Rethinking the Grocery Store:

Inclusive Wayfinding System for Visually Impaired Shoppers in Grocery Stores

by

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Abstract

Many people with disabilities face considerable barriers while shopping in grocery stores. One such barrier is that they cannot find their way around easily, especially when they visit the grocery store for the first time and have not yet built a cognitive map in their memory. They may also experience delays in finding the right product or waiting for assistance from store employees, thus leading them to rely on family, friends, relatives, or volunteers to help them with their shopping. Problems start when these people are not available, in which case the individual is forced to cancel their visit to the grocery store and reschedule the trip.

Grocery stores include many different zones and services, the aisles area being one of the main barriers to access for people with different disabilities. This area features many different sections such as canned goods, dry packaged goods, spices, drinks and snacks, baking supplies, baby items, cereals, cleaning products, pet supplies, and health and beauty items. For visually impaired individuals, however, it can be hard to reach these various sections and find the relevant products. The objective of this research is to design an inclusive and innovative wayfinding system in grocery stores for visually impaired shoppers in order to help them find the center zone, orient between different aisles, decide where to go, move easily between different sections, and select products with ease. The research approach will be based on the literature review and the application of the Delphi method.

***Keywords*:** Grocery store, Wayfinding, visually impaired shoppers, vision impairment, accessibility, inclusive design, sensory environment

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This research paper is dedicated to your quality of life.

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Abbreviation

AODA: Accessibility for Ontarians with Disabilities Act

CLVT: Certified Low-Vision Therapist

CNIB: Canadian National Institute for the Blind

CVRT: Certified Vision Rehabilitation Therapists

HCD: Human-Centered Design

LV: Low Vision

MD: Macular Degeneration

NFT: Need for Touch

OCADU: Ontario Collage of Art and Design University

PL: Grocery Store Planner

RP: Retinitis Pigmentosa

SEM: Social-Ecological Model

US: United States

VI: Visually Impaired

1 Chapter 1: Introduction

1.1 Background

The use of self-serve grocery stores is very popular today, providing the consumer a range of product and cost choices, and ability to gauge quality to individual standards. The first self-serve grocery stores began to emerge in North America and Western Europe during the middle of the 20th century, and large self-serve supermarkets became common since the late 1960s (Humphrey, 1998; Shove & Southerton, 2000). In-store grocery shopping has emerged as a common personal task indicative of our ability to lead an independent, capable, and engaged life. Shopping in grocery stores however commonly requires the use of visual and physical abilities.

People who are visually impaired (VI) face considerable barriers while shopping in grocery stores. They cannot find their way around easily especially when they visit the grocery store for the first time and have not yet built a cognitive map of the grocery store environment. They may also experience difficulty in finding desired products or delays while waiting for assistance from store employees. This often leads to the reliance on family, friends, relatives, or volunteers to help them with their shopping. When such help is not available, they are forced to cancel their visit to the grocery store or reschedule the visit.

Some alternative shopping services, such as home delivery and online shopping are available for VI people. These services, however, are not available

everywhere and they require the shopper to place their order with the store and wait for delivery. Furthermore, anecdotal evidence shows that VI people would prefer to shop in person and enjoy the shopping experience of exploring the store.

Grocery stores are divided into different zones: a decompression zone, a front zone, a center zone, and a checkout zone. The most challenging zone for VI shoppers is the center zone with aisles as they are often challenged to shop independently in that zone even if they are familiar with the store. The aisle area consists of different types of aisles such as food aisles, cleaning aisles, and health and beauty aisles that have minimal visual or physical differentiation. In each aisle, there are many sections, and in each section, there are different types of products. The built environment in the center zone is not specifically designed to be accessible to shoppers with different abilities, and for this reason, VI shoppers often have difficulties orienting, navigating between the different aisles and sections.

The questions that naturally arise are the following: What then of VI people who want to do their shopping independently? How can we design an inclusive system to help them find their way around the grocery store independently? And what is the role of interior design in the solution of this problem?

1.1.1 Vision Loss

Vision loss can affect a person's daily activities and reduce their quality of life. Vision loss that cannot be corrected by glasses, contact lenses, or surgery is termed visual impairment (Arditi & Rosenthal, 1998). According to the CNIB (formerly known as the Canadian National Institute for the Blind), approximately half a million Canadians are estimated to be living with significant vision loss that impacts their quality of life, and every year, more than 50,000 Canadians are expected to lose their sight (CNIB, 2014). According to CNIB, there are 186,954 VI individuals in Ontario, 64,546 in British Columbia, 17,244 in Manitoba and Saskatchewan, and 52,899 in Alberta. Also, the number of people with vision impairment is expected to increase in future due to the aging population (CNIB, 2014).

