your experience and opinions about my project; you have given me rich insights and helped me to improve.

Special thanks to all my family, coworkers, fellow DAI students, and friends who supported me with motivation, enthusiasm, and provided the latest information. Thank you to my aunt who accompanied me here in my first year, and for always helping me out throughout all my education. To everyone who shared personal experiences and opinions in the interviews and survey part of this project, I would not have been able to complete this project without the information you provided.

Finally, to DAI and SFSU, I am truly appreciative of everyone for providing such an inspiring study environment and for giving the opportunity to further my education.

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Glossary of Terms

ADLs: activities of daily living, include bathing, dressing, eating, and getting around the house.

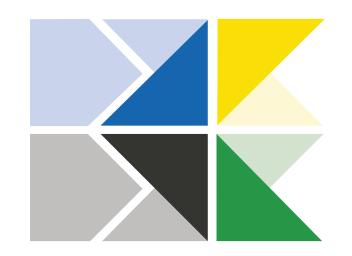
IADLs: instrumental activities of daily living, include preparing meals, shopping, managing money, using the telephone, doing housework, and taking medication.

ACC system: Adaptive Cruise Control system, which is widely used in an automobile that allows it to navigate by itself. It can let the car keep at a certain speed, or keep a same distance with the car in the front.

Human-centered Design: Human-centered design is based on the physical and psychological needs of the human user, enabling the user to function at the highest level possible. It includes products and aspects of the physical environment that meet the needs and abilities of the user, not those that demand adaptation to the design by the user.

HCD tool: Hear; Create; Deliver. It is a design kit from IDEO, which is very useful for human centered design.

Benchmarking: Benchmarking is the process of comparing one's business processes and performance metrics to industry bests or best practices from other companies. Dimensions typically measured are quality, time and cost. In the process of best practice benchmarking, management identifies the best firms in their industry, or in another industry where similar processes exist, and compares the results and processes of those studied (the "targets") to one's own results and processes. In this way, they learn how well the targets perform and, more importantly, the business processes that explain why these firms are successful.



01

Introduction

1-1 Introduction

Grocery shopping is an activity in each person's daily life and which cannot be avoided. More than four out of five adults in the U.S. (83%, or 203 million people) claim to have at least 50% of the responsibility for their household's grocery shopping (Figure 1-1, Food Marketing Institute, 2015).

Although the grocery-shopping experience can be satisfying under general conditions, some consumers still find it troublesome and difficult, especially seniors who have less strength and ability. As the aging population is growing rapidly, this is a tremendous problem that countries all over the world will have to address in this century. In the U.S., the older population—aged 65 or older—numbered 44.7 million in 2013 (the latest year for



Figure 1-1: Grocery Shopper Types Copyright © Food Marketing Institute

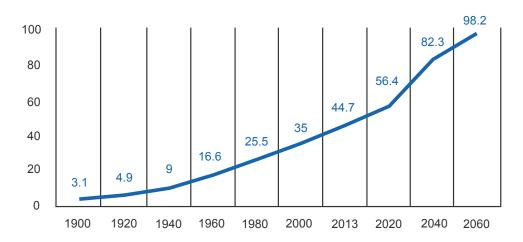


Figure 1-2: Number of persons 65+: 1900-2060 (numbers in millions) Copyright © U.S. Department of Health and Human Services

which data is available). They represented 14.1% of the U.S. population, or about one in every seven Americans. By 2060, there will be about 98 million older persons, which is more than twice the number in 2013 (Figure 1-2). People 65+ represented 14.1% of the population in the year 2013, but this number is expected to grow to 21.7% of the population by 2040 (U.S. Department of Health and Human Services, 2014).

Disabilities and activity limitations occur more frequently among aging populations than they do in any other age range. According to the same survey report, some type of disability (such as difficulty in hearing, vision, cognition, ambulation, self-care, or independent living) was reported by 36% of people aged 65 and over in 2013 (Figure 1-3). Using limitations in the activities of daily living (ADLs) and instrumental activities of daily living (IADLs) to measure disability, 33% of community-resident Medicare beneficiaries aged 65+ reported difficulty in performing one or more ADLs, and an additional 12% reported difficulty with one or more IADLs in 2012 (U.S. Department of Health and Human Services, 2014).

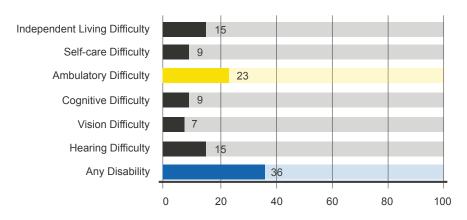


Figure 1-3: Percentage of persons 65+ with a disability, 2013 Copyright © U.S. Department of Health and Human Services

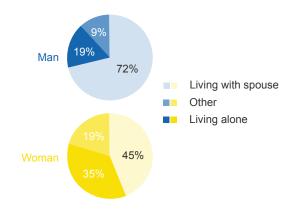


Figure 1-4: Living Arrangements of Persons 65+: 2014 Copyright © U.S. Department of Health and Human Services

Most senior citizens live alone or with their spouses (without younger family members) in the U.S. According to the profile of older Americans, over half (57%) of older noninstitutionalized persons lived with their spouse in 2014. About 28% (12.5 million) of all noninstitutionalized older persons (8.8 million women, 3.8 million men) lived alone in 2014. They represented 35% of older women and 19% of older men (Figure 1-4, U.S. Department of Health and Human Services, 2014).

As most senior citizens wish to live independent lives and age in place to achieve well-being, grocery shopping is an activity included in IADLs that represents a restriction of their ability to live independently. "Frequent shopping among the elderly is related to increased walking -- a low-impact physical activity that can improve heart health as well as balance and coordination," said Kelly D. Horton, a research and policy specialist at the Center for Healthy Aging in Washington, D.C. "Shopping provides an enjoyable activity and helps older adults feel included in their community," continued Horton. "In addition to physical activity, frequent shopping among older adults has also been related to improved nutrition intake" (Amanda Gardner, 2011). Because "Ambulatory Disability" is the most common of the six types of disabilities identified

by the ACS, the experience of grocery-shopping can be affected significantly. People who have to use walking aids will find it extremely difficult shop for groceries by themselves. This research-based design will focus on personal shopping aids to explore the possibility and practicability of achieving a better shopping experience, thus leading to a happy, healthy, and independent lifestyle for the seniors.

1-2 Statement of problem

Grocery shopping can be difficult for seniors with ambulatory disabilities and declined strength. Browsing in a store while using shopping carts and carrying heavy groceries home is extremely troublesome for people using walking aids.

1-3 Anticipated Sub-Problems

The product design will need to consider:

- 1. The use of the product in problematic environments such as crowded and congested markets, and when going up/down steep hills.
- 2. The use of the product in likely scenarios such as getting on/off public transportation, being put into a private car, and when going up/down stairs.

- 3. The safety of this product must be considered, including both potential harm to human beings and the product being lost or stolen.
- 4. The price of this product must be affordable for elderly users.
- 5. Environmentally related problems must be considered, such as whether the product is energy efficient and whether the materials used are environmentally friendly.

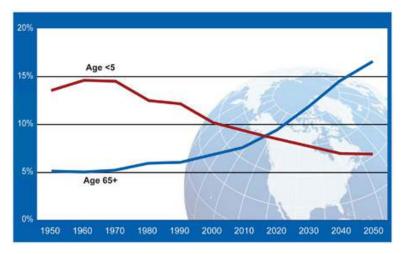


Figure 1-5: World Population Prospects: The 2010 Revision Copyright © United Nations

1-4 Significance of the Problem

The number of people aged 65 and over will exceed the number of children under five for the first time in 2016 according to United Nations (Figure 1-5). In 2008, the proportion of elderly people in Japan exceeded those in Sweden and Italy, and Japan became the demographically oldest of the world's major nations (Kinsella, 2009). The younger Japanese generation is experiencing a heavy burden in terms of taking care of the elderly in their families. As being an only child is common in the younger generation, a large number of elderly people may turn to one young person for support, both financially and physically, which is extremely stressful. Those of working age are expected to provide direct or indirect support for those who are dependent. Such support may be provided within the family, through religious or community institutions, or by the state.