VI people experience difficulties in their daily activities related to their conditions, and that includes the ability to individually shop for groceries. Architects and designers of grocery stores ought to consider developing and incorporating revisions to store design that assist VI individuals' access and independently find their way to products. This requires designers to understand each task that grocery shopping entails. These tasks can be divided into seven stages: preparing the shopping list, going to the grocery store, finding the different zone(s), finding the right product(s), purchasing the product(s), exiting the store, and going home (Kulyukin & Kutiyanawala, 2010).

1.1.2 Stages of Shopping

According to the literature review and Delphi survey, VI shoppers face many barriers in different stages of their shopping experiences.

Preshopping stage

- Rely on a friend or a family member to go with them to do the grocery shopping
- Rely on a friend or a family member to drive them to the grocery store in case the store is not within walking distance or if they are not familiar with using public transportation

Shopping stage

- Shoppers with vision impairment are not able to shop with comfort and ease in grocery stores on their first visit since they have not yet built a mental map of the store. Additionally, grocery stores are primarily designed for sighted shoppers. As a result, VI shoppers are not able to easily locate specific areas in the store, including the entrance, the cart zone, and other departments; this will likely lead to frustration and anger in their shopping experience.
- Customer service is unavailable to them upon entry, and most grocery stores are not designed with the customer service area near the main entrance; rather, the customer service area may be located in inaccessible or inconvenient locations in the store.

- Due to illegible signage in the stores, VI shoppers may experience delays in finding their desired zone, section, and/or product.
- VI shoppers may be able to shop within the perimeter of the store, but the center zone, which contains aisles, is their main challenge. Although each aisle contains many sections and each section contains different types of products, the built environment in the center zone is not accessible, safe, convenient, or easy to shop for customers with different abilities. It is often not designed with well-placed legible signage for VI shoppers. For this reason, they are challenged in orienting and navigating between different aisles and sections.
- VI shoppers have several difficulties as listed below:
- They are not able to locate produce bags in the vegetable and fruit section because the signage is illegible to them.
- They bump their cart into the freestanding displays within the aisles area, and this is not safe.
- They are unable to find the items on sale without depending on another individual because the signage is illegible to them.
- Information for most products is not accessible or conveniently accessible for VI shoppers.

Checkout stage

- VI shoppers do not know what products are being tallied while checking out.
- VI do not know the price of the item being checked out.
- VI shoppers cannot take advantage of price matching.
- VI shoppers are less likely to use cash and are more likely to use credit or debit cards.
- Changing the terminal layout makes them inaccessible to VI shoppers.
- VI shoppers do not know if the total price is measured using standard units (ounces and pounds) or metric (grams and kilograms).
- VI shoppers require assistance in bagging their items.

For the study, the research will focus on exploring the design of environmental features that will enhance the center zone (the aisles) shopping experience for VI shoppers in a way that will be an effective model for other grocery stores to adopt into their current systems. The design is based on using effective wayfinding cues and creating a multisensory environment.

1.2 Objectives

Although human beings are differently sized and abled, people with vision impairments are usually not considered when formulating designs for private commercial spaces that attract the public. Built environments are designed according to the size of the average person. A well-designed model is one that can enable all users to function easily and successfully within the environment and can be adopted by any business. Architects, designers, and other professionals should be encouraged to create inclusively designed environments that fit the needs of a diverse range of people, including people with disabilities (Advisory Committee on Accessibility, 2010).

The Accessibility for Ontarians with Disabilities Act (AODA) is a legislation that aims at having complete accessibility within the province of Ontario by the year 2025. Accessible built environment is one of the key areas covered by the legislation. Therefore, grocery stores should be designed to accommodate shoppers with different abilities.

The objective behind this research is to design an inclusive and innovative wayfinding system in grocery stores for VI shoppers in order to help them find the center zone, orient between the different aisles, decide where to go, move easily between the different sections, and select products with ease. The design proposes the following:

- Creating t least two sensory environments

- Applying Wayfinding cues for VI shoppers
- Adjusting current shelving systems and the physical environments that surround them

1.3 Research Questions and Methodology

Two questions that have to be answered in order to achieve the objective:

1. What physical environmental features should be used in the new design for VI shoppers in order to create successful wayfinding systems in the center zone (aisles) in premium grocery stores that will not adversely affect the general population?
2. How can designers create a wayfinding system that may be effectively adopted by service providers (premium grocery stores)?