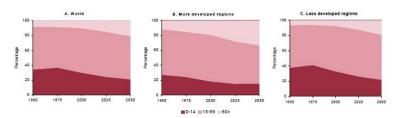


Figure 1-6: Distribution of population by broad age groups: world and development regions, 1950-2050

Copyright © United Nations

As the aging population is growing, the potential social support needs are also increasing. The young-old balance is shifting across the entire world (Population Division, DESA, UN, 2010). Elderly people are constituting a larger

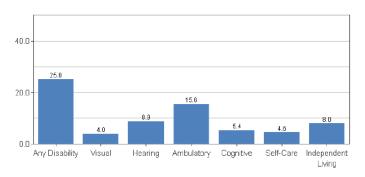


Figure 1-7: Prevalence Rate: Age 65 to 74 years (%)

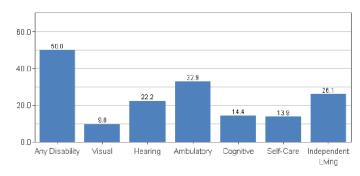


Figure 1-8: Prevalence Rate: Age 75 years and older (%)
Copyright © Employment and Disability Institute at the Cornell
University ILR School

proportion of the population, particularly in developed countries (Figure 1-6).

The percentage of people with disabilities also grows rapidly as age increases. The 2012 disability status report of the U.S. shows that the overall percentage (prevalence rate) of people with a disability who were aged 65 to 74 in the US was 25.0 percent, while this figure was 50 percent for those aged 75 and older. Of the six types of disabilities identified by the ACS, the highest prevalence was "Ambulatory Disability", with 15.6 percent for ages 65 to 74, and 32.9 percent for those aged more than 75 (Figures 1-7, 1-8) (Employment and Disability Institute at the Cornell University ILR School, 2014).

How to allow people to live independent and happy lives after their physical and mental abilities start to decline and ways of easing the burden of family and social care has become an increasingly significant area that many researchers are studying. Encouraging an active life style and reducing sedentary behavior is one of the keys to achieving happiness and well-being across the long span of life (Kinsella, 2009). However, many elderly people are unable to be as active as they were, although they still want to maintain the lifestyle they have lived

for many years. As their daily activities decrease and they leave the house less often than before, their health might also decline, both physically and mentally. They are probably becoming more dependent on other people and feeling less satisfied with their lives. Achieving health, independence, happiness, and well-being across the long span of life is every person's wish. Since seniors expect to continue their current life styles, they have to overcome disabilities with the help of certain tools or services.

1-5 Scope and Limitations

The intended users of this creative work will be elderly people with ambulatory disabilities and people who want assistance to reduce exertion while shopping for groceries. Due to the fact that elderly people with limited mobility do not usually take small children with them when grocery shopping, children's participation in this design will be limited. It is also more likely to be a personal shopping aid than a service provided by the shop because it will solve the problem of transporting groceries from the store to home.

1-6 Design Tools and Methods

In this creative work, human-centered design and universal design principles will be used to approach this problem. The design will be based on the physical and psychological needs of the users without the demand for the users' adaptation to the product or having to change their behavior in order to use it. The HCD toolkit is the main tool that will be used, as it describes the three stages of design, namely hear, create, and deliver. As humans are the main target of design, empathy is the key to understanding the people for whom one is designing. Only when a designer determines the true demands and expectations of the users can a design have a good foundation. Universal Methods of Design will also be referred to develop and study this problem in more depth and to find solutions in a more creative way. A Designer's Research Manual explains the methods and essentials of observation. It also describes why constant iteration is an important way to bridge the gap between the problem and the solution.

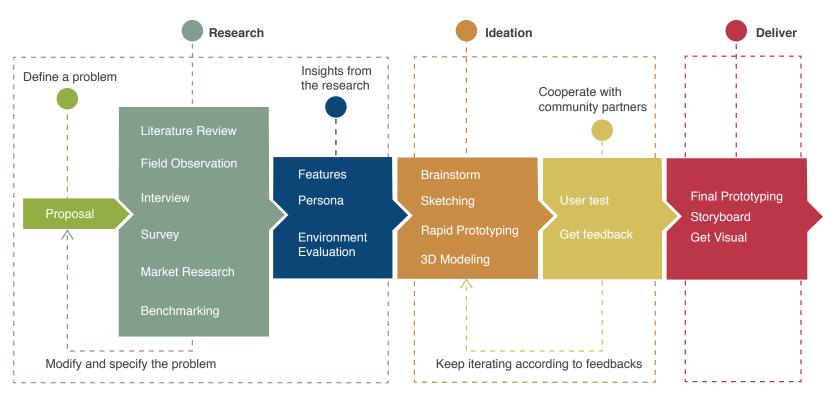
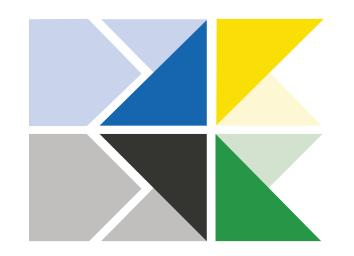


Figure 1-9: Design process



02

Literature Review

2-1 Senior citizens' shopping habits

Researchers have found that elderly people who go shopping daily live longer than do their less shoppingprone peers. According to a study published recently in the Journal of Epidemiology and Community Health, "Retail therapy" seems to benefit men more than it does women. In a shopping satisfaction survey of older consumers conducted in Scotland, problems have been reported when trying to use large trolleys or carry baskets, being unable to read price displays and labels, when reaching high and low shelves, when stretching to fill empty trolleys and reaching into deep freezers. Furthermore, respondents wanted seats to be provided, toilets available, and good lighting within the store (Hare, 2003). The factors influencing satisfaction with the shopping experience went beyond in-store design, staff, and merchandise-related factors. Instead, social issues, accessibility, the external shopping environment and personal factors influenced satisfaction with food shopping. The strongest dissatisfaction was found to be with the external shopping environment, particularly in terms of the variety of shops. The author also explained that it is important to consider the diverse needs of the sub-groups and not to simply see the elderly as a homogeneous group (Hare, 2003).

2-2 Research on the similar topics

A former student in the DAI MAIA Program, Elnaz Davoudi, conducted research on the elderly user's shopping experience. In Davoudi's Designing the Shopping Experience with a Holistic Approach to Aging in Place, she conducted an informative literature review, market research, ethnographic research, and data analysis, to explain the problems facing the elderly when shopping in a clear and comprehensive manner. Her work is a credible example of the use of inclusive design methodologies.

IDEO conducted an intensive shopping cart projectdevelopment experience for ABC's Nightline in 1999, which was very inspiring. They engaged in an intensive



Figure 2-1: Shopping cart concept for IDEO

and consolidated design development process that encompassed field research in grocery stores, sketching concepts, and rapid-prototyping, to name just a few processes. Their result was a streamlined shopping cart with a metal frame into which people could put portable plastic baskets to increase the flexibility of use (IDEO, 1999). This design was welcomed by customers; however, it did not appear on the market. It is difficult to say why supermarkets do not use these kinds of carts in their shops. Possible reasons are that the target clients are not clearly defined, or there could be problems with manufacture. Despite not being widely used, the thinking

Figure 2-2: Shopping cart in Carrefour Market France

behind the design thinking and the features thereof are still ahead of their time. Shopping carts with a similar design appeared in France ten years later in Carrefour Market, according to Yannig Roth, a Marketing Manager at eYeka and a PhD in marketing at Université Paris 1 Panthéon Sorbonne, in his blog, which indicates that some concepts that appeared in this project were not only innovative, but are also practical (Yannig Roth, 2011).

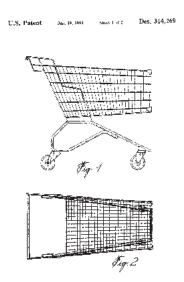


Figure 2-3: Shopping cart, Patent Number USD314269 S Copyright © Trubiano, A, 1991

2-3. Existing shopping cart patents

A large number of shopping cart designs has been patented in the U.S. The most basic one was designed in the late 1980s, patent number USD314269 S (Trubiano, 1991). It is merely a giant metal-framed basket with four wheels, and is still widely used in big supermarkets at present. In the last ten years, plastic has become more popular for building shopping carts because of the improvement in manufacturing methods. Hard plastic

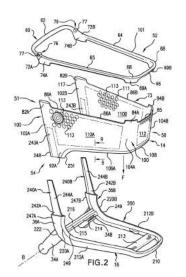


Figure 2-4: Shopping cart,
Patent Number US7793948 B2
Copyright © Splain, 2010

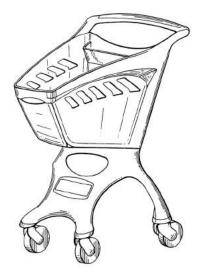


Figure 2-5: Shopping cart,
Patent Number USD444281 S1
Copyright © Gaze, 2001

is lighter, cheaper, and appears more stylish than does steel, as shown in Patent US7793948 B2 (Splain, 2010). In addition, the size of shopping carts has decreased and designers have put more effort into designing flexible wheels to make carts easier to push around the store, especially in congested places. Such carts are widely used in Target, Walgreens, CVS, and the like. They are designed to be assembled easily, to be functional, and to be appealing. For stores, they also have the advantage of being easy to stack, inexpensive to maintain, and easy to clean. Some shopping trolley designs even mold the entire body of the trolley using one piece of plastic, which reduce the process of assembly, and makes the construction stronger and more stylish (Gaze, 2001). It even reduces costs via mass production.



Figure 2-6: Popular private shopping carts

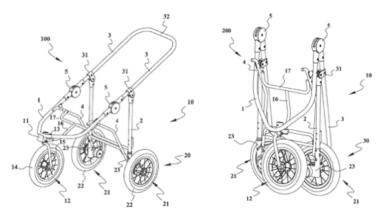


Figure 2-7: Jogging stroller frame with a front wheel automatic flattening folding mechanism, U.S. Patent Application 14/482,537.

Copyright © Wu, 2014

More recently, shopping carts have become more personal, especially for people who do not have cars. As it has always been a struggle for them to carry heavy groceries home, they carry their own shopping carts to the store instead of using the shopping carts provided. These private shopping carts are very simply designed, cheap, and portable. As shopping carts become more personal, some foldable shopping carts have been designed to have multiple functions and to save space. One such patent shows that the front wheel of the trolley can be folded and how the

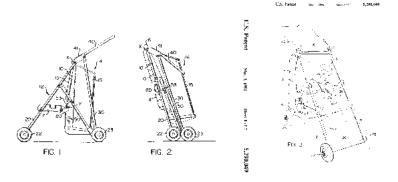


Figure 2-8: Push chair/shopping trolley, U.S. Patent No. 5,290,049.

Copyright © Crisp, D. J., & Cocks, D. C, 1994

mechanism works (Wu, 2014), while another patent shows a cart with both a shopping bag and a baby seat (Crisp, 1994).

There are also some other designs that show how mechanisms and electronics can be implemented in a shopping cart. Espejo invented a transportable shopping cart that can lift a basket into a vehicle and then be folded into the vehicle (Espejo, G. B, 2006).

Trolley bags that are reusable and convenient for shopping

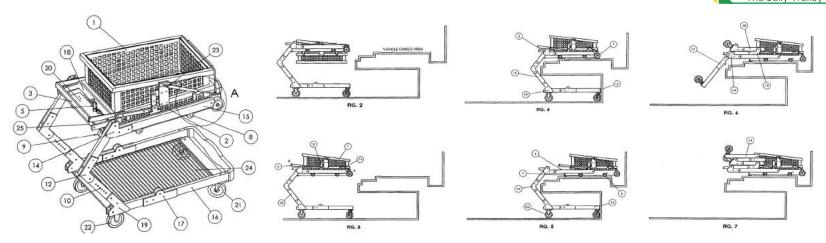


Figure 2-9: Transportable shopping cart, U.S. Patent No. 7,080,844.

Copyright © Espejo, G. B, 2006

trips have recently been invented (http://packingsorted. co.nz/). This product is made of four bags that can be put into a trolley in the store and detached and taken out separately when required. This makes organization easier and faster, which produces a more pleasant shopping experience for customers.



Figure 2-10: Copyright © Trolley Bags

2-4 Benchmarking

It is also useful to look at designs of items that are similar, such as wheelchairs, baskets, bags, and baby trolleys as benchmarks. In Michael Graves Design Group's project Impatiently Waiting, the designers used benchmarking to learn details about comparative offerings and to gain an insider's perspective across multiple industries when designing a hospital using wheelchair (Rob Van Varick, 2014).

It will also be helpful to study electronic devices and smart-product use as some technologies might be able to be applied to solve shopping problems in a new way. In recent decades, these smart objects have assisted users in variety of tasks, enriching life experiences, and making the impossible possible.

This also means that aging is more pleasant than it used to be, as people have fewer worries about maintaining a healthy and independent life style both physically and financially after they become seniors. Many companies produce wearable devices for health monitoring and emergency calls, such as Live!y. Some companies provide online services for the elderly to increase their motivation or enhance financial security. Companies such

as Google are also experimenting with self-driving cars, which would provide convenient transportation on a larger scale. Some engineers from Volkswagen adapted the ACC (Adaptive Cruise Control) system, which is widely used in automobiles, in a baby stroller, to enable it to follow the parents around (http://www.adweek.com/adfreak/vw-designs-baby-stroller-automatic-braking-after-joking-about-it-ad-166332). Smart household products either save labor and effort, or provide information and tips, which frees people from chores and enriches people's lives. Such

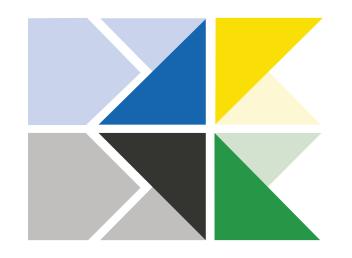


Figure 2-11: Kinet grocery cart

http://www.popsci.com/technology/article/2012-03/video-smartshopping-cart-future-follows-you-through-store

items include the iRobot Roomba Vacuum Cleaning Robot, which works automatically and keeps the room clean without any human effort, and smart refrigerators with LED displays to tell people the condition of food being stored and to provide healthy recipes. To improve the groceryshopping experience, many retailers have started to use a self-checkout system, which not only reduces customers' waiting times in a queue, but also reduces the shoppers' cost by saving on cashiers' wages. Microsoft, Chaotic Moon and Whole Foods have also entered into partnership to create a Kinect shopping cart (Figure 2-12), which would follow the customer around the store. It consists of a motion sensor and touch screen on a conventional shopping cart, which provides a digital shopping list and a self-checkout system (Clay Dillow, 2012). Technologically enhanced shopping is an unavoidable trend that it is changing consumers' behavior when grocery shopping. Nearly a third (32%) of consumers are using online coupons, while nearly the same amount (31%) use mobile technology for tasks such as making shopping lists, finding recipes, or researching products when grocery shopping. Almost one in four shoppers (23%) checks prices at a variety of stores online before going grocery shopping. One guarter of shoppers (25%) uses technology in at

least two ways when grocery shopping, with one out of ten shoppers (9%) using it in three ways (Food Marketing Institute, 2012).