A literature search revealed no published studies about the creation of multisensory environment in grocery stores layout in order to enhance the shopping experience of VI shoppers. Therefore, this study will focus on the following contexts that have been developed from the literature review and the Delphi Survey: the concept of vision impairment, the science of shopping and shopping behaviour, and wayfinding cues for the VI users. The study will

- Develop the conceptual framework that presents physical environmental factors with different themes that should be used in

the design to create a successful and inclusive wayfinding system in the center zone (aisles area).

- Use a set of Delphi survey (a survey of one set of experts [Gunaydin, n.d.] in vision impairment [LV] and another in grocery store planning) to gather information on shopping experience for persons with VI and store planning.
- Discuss the agreement and disagreement between the two groups of experts (grocery store planners [PLs] and LV experts) from the first survey and how these findings will be incorporated in the designed model.
- Develop 3-D models for the center zone to represent the wayfinding system and present them to the two groups of experts in the second iteration for their feedback.
- Examine the final findings from the second iteration (wayfinding model).

The study is designed in four stages:

1.3.1 Stage 1: Data Collection (literature review and Delphi survey)

It is very important to understand the following: What are the different types of vision impairment, and how do VI people cope with their vision loss? What affects the shopper's behaviour in their grocery shopping journey? What are the AODA wayfinding regulations for VI users? What are the different types

of wayfinding that rely on the different senses? And what are the available devices that help VI shoppers to navigate grocery stores?

1.3.2 Stage 2: Data Analysis

This section will present the results of the Delphi survey round 1 by using descriptive statistical analysis. The survey analysis will provide applicable information for advancing the environmental factors and features of the SEM for LV grocery store shopping relative to the five main themes (Inclusive approaches): appeal/comfort, accessibility, convenience, legibility, and safety. The data analysis will focus on shopper experience, wayfinding cues within the grocery store, and product identification and information.

1.3.3 Stage 3: Creating the Design Model

The research considered human-centered design (HCD) for the interior design model that will be used to create the wayfinding experience.

1.3.4 Stage 4: Testing the Model

The aim of the second round was to gather experts' comments and feedback about the design model. It is really important to evaluate the wayfinding model relative to the five main themes (Inclusive themes): (1) appeal/comfort, (2) accessibility, (3) convenience, (4) legibility, and (5) safety. Also, it will present whether the proposed environmental factors and features are applicable to grocery store organization as well as the usability of the different features with different types of shoppers with various vision impairments.

1.4 Social-Ecological Model

In order to arrive at an accessible grocery store design to enhance the shopping experience of VI shoppers, this study adapts the social-ecological model (SEM) (Nicoll, 2006, p. 46) to study the relationship between the individual factors, the environmental factors, and the organizational factors. Individual factors are the factors that influence the personal shopping experience. Organizational factors are considered in relationship to the individual factors and the environment. Environmental factors are the physical, digital, and other nondigital factors that are the focus of the study. Figure 1 presents the SEM of this study.

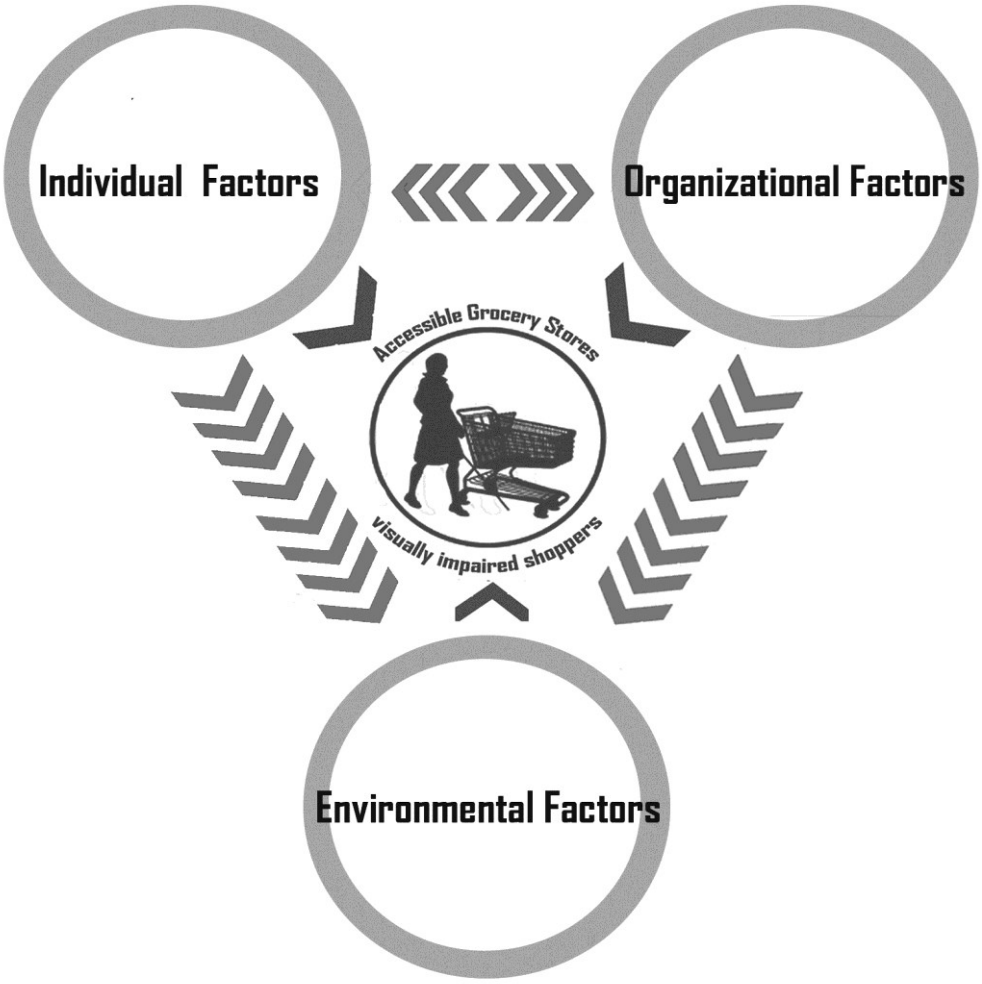


Figure 1: Social-ecological model 1

The next chapters present individual, organizational, and environmental factors that expand the SEM into a conceptual framework and inform the initial design of the grocery store wayfinding model.

2 Chapter 2: Research Methods

This study employs two different approaches to answer the main research questions. The research approach will be based on the literature review and the application of the Delphi method. The literature review will focus on two central contexts. The first context consists of grocery store planning strategies for the aisle zone, accessibility, and wayfinding requirements within the building environment for VI people. The second context will focus on the science of LV and on how people who are affected by LV cope with their vision impairment, while the Delphi survey will be employed in the study to collect reliable information and enhance the effectiveness of the store planners and LV experts' decisions regarding the proposed design.

The aim of the Delphi survey is to determine which different themes should be included in the design to create an inclusive wayfinding system that will enhance VI shoppers' independent shopping experience. A successful wayfinding system should allow VI shoppers to (1) recognize the start points and end points of the shopping journey, (2) identify their location within the space, (3) recognize whether they are travelling in the right direction, (4) orient themselves within the building environment, (5) identify the destination upon arrival, and (6) escape safely in emergency situations (Innovation, 2007). Wayfinding criteria should include the following: (1) architectural clues, (2) graphic communication, (3) audible communication, and (4) tactile

communication. Wayfinding cues, together with wayfinding design, give rise to a successful and inclusive grocery store wayfinding system (Innovation, 2007). With the application of the principles of universal design, inclusive design can accommodate people with different disabilities. These principles include (1) simple and intuitive use (comfort/appeal theme), (2) size and space for approach and use (accessibility), (3) low physical and vision efforts (convenience theme), (4) perceptible information and flexibility in use (legibility theme), and (5) tolerance for error (safety theme) (Innovation, 2007). Guidelines or accessibility building codes for people with vision impairment are unavailable for the grocery store building environment. Hence, the Delphi method will be suitable for gathering experts' opinions on the design process and testing the design for its capacity to meet the five different themes and to create an inclusive wayfinding system.

Moreover, the Delphi method will collect information from the PLs about the design limitations and will test whether the design features are applicable by grocery store organization or not.

2.1 Literature Review

A literature review evaluates work that has been done by other researchers in the same area, discussing how previous research relates to the current study and identifying gaps in the literature. These gaps represent opportunities to create knowledge. No studies exist relating to the creation of multisensory environment

in grocery stores in order to enhance the shopping experience for VI shoppers, so the literature review will focus on the three main areas: (1) the science of vision impairment, (2) the science of shopping and shopping behavior, and (3) wayfinding cues for the VI users. The literature review will compare and contrast the present study with other recent closely related studies, describing what makes the present study original and unique (Hofstee, 2006).

2.2 Delphi Survey

This study will use a Delphi survey to gather experts' opinions on the design process (Gunaydin, n.d.). A Delphi survey is a technique for collecting reliable information from subject matter experts and promoting effective decisions. This technique presents groups of experts with a series of questions. These data are then compared and analyzed in order to develop a design.