03

Design Research

3-1 Interview

Three women aged from 82 to 93 were interviewed in this research. They all lived alone or with their spouses and were the primary shoppers in their households.

The interview was conducted by asking the following questions:

- Would you please tell me something about your situation in general?
- Would you please describe a typical grocery-shopping journey?
- Do you use online shopping or a delivery service?
- What kind of things do you buy in the store?
- What do you like about going shopping in the store?
- What do you dislike about going shopping in the store?
- How often do you go grocery shopping in the store?
- What is the quantity of groceries that you buy during one shopping journey?
- What is the most difficult part of the shopping journey for you?
- What do you think of the shopping carts provided in the store?
- Do you like the walkers and personal shopping carts that are currently available in the market?
- What do you expect from the new personal shopping cart design?

In general, two of the women that have been interviewed had to walk using two walking sticks, which means that their hands were always occupied. They all lived in the central part of San Francisco, surrounded by stores and restaurants within a five-mile radius. One woman drove to the store while the other two walked or travelled by taxi. During a typical shopping journey, the two women with ambulatory difficulty would have to ask either a shop assistant or a cab driver for help to carry their groceries to the car or to the house.

They shopped both in stores and online. They usually shopped online for heavy items such as laundry detergent, gallons of milk, water bottles and the like. They went to the store to buy fresh food, snacks, and (sometimes) flowers. Their favorite part of the in-store shopping experience was that they could look at goods that were on sale and pick up fresh fruits and vegetables, while the experience of going out also made them feel more alive and part of the community. However, people who walk using two crutches are not able to shop at the farmer's market because no shopping carts are available, and they do not have free hands to pick things up and carry them.

They all shopped for one or two people and they went shopping at least once a week. Therefore, the quantity of groceries they bought at one time was not large and amounted to two or three standard bags. And if they had not brought a personal cart with them, they would stop adding items once they felt they would be unable to carry more items home. The most difficult aspects for them was when they were moving the groceries from the store's cart to their own carts or bags and carrying them to their car or cab, and later when they had to carry them to their houses and go up the stairs.

They thought that the shopping carts provided by the store were easy to use because they were rigid and sufficiently stable to lean on and to support their weight while pushing the carts. They sometimes used the scooters provided by the store, but mentioned the problem of the size of the scooters as they sometimes got in other people's way. Furthermore, the sitting position was too low for them to reach out to pick things up, while it was also too hard for them to get up and sit back down again. Therefore, they still preferred to push a shopping cart rather than to use a scooter. Two of the women had their own pull-along

multiple-use cart that they brought to the store with them. These carts are small enough to be put into a car and are too expensive. However, they only used them to transport goods from stores to cars and then home, as they found it difficult to pull the carts while walking using two sticks. Because the carts tilt easily, they could not use them as walking aids. They said that an advantage is that some existing carts have multiple pockets to put things in, but they preferred pushing them to pulling them, and said they needed to be more rigid and stable.

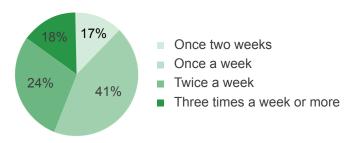
The feeling of security when leaning on a cart was their main concern regarding the new shopping cart's design. They also liked the idea of sorting the goods in the cart so that they could take frozen food out first and put it into the fridge when they arrived home. Multiple bags, pockets, and hooks on which to hang their purses, sticks and other personal belongings were also desirable. The cart would also need to be foldable to put into a car and easy to take up the stairs.

3-2 Survey

An online survey was conducted on Surveymonkey. com. The questionnaire contained ten questions. 97 valid responses were received from random people aged 65+ living in the United States.

The results are as follows:

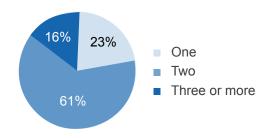
How often do you go shopping?



By what means do you usually go shopping?



How many people do you shop for?



Do you have ambulatory difficulty?

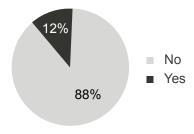
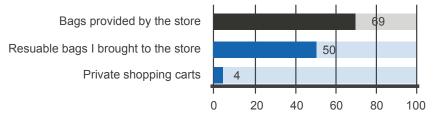


Figure 3-1: Survey results

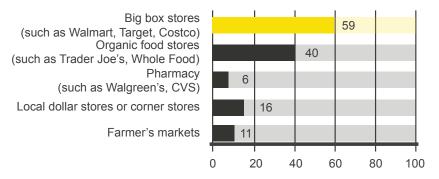
What implements do you use to carry groceries in the store?



What implements do you use to carry groceries on your way home?



Where do you usually go grocery shopping?



 What's your dissatisfaction with the existing shopping carts?

28% - Too big or too deep to reach out to my items

23% - Not easy to push and control

12% - Don't have sections to categorize and organize stuffs

"not enough small carts, as I am usually ony buying a few items at a time"

"Wheels on the cart that wobble"

"Would like to have baskets without kiddle seats in them, but with dividers (collapsible?) to sort fragile items from heavy ones."

· What features do you wish to have on shopping carts?

31% - Better mobility and flexibility

29% - Proper storage and sorting

13% - Self-check-out system

"Have screen to display sale items"

"wheels made from something that won't get flat spots on them. I HATE bumpy carts!!!!"

"none of the above, it will make the cost of shopping higher."

"cup holders for my coffee"

From the survey, most participants go shopping once a week, drive by themselves, and shop for three or more people. And most of them don't have ambulatory difficulty. They prefer to use baskets and shopping carts provided by the store and ask them for bags to carry groceries home, while half of them also bring their reusable bags. The most mentioned problems of the existing carts are too big and deep, and also wobbling wheels which makes it hard to control. They also would like to have sorting feature in the cart. So the new design of cart will make to controlling better and facilitate the sorting of items.

3-3 Field Observation

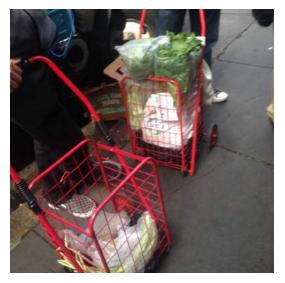
The first field observation area was in San Francisco's Chinatown area where there are busy and densely populated farmer's markets. Middle-aged and 65+ females accounted for the highest percentage of the demographic. Most of the customers carried one or more reusable bags on their shoulders, which allowed them to navigate the highly congested area more easily and made navigation more flexible.

Of the people who used personal shopping carts, two types of shopping carts were the most popular. One has a frame of steel wire, while the other resembles a backpack with wheels and handles. Surprisingly, most of the people who used personal shopping carts were middle-aged rather than those aged 65+. It seems that middle-aged people tended to shop for more groceries than they could carry on their shoulders in order to provide for the needs of their entire families, while the more elderly only shopped for small amounts to provide for one person or two people.