This study will survey two groups of experts: (1) store planners and (2) LV specialists. Two surveys were developed, one for each of the expert areas, that would collect data from the experts about what physical features derived from the socio-ecological framework would address the five concepts for independent use of grocery stores by LV individuals relative to the other set of factors associated with their expertise. As such, LV experts addressed issues that linked individual factors of LV with physical environmental factors of shopping and store planners addressed issues that linked organizational factors of grocery stores with physical environmental factors of shopping. The survey, provided in

Appendix A, was provided in written format to the experts with follow-up interviews by phone or in person and utilized check-box, Likert scale answers along with open-ended answers.

A Delphi survey can include repeated iterations to achieve the required result. This study will include two rounds with two surveys, one for each group.

2.2.1 Round 1

In the first round of Delphi survey (Appendix A), LV experts have been asked very specific questions about grocery shopping for LV shoppers, the science of shopping and the science of vision, and recommendations about wayfinding cues for LV users. The PLs were asked to answer structured questions about what are the standards to design a grocery store, the science of shopping and shopping behaviour, and wayfinding cues and techniques that can be adopted in grocery stores building environment.

The answers to these questions will help to understand the needs of LV shoppers to shop independently in relation to the five main concepts that relate to the physical environmental factors; also, it will address the limitation in the design that relates to the organizational factors of the grocery store.

2.2.2 Round 2

The second round of Delphi survey (Appendix B) will gather experts' comments and feedback about the preliminary design. Each participant will receive a copy of the design model, along with a second questionnaire intended to

gather more detailed information. In this round, experts will make detailed clarifications and adjustments in order to come out with final recommendations (Chien Hsu, 2007).

2.2.3 Participants

Because the Delphi study relies on participants' expertise and specialized knowledge, it is important to select knowledgeable participants to gather the needed data and to develop the design. All participants should be able to answer the questions and revise their opinions throughout the study in order to reach a consensus (Chien Hsu, 2007). Participants will be chosen based on their professional knowledge and expertise. The first group will consist of four store planning experts, and the second group will consist of six LV experts. Delbecq, Van de Ven, and Gustafson (1975, p. 85) note that participants should include

(1) the top management decision makers who will utilize the outcomes of the Delphi study and

(2) the professional staff members together with their support team.

The participants for this research were as follows:

Grocery store planning experts. For the study, four experts in grocery stores were accepted to participate in the study in both rounds; invitations were sent to many grocery stores, but it was really hard to convince them to participate because they had a concern that the survey would make them disclose some confidential information about their organization and their strategies. The average

age of the participants was 25–54 years. Loblaws is a supermarket chain with 70 stores in Canada and headquarters in the Bramptom area and is one of the main participants in this research. The senior director of store planning was the participant, and he has 37 years' experience in retail sales and support. The second participant was from the United States, Bellevue area, and he is a managing partner in a design consulting and project management enterprise specializing in grocery store design, layout, and planning services. The third participant is a store design supervisor from Calgary, and he has 25 years' experience in this field. The fourth participant was an architect from New York who has a retail design firm specializing in the food service industry with more than 25 years' experience in this field, and he considers himself as a person with LV.

Low-vision expert participants. Six LV experts have accepted the invitation to participate in this study for the first round of the survey, while five participants out of six, five females and one male, participated in the second survey. The average age of the participants was 25 to over 65 years. Two of the females were independent living skills specialists who have a master's degree in this area, and they work for the CNIB; one of them is a VI person. The third participant is from North Carolina, United States; she is a certified as a low-vision therapist (CLVT) and a vision rehabilitation therapist (CVRT), and this participant was not able to participate in the second round of the survey. The

fourth participant was the founder and the president of Connect 4 Life Charity to help people with disabilities to access education and training programs; also, she is one of the accessibility advisors for the city of Mississauga, and she consider herself a person with vision impairment. The fifth female participant was a professor at OCAD University with a doctorate degree in online information and web accessibility for users with vision impairment. The last participant was a male from the United States, and he works as a university professor in the Department of Psychology at the University of Minnesota; also, he is a head at the Minnesota Laboratory for Low-Vision Research, and he considers himself a person with vision impairment.

3 Chapter 3: Literature Review and Delphi Survey

3.1 Introduction

This chapter presents findings from two sources: (1) literature review and (2) research gathered from a Delphi survey conducted with LV experts and PLs as part of the project. The information gathered resulted in the development of conceptual SEM framework for independent LV shopping.

3.2 Visual Impairment

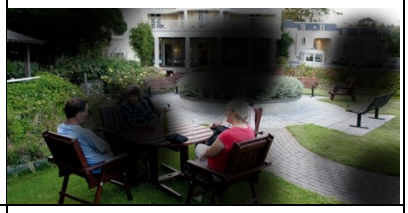
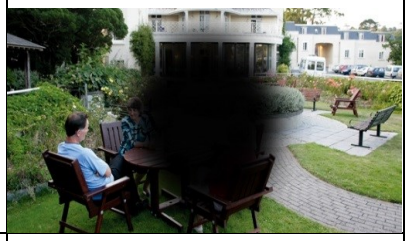
3.2.1 What Is Visual Impairment?

The term "visually impaired" (VI) refers to individuals with LV who can rely on a combination of their limited vision and other senses to do daily tasks. VI individuals are unable to read from a normal viewing distance even with the aid of eyeglasses and contact lenses (Catteneo & Vecchi, 2011, p. 138). Two terms in vision impairment that need to be understood are "object vision" and "travel vision." Object vision is the ability of people to determine what kind of object they are seeing but not knowing its type or details, for example, seeing a person but being unable to recognize them. Travel vision refers to the ability to move in space independently without the help of a cane, a guide dog, or a guide (Chapman, 2001, p. 14). The table below provides more details:

Table 1: Vision impairment definition ((Chapman, 2001, pp. 15–19)

Visual disability scale	Type	Ability
20/25–20/65	Subnormal vision	• Driving • Reading • Excellent travel vision • Excellent object vision
20/70	Mildly impaired	• Magnifier for reading • Telescope glass for driving • Good travel and object vision
20/75–20/200	Moderately impaired	• Poor object vision • Good field vision • Use of LV aids • Telescope glass for driving
20/200–20/800	Seriously impaired	• Reading with LV aids • Cannot drive • Object vision is very poor • Travel vision is acceptable (but not for the lower end of this scale)
20/800–20/1200	Severely impaired	• Loss of travel vision • Object vision is poor or • Very strong magnifiers are used to read large print
20/1200–20/6000	Very severely impaired	• Using a white cane or a guide dog for travel • Slight object vision with light perception

Table 2: Cause of vision loss (Chapman, 2001, pp. 74–108)

Cause of vision loss	Effect on sight	Treatment	Sight condition
Cataract	Gradual clouding of the lens or an area of the lens	Corrected by glasses, lenses, or surgery	**Figure 2: Cataract** 
Diabetic Retinopathy	Affects both central and peripheral vision	Treat diabetes (the cause of diabetic retinopathy)	**Figure 3:Diabetic Retinopathy** 
Glaucoma	Glaucoma destroys the The peripheral vision	Medication and surgery	**Figure 4: Glaucoma** 
Macular Degeneration (MD)	Many diseases affect the maculae and cause central vision loss, but they never blind the person;	Research is in process	**Figure 5: Macular Degeneration** 
Retinitis Pigmentosa (RP)	A gradual loss of light-sensing cells caused by mutations of certain genes, which send faulty signals to the retinal cells	No treatment; RP coping skills are centered around providing more light and to be focused light	**Figure 6: Retinitis Pigmentosa** 

3.3 Coping with Vision Loss

Individuals with LV could use certain techniques to help them complete their daily activities. These techniques are actually effective even for sighted persons:

- Get closer to the viewed object.
- Eccentric viewing is 100% helpful for individuals with MD and moderately effective for those with cataracts or diabetic retinopathy.
- Scanning is 100% effective for individuals with RP, glaucoma, and diabetic retinopathy. It is also highly effective for individuals with cataracts and MD.
- Proper use of light is 100% effective for anyone with the five different diseases.
    - Contrast enhancement helps everyone see things better. Yellow, amber, and reddish amber enhance contrasts and visual ability (Chapman, 2001, pp. 110-135).

3.3.1 Vision Impairment and Sensory Compensation

People rely on their different senses to understand and experience their environments. One of neuroscience's important findings is that vision impairment and vision loss sharpen the other senses (especially hearing and touch) in order to cope with the loss of sight (Catteneo & Vecchi, 2011, p. 11).

Hearing. One of the most important auditory experiences is sound localization, which is how sound is spatially located in three different dimensions: elevation, range, and azimuth.

Despres, Candas, and Dufour (2005b) performed an experiment with 20 blindfolded-sighted, 24 myopic, 5 amblyopic, 11 adventitiously blind, and 9 congenitally blind subjects to determine how they oriented themselves according to auditory cues. Individuals who had the most vision loss (blind) were more accurate in positioning themselves compared to sighted and VI subjects, but the early blind subjects made smaller errors in positioning themselves compared to late-blind subjects. Late-blind, myopic, and amblyopic subjects were significantly better in orienting themselves in the space compared to normally sighted individuals. As a result, intersensory compensation is likely to be weaker for VI individuals compared to blind individuals and stronger compared to normally sighted individuals. Moreover, VI individuals are considered worse than blind people in building spatial maps for their environment on the basis of auditory cues because their auditory maps are built in support with their vision, which may have caused some confusion and inaccuracy (Cattaneo & Vecchi, 2011, pp. 138–141).