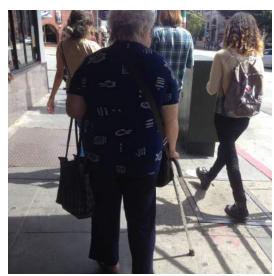












The second place observed in the study was the Wholes Food Store at Nob Hill where fewer people were shopping. Most of the customers drove to the store. Of the few people who travelled by foot, only one brought a personal shopping cart, while the others used reusable shopping bags or paper bags from the store. Only one woman went into the shop with her trolley, but came out without anything in her basket.

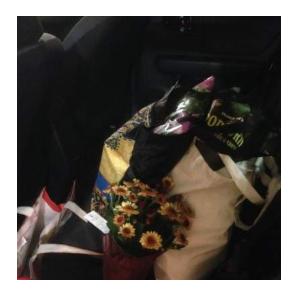


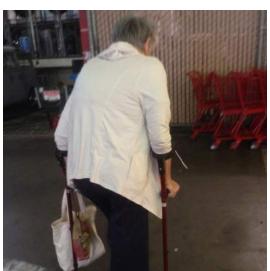












An observation of a shopping trip to a Trader Joe's in North Beach with one of the community partners was also conducted. It was a typical shopping journey that she did every week. She drove to the store, walked into the store using two crutches, took a shopping cart, put one crutch into the cart and pushed it with one arm. She navigated the entire store, selected everything she wanted, checked out, and had someone help her to put the bags on the back seat of her car because she finds it difficult to open the trunk.



From the field observation, none of the seniors with ambulatory difficulty was observed to shop in the farmers' market. Some of them were just walking around and didn't buy anything because they could not carry the groceries. The woman who I went shopping with, preferred to use the cart provided by the store to support her weight when she was navigating in the store, while she brought a personal cart to transfer the groceries home. So the new design of the cart will focus on the stability and flexibility which enable the targeted users to use both in the store and on the way home.

3-4 Market Research

This is a study on the existing personal shopping carts in retail stores such as the Container Store. And a research on Amazon was also conducted to learn about the price ranges and read customers' reviews.

Price of personal shopping carts range from \$15-60. They are all designed to be pulled.

Some of them must be assembled by the customers for storage and shipping reasons. Some people complained that the wheels were too weak and fell off regularly.







Whitmor 6318-2678 Deluxe Rolling
Utility Cart, Black
\$34.72



Stair Climbing Rolling Shopping Multipurpose Laundry Utility

Cart with Seat

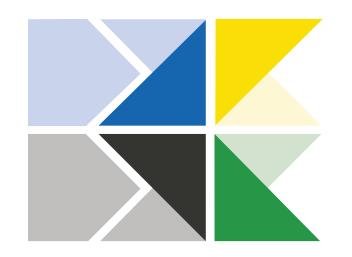
\$46.99



Folding Shopping Cart - Versacart Utility Cart - Transport Up to 120 Pounds (Water-Resistant Heavy Duty Canvas) \$54.95



Hook and Go Portable Folding Supermarket
Shopping Cart \$59.95



04

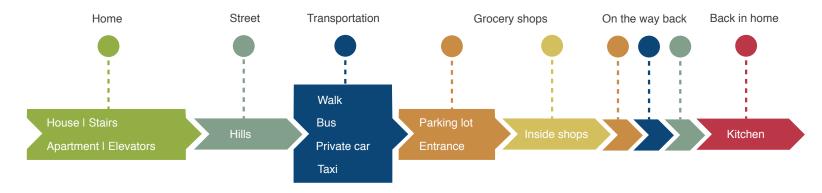
Research Conclusion

4-1 Features of the New Design

- Should be strong enough to lean on.
- Pushing is better than pulling.
- Should be both stable and run smoothly.
- Wheels should be light and not break easily.
- Need a brake, particularly when going down hills.
- Handles should be wide and comfortable.
- Poles, crutches, or walkers need to be attached to carts.
- Size should be smaller and the cart should be more flexible.
- Adjustable in height.
- Need sections to sort groceries, such as frozen food and fragile food.
- In the loading area, each section should be able to be taken out separately.
- Easy to clean.
- Have a cup holder.

4-2 Environment Evaluation

A shopping journey



Product life cycle

The first way will take more storage and shipping space, which makes the product cost higher.



The second way couldn't assure the quailty of the produt if let the users to assemble some parts.

Figure 4-1: Shopping Journey Evaluation & Product Life Cycle

4-3 Persona







Mary 76

Mary lives by herself in Richmond, SF. She has difficulty in walking, which means that her hands are always occupied by two crutches. She is very optimistic and energetic. There are many restaurants and shops close to her house. She enjoys walking along the streets and looking around in different shops. However, she finds it difficult to buy things she likes because it is not convenient for her to carry them home. She wishes she had a stylish personal shopping cart that she can take with her everywhere.

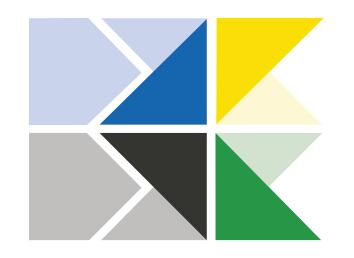
Bob 83

Bob lives with his wife in Chinatown, SF. His wife suffers from Alzheimer's, which means she can barely venture outside. Thus, Bob has to do the shopping for the two of them. Luckily, there are many farmer's markets in the Chinatown area. He usually walks there at least three times a week to buy fresh groceries in small portions. He does not like to use carts because they are not easy to pull. However, as he is getting older, he finds it more tiring to carry bags home. He is looking for a suitable tool to make his life easier.

Susan 79

Susan lives in Ingleside, SF, where there are no shops within walking distance. She has mild ambulatory difficulty and she can still drive.

Therefore, she drives to buy groceries once or twice a week. She likes to use the shopping carts in the store because they can support her weight. However, she always needs help to carry bags to her car after checkout and to bring bags to her kitchen from the car. She wants a personal cart that is small enough to fit into the car and which can hold a number of smaller bags.



05

Design Ideation

5-1 Initial Idea

The frame is made of aluminum pipes to ensure stability.

A geometric shape, such as a square or a triangle, should be the design style for this cart.

The rear legs, handle bar and basket frame can be folded when not in use to save space and to fit into a car.

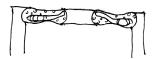
The grocery area should facilitate the sorting of items and should be able to hold three bags of groceries.

The grab bar will ensure the square shape of the frame in maintained, while the rubber handles on the grab bar will make holding the bar more comfortable.

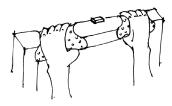
There is a cup holder, and two clips that can hold two crutches or poles on the bar.

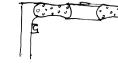
The flat surface in the middle can be used to hold notes and shopping lists as it has a magnet clip.

Casters are used on this shopping cart, imitating luggage that moves smoothly and does not break down easily. The front two wheels are standard ones, while the rear two are fitted with brakes.







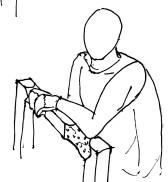


















A full scale prototype was made to test the size and features of the initial design.

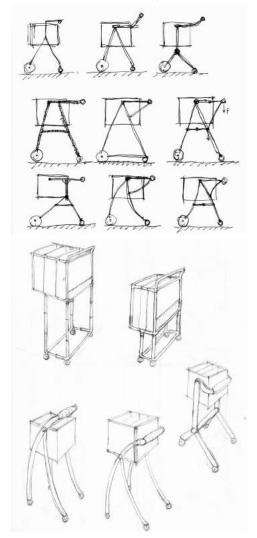
It was shown to the community partners to ask for feedback. They said the basket area is the most attractive part of the cart, and they were concerned about how well it could work in real life situation, such as going over a curb.

The feedback from my professors concerned more about the shapes and style of the cart which was too up straight and rigid looking. So the basket area will be preserved and iterations will be made mainly on the frame design.