Tactile ability. Tactile acuity has been measured for VI individuals compared to blind and sighted individuals. According to the test by Goldreich and Kanic (2003), a heterogeneous group of blind people with different degrees

of blindness were tested; VI individuals performed similarly to blind individuals and better than sighted individuals.

All tests suggest that severe visual impairment may result in auditory and tactile acuity gains; however, in some specific situations (such as auditory localization), the brain sometimes relies on visual input over other senses (as opposed to VI individuals), and this may cause confusion and errors (Cattaneo & Vecchi, Sensory compensation, 2011, pp. 140-141).

Spatial cognition for LV individuals. Spatial cognition for VI individuals is considered to be limited, but still, they can build a visual representation of the environment in which they are familiar. Some experiments have tested the spatial abilities for VI individuals compared to sighted and blind individuals. These experiments found that VI individuals are similar to sighted people in building their spatial knowledge of their environments whereas blind individuals face difficulties, especially when the tasks are related to moving in straight lines; they build their understanding of the space, objects, and the environment through auditory and haptic information. This information helps VI individuals build analogical representations that they use to cope with everyday situations. Blind individuals are able to translate visually missing information into other sensory and cognitive codes. Blindness is not less vision; rather, it is another form of vision (Cattaneo & Vecchi, Spatial cognition, 2011).

3.3.2 Assistive Tools for Low-Vision People

Assistive tools or LV aids are objects that help people with LV do their daily tasks independently.

Optical aids

- Magnifying spectacles: there are two types of magnifying spectacles. The first has varying power and does not need a doctor's prescription. The second is ordered for each patient depending on the need.
- Telescope glasses: regular spectacles with a telescope lens
- Head-borne magnifier
- Handheld magnifier
- Stand magnifiers/lighted stand magnifiers
- Telescope aids: these aids are used to view objects at a distance

(Chapman, 2001, pp. 139-157).

Table 3: Optical aids

				
Figure 7: Telescope glasses	**Figure 8:** Head-borne magnifier	**Figure 9:** Handheld magnifier	**Figure 10:** Stand magnifier	**Figure 11:** Telescope aid

Video visual aid

A video visual aid is an assistive tool that helps LV and blind people read and write, even if these individuals do not have object or travel vision. This tool is useful for the VI who rank 20/800 and lower on the visual disability scale.

Table 4: Video visual aid as an assistive tool **(Chapman, 2001, pp. 167-171)** Aids for computer users, reading aids, and voice aids

Disease	Cataracts	Diabetic retinopathy	Glaucoma	MD	RP
Usefulness (Scale 1–10)	10	10	7–9	10	7–9

Special software is used to enlarge prints and graphics to 2” or 3” tall, and other software convert text to electronic speech (Chapman, 2001, pp. 172-175).

Table 5: Special software as assistive tools

Disease	Cataracts	Diabetic retinopathy	Glaucoma	MD	RP
Usefulness (Scale 1–10)	10	10	7–9	10	7–9

Special aids for field loss

Vision expanders. The vision expander provides a wider field of vision and helps people with glaucoma and retinitis who develop tunnel vision.

Table 6: Special aids for field loss

Disease	Cataracts	Diabetic retinopathy	Glaucoma	MD	RP
Usefulness (Scale 1–10)	1	1	8–10	1	8–10

Night scopes. Night scopes help those with night blindness (such as those with RP) to see everything in hues of green (Chapman, 2001, pp. 176-179).

Mobility devices

- Laser canes can detect hazards and obstacles within 12 feet of the cane. The cane's handle also vibrates when an object is in front of the user.
- Sonic mobility devices are mounted over the users' heads and detect any hazards or objects with vibrations; this device is mostly used in outdoor environments.
- GPS devices helps blind individuals travel in outdoor environments by identifying locations and routes (Julius, 2010).