5-2 Iteration Round 1



5-2-2 Form Study Sketches





5-2-3 3D Models

Form No. 1

In this concept, the frame was made by aluminum pipes connected with plastic joints. The pipes were bended to give the cart an organic curve which appears more dynamic. The bigger wheels in the front supposed to make it easier for the cart to go over curbs.







Form No. 2
In this concept, the body of the cart was made of carbon fiber parts which was light and rigid. The legs were clean and simple shaped connected by a pipe in the middle.
And 90-degree bended pipe connected the handle and the body. There was a triangle structure if look from the side.







Form No. 3
In this concept, the cart had one main joint in the middle which connected three legs, the handle and the basket frame all together. It had a triangle structure look both from side and front.







5-2-3 Quarter Scale Models

Form No. 1

This model showed the basic shape of the cart which was nice as expected. The mistake of the design was that the



gravity center of the cart was in the front which made it easy to flip over when the front wheel hit a curb and hard to push forward.



Form No. 2
This model had the same gravity center problem as the first one. The span of the legs was not long enough to keep it stable while being pushed forward. And the handle



which was connected with a 90-degree bended pipe did not feel rigid to lean on.



Form No. 3
This model had the best gravity center. However, the frame seems too thin and weak with all pipes and only one joint.
It is easy to push but hard to turn around.





5-3 Iteration Round 2

5-3-1 3D Models

Form No.1

After the quarter scale prototyping, form No. 3 was abandoned since the fragile and thin looking frame did not meet the requirement of stability. So modifications were

made on the No. 1 and No. 2 form to fix the gravity center problem. In No. 1 form, the legs spread out more and the wheels were bigger in order to increase stability.







Form No. 2
The front legs spread out more to make the gravity point in the center.







5-4 Iteration Round 3

According to the previous modeling and prototyping, form No. 1 showed the strongest potential. So the following iterations continued to do deeper studies based on form No. 1.

A full scale testing prototype was also being made and iterate at the same time. The materials used for the prototype were mainly EMT pipe, wood stick, 3D printing parts, and existing products like wheels and casters.



5-4-1 3D Models

Form No. 1, 3rd version

In this version, the legs were closed back a little bit, to have a better scale and reach the balance of size and stability. The front wheels were 8 inch in diameter, and the rear wheels were 5.5 inch. In the testing of full scale prototype of this design, it showed that the big front

wheels failed to make it easier to go over curbs, instead made it harder to use the cart since it could not turn. So a modification was made on the wheels.







Form No. 1, 4th version
The 8 inch wheels were changed to the back, and two 6 inch casters were used in the front, which made the cart to turn smoothly.







Form No. 1, 5th version

As the scale and basic form of the cart were set, this version went deeper on each part. All the parts were rounded and curved to match the shape of the entire cart, which gave more dynamic and beauty. More functions were added to it, such as clips to hold walking sticks and

a cup holder. Also, an additional support bar was added between the rear legs to increase the stability of the cart.





Form No. 1, 6th version

In this version, the arms connecting the handle were moved into the main part in the middle, in order to make the cart to be able to fold better. And another color theme was designed to see the look of the cart in different colors.





5-4-2 Full Scale Prototype

This full scale prototype was based on form No. 1 3rd version. The white parts were all 3D printed, the curved legs were made of EMT pipe and the straight legs and



bars were made of wood sticks. They were connected together by screws and A/B glue was also used in some joints to enhance the strength. It could hold the basket



with groceries, but not rigid enough for a person to put his weight on the handle bar, since the 3D printed joints were easy to break apart.





5-4-3 Field Test

This was a photo documentation of a shopping journey with the cart. This prototype was modified to between 4th and 5th version of the 3D model. The front two wheels

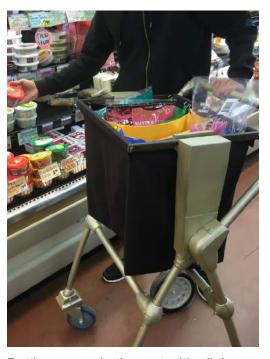
were 360-degree turning casters and some of the parts were curved.



The cart was running smoothly in the parking lot.



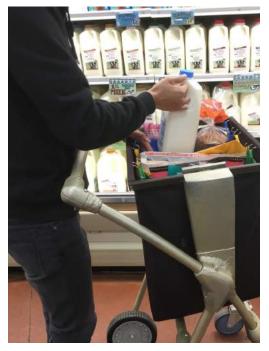
Selecting vegetables with the cart and put the vegetables all in the green bag.



Putting sauce in the cart with all the freezing items in the same bag.



Pushing the cart in front of the freezer.



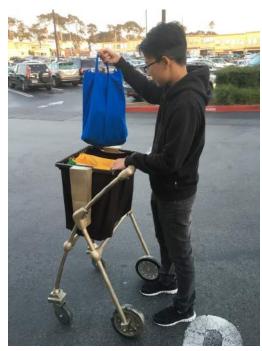
Put milk in the bottom of one of the bags.



Leaning on the cart to have a rest.



All the items were organized in the three bags. The fragile ones were on the top.

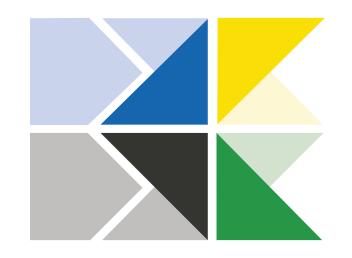


Taking out the bags one by one in the parking lot.



All the bags were put on the back seat of the car.

The field test showed that the cart was easy to use in the store. It was very smooth and flexible to push and navigate around with it. It could hold enough groceries for two people for a week. And the three bags enable the user to organize different types of groceries very well. It could be stuck when the front wheel hit a bump or a curb, probably because the span of the front wheel was not far enough from the handle. While it was not difficult to use on this journey since all places were accessible for wheel chair. And the accessibility of the cart to cars and stairs could not be tested because the folding function could not be realized on the prototype.



06

Final Design

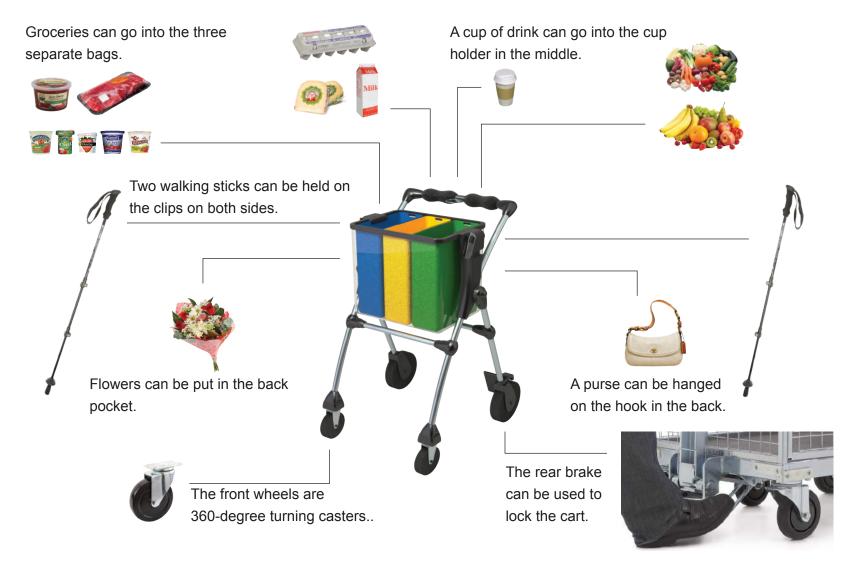






It is the front view of the cart.

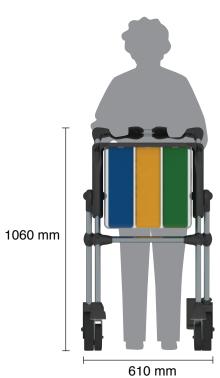
It is the back view of the cart.



6-2 Orthographic Views and Scales







6-3 Folded Up

Step 1: Take out the basket





Step 2: Push the rear legs forward



Step 3: Push down the handle











Frozen Food





Vegetables

Fruits





Fresh meat

Eggs





Bottles, jars, and cans







Sort

Flowers

Pre-made food









Milk

Snacks





6-4 Design of the Loading Area

6-4-1 Grocery sorting







Separate heavy things in different bags and put light and fragile things on the top. Flowers can be put in the side bags.



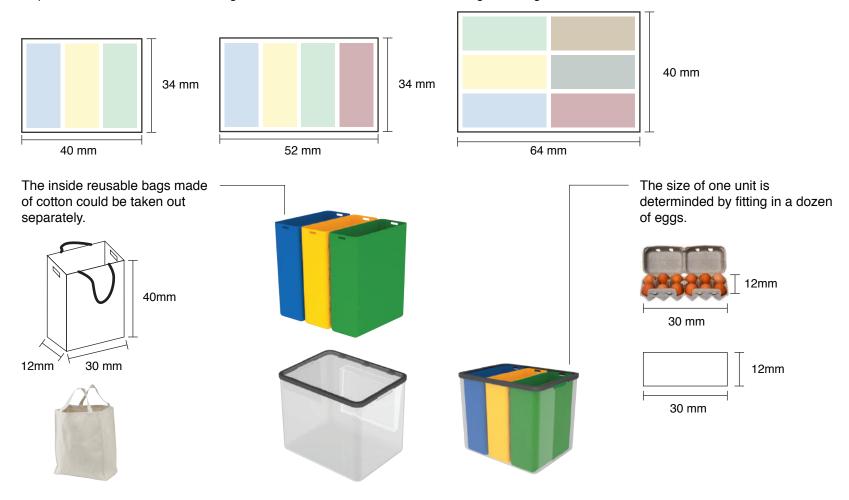


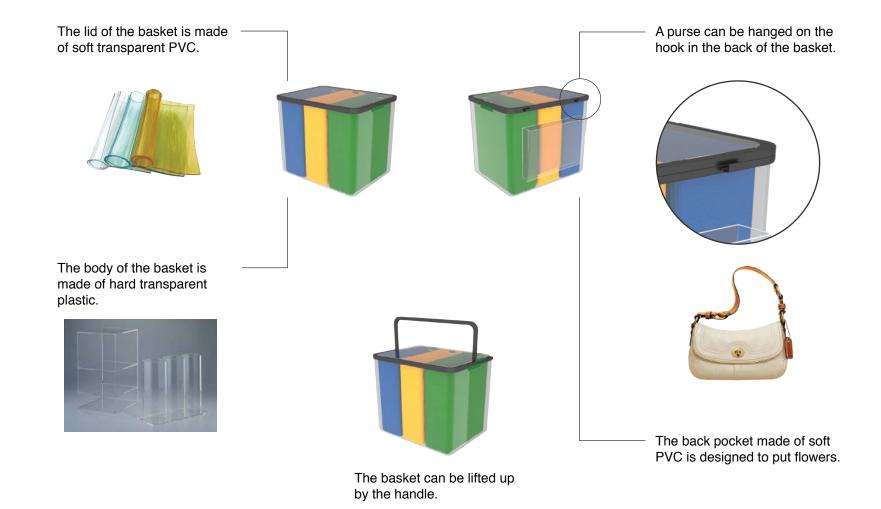




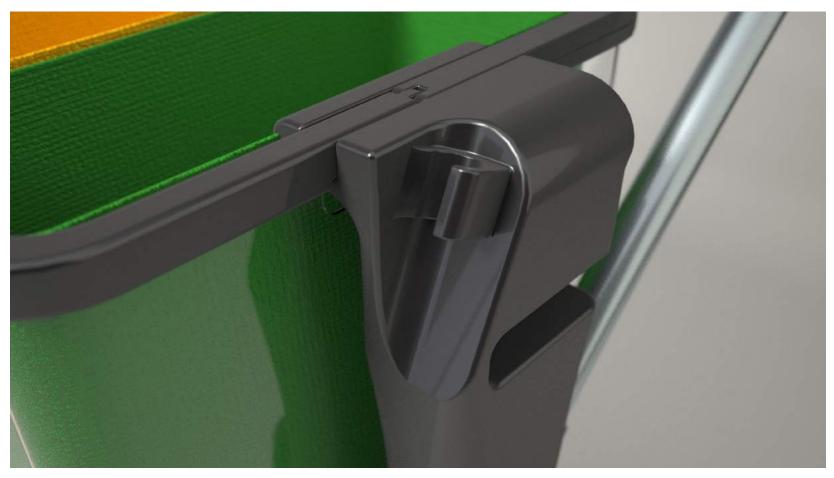
6-4-2 the Design of Basket

Explore different sizes of the loading area and alternative combinations of single loading units.





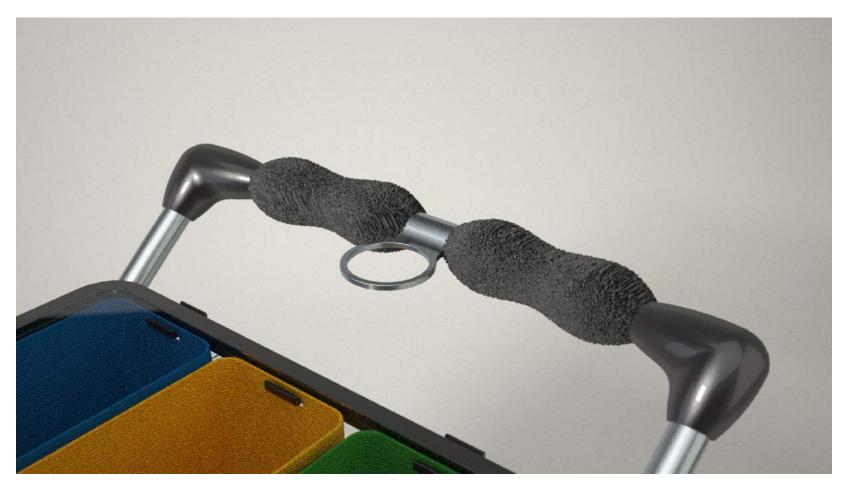
6-5 Details



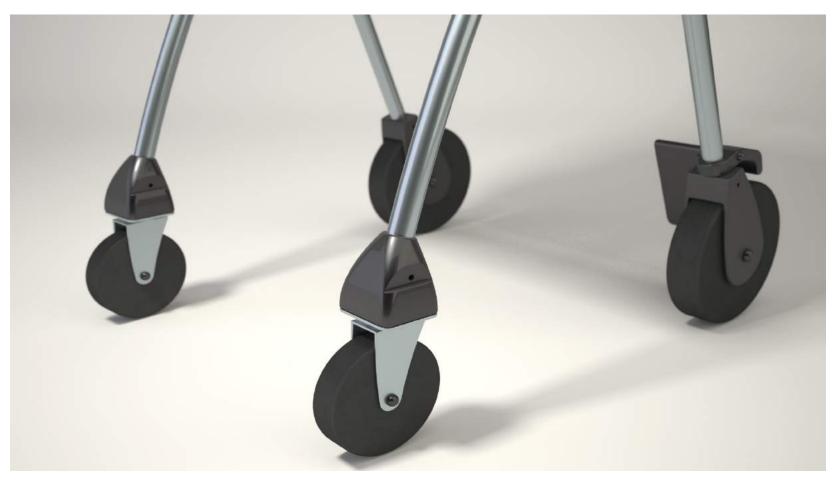
The two clips on each side of the frame are designed to hold walking sticks.



The joint is designed to fold up the cart and the legs can be locked in place.



The handle of the cart is wrapped with suede and there is a cup holder in the middle.



The front two wheels can rotate 360-degree and there is a brake on the left rear wheel. The user can step on the pedal to lock the wheel and step on it again to unlock it.

6-6 Using Scenarios



It can be used in the crowded farmer's markets.



It can be used by the seniors to walk around in the city.

6-7 Final Prototype

The final prototype was modified on top of the working prototype. The joints were blended into the legs by clay,



the gaps were filled up with Bondo and sanded. The joints and lags were also painted in different color.



Photos of frame only.





Detail photo of the basket.

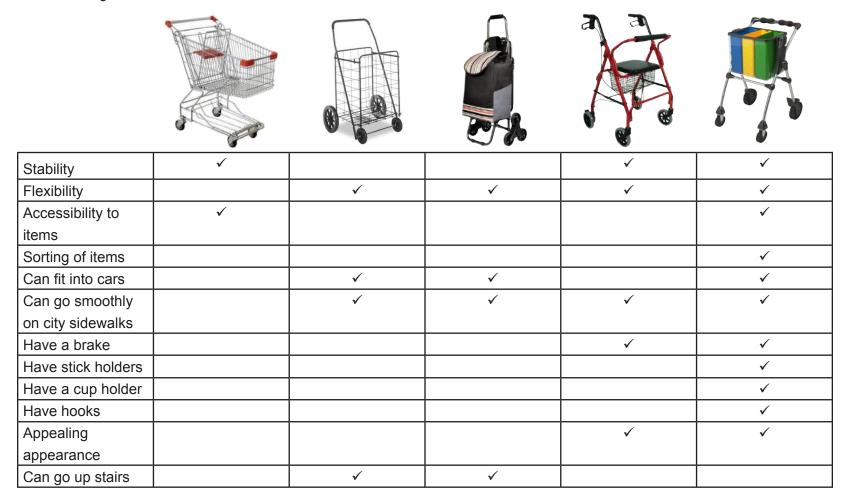


Detail photo of the joints.



6-8 Conclusion and Future Direction

This is a comparison chart of some existing products with the new design.



The chart shows that the new design of trolley can meet the most of the functions that senior citizens require to go grocery shopping. It is especially functional when it comes to holding and sorting items, and providing extra hooks and clips to hold purses and other personal belongings. The appearance of it suggests that it is not an elderly people's product, but is a shopping cart that people of all ages can use to have a better shopping experience with.

In this study, the design of a new personal shopping cart has been proposed and a half-functional prototype has been built to test a part of the functions. It gave the user a delight and joyful journey when it was used in the stores. However, the field testing was limited from the parking lot to the store and back to the parking lot, due to the fact that the folding function could not be realized in the prototype in this stage. And it has not been tested with senior users, because the plastic parts used in the prototype were not rigid enough to support a person's weight. The next step of this study will be more detailed design of the mechanism in the cart, and a full functional prototype made of designed materials will be built. In this way, the entire journey, from home to store and back to the kitchen, can be tested and senior users can also participate in the testing. So that more feedbacks and comments can be collected for the next iteration.

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Appendix

A. Elderly Shopping Experience Survey

1. What is your age?		Responses	
• 45 to 64		5.15%	5
• 65 to 74		81.44%	79
• 75 or older		13.40%	13
			97
2. How often do you go g	rocery shopping?		
once two weeks		17.53%	17
 once a week 		41.24%	40
 twice a week 		23.71%	23
 three times a we 	ek or more	17.53%	17
			97
3. How many people do	you shop for?		
• 1		22.68%	22
• 2		60.82%	59
• 3 or more		16.49%	16
			97
4. By what means do you	usually go shopping?		
• Drive by myself		92.78%	90
 Take public trans 	sportation	1.03%	1

	• Walk	3.09%	3
	 Have other people assistant me 	3.09%	3
			97
5.	Do you have ambulatory disadvantage?		
	• No	88.66%	86
	Yes, mildly	7.22%	7
	Yes, medium	3.09%	3
	 Yes, seriously 	1.03%	1
			97
6.	Where do you usually go grocery shopping?		
	 Big box stores (such as Walmart, Target, Costco) 	58.76%	57
	 Organic food stores (such as Trader Joe's, Whole 	39.18%	38
	Food, Safeway)		
	 Pharmacy (such as Walgreen, CVS) 	6.19%	6
	 Local dollar stores or corner stores 	16.49%	16
	Farmer's markets	11.34%	11
			97
7.	What implements do you use to help you to carry		
	groceries in the store?		
	 Basket provided by the store 	29.03%	27
	 Shopping cart provided by the store 	81.72%	76
	Scooter provided by the store	2.15%	2

My reusable bags	21.51%	20
 My personal shopping cart 	1.08%	1
Other	1.08%	1
		93
	I usually shop for a few thing	gs, which I carry.
8. What implements do you use to help you to carry		
groceries on your way home?		
	00.000/	
Bags provided by the store	68.82%	64
 Reusable bags I brought to the store 	49.46%	46
 Private shopping carts 	4.30%	4
• Other		93
	sometimes my own bags	
	Boxes provided by the store	9
	rolling book bag	
9. What's your dissatisfaction about the existing shopping		
carts?		
 Not easy to push and control 	22.58%	21
 Too big or too deep to reach out to my items 	27.96%	26
 Too heavy to hold, push, or pull 	1.08%	1
 Not big enough to hold all my objects 	2.15%	2
 Don't have sessions to categorize and organize stuffs 	11.83%	11
Not stable enough for me to lean on it	1.08%	1
• Other	39.78%	37

not enough small carts, as I am usually ony buying a few items at a timeWheels on the cart that wobble i like the smalker carts being provided at sime if the stores

Would like to have baskets without kiddie seats in them, but with dividers (collapsible?) to sort fragile items from heavy ones.

not the carts getting stuck together, but my inability to figure out why and to get them apart!

i seem to always get the one with the malfunctioning wheel!!!

bad wheels

Dirty

I like the small baskets at Lucky.

10. What features do you wish shopping carts to have?

Proper storage and sorting	29.03%	27
Self-check-out system	12.90%	12
 Better mobility and flexibility 	31.18%	29
 More stable and stronger to make me feel 	5.38%	5
secure to lean on it		
A brake	1.08%	1
 Automatic running and navigation 	2.15%	2
Other	37.63%	35

lighter and easier to control.

Have screen to display sale items

wheels made from something that won't get flat spots

on them. I HATE bumpy carts!!!!

hey are fine IMHO

they're shopping carts.don't expect more or less

Never thought about it

smaller

none of the above, it will make the cost of shopping

higher

Feel that most Shopping Carts are Adequate

better wheels

cup holders for my coffee, better seat belts for kids

Kept clean

Small carts are available but often not enough of them

for demand

Appendix

B. Schedule

September 2015	October 2015
Define the problem and Finish CWP / Literature review /	Field observation / Market research / Interviews / Survey
Project plan	
November 2015	December 2015
Brain storm / Persona / Sketching / 3D modeling	Story telling / rapid prototyping for the first round
January 2016	February 2016
Ask for feedback / Sketching / 3D modeling / Rapid	Ask for feedback and itinerate for the 3rd round
prototyping for the second round	
March 2016	April 2016
Build the final prototype	Write essay / Presentation slides / Print hard copy