3.3.3 Tools That VI Shoppers Make Sure They Have When They Go Shopping

According to the Delphi survey, all LV experts have agreed that VI shoppers will need some or all of the following tools in their grocery shopping journey:

- Magnifier to help VI shoppers enlarge small text, such as the product price and ingredients
- Shopping list on their smart device
- White cane if they are shopping alone, as the white cane will allow customer service to identify and approach them to ask if they need help
- Guided dog to help them in navigation
- Bar code scanner to help them identify the product
- Debit card or credit card to cash out easily
- Monocular telescope (magnifying reading glass)

This literature review discussed the different types of vision impairment and how people with vison impairment cope with their vision loss using assistive tools and their other senses such as hearing and touch. The findings in this review suggests that the world of vision impairment is as rich as the world of sighted people or even more. The surrounding environment is usually designed for visual experience, yet the VI people are able to use their other senses to translate the

missing visual experience into other sensory and cognitive codes. Vision impairment is not less of vision; it is another way of visualizing things.

3.4 Shopping in Grocery Stores

3.4.1 Shopping Behaviour

Many different factors affect shoppers' decisions related to grocery shopping. Each group of consumers has different factors that influence the choices they make, although common factors exist among all shoppers. The shopper's perception of a grocery store is affected by two main dimensions: the variety/quality of products and the price.

Premium grocery stores with a wide range of products. This type of grocery store is larger than traditional ones. They ensure customer service, quality of products, and a wide range of products including prepared dishes, salad bars, meats, seafood, fresh products, nonfood items, and a drug section that contains pharmaceutical needs. The drug section represents about 25% of the selling area and 15% of the sales (Kahn & McAlister, Consumers' grocery shopping behaviour, 1997) .

Premium grocery stores with a limited product selection. This type of grocery store has a wide range of fresh products in special displays, selected grocery items, and a limited range of nonfood items. This type of grocery store more greatly emphasises healthy products (Kahn & McAlister, Consumers' grocery shopping behaviour, 1997) .

Economy-price grocery stores with a limited product selection. Some grocery stores emphasise low prices products, limited selection, and scaled-back customer service. These are wholesale stores where most of the items are sold in large quantities. Shoppers have to pay an annual membership fee to shop in this type of grocery store (Kahn & McAlister, Consumers' grocery shopping behaviour, 1997).

Economy-price grocery stores with a wide range of products. This type of grocery store usually offers a wide range of products with lower prices. Hypermarkets are an example of this type of store; these stores sell large items, for example, furniture and chandeliers, as well as groceries. This type of store is successful in Europe but not in the United States; U.S. consumers are not accustomed to purchasing big ticket items in grocery stores and prefer to shop for those items in specialised stores where they can find a variety of any particular product.

Supercentres are considered to be discount stores. Walmart offers a wide range of products but fewer than hypermarkets. They have lower prices than other grocery stores but not less than wholesale stores (club stores); the difference between supercentres and hypermarkets is that shoppers do not have to buy in bulk (Kahn & McAlister, Consumers' grocery shopping behaviour, 1997).

According to the research survey, LV and PL experts have agreed that people with disabilities (including VI shoppers) will prefer to go to premium

grocery stores where they can find a good customer service and accessible environment. LV experts mentioned that economically priced grocery stores attract a greater aging population as well as a low-income younger population. On the other hand, PL experts have ensured that the aging population prioritizes accessible environments over economical prices. LV and PL experts have agreed that premium grocery stores with a wide range of products and high pricing attract a population with an average age of 18 to over 65 with good income.

Online grocery shopping. Online grocery shopping online is not something that is customarily done by all shoppers. For those who choose to shop for groceries online, one of the most popular grocery stores is Peapod (based in Chicago), which offers online shopping and delivery services. Most of Peapod's customers shop in the evening and spend 37 minutes deciding what to purchase. Shopping online differs from the physical shopping experience in that the online shopper cannot explore the store or enjoy store activities, and impulse shopping is less likely to happen (Kahn & McAlister, Consumers' grocery shopping behaviour, 1997).

According to the Delphi survey, three out of six LV experts have determined that VI shoppers will do their grocery shopping where they can't touch anything such as online shopping, while Melanie Taddeo (LV expert) has stated that "it is really hard to do the grocery shopping online since you are not be

able to recognize the quality of the product. Also, the websites are not accessible."

3.4.2 How Do Shoppers Decide Where to Shop?

According to consumer reports (Reports, 1993) that surveyed 10,000 readers about grocery shopping habits, the most important factor that influences grocery store choice is its location (its closeness to the shopper's home). The second important factor is the store's variety of products, and the third important factor is price. These results are consistent in all studies. Another study that included the United States, Canada, Netherland, and United Kingdom found that location, convenience, checkout speed, affordability, best weekly specials, friendly services, and shopping environment are the main factors that shoppers use to choose their grocery stores (Arnold, Stephen, Tae, & Douglas, 1983).

Creative grocery stores tend to design strategies to bring customers into their stores. These strategies include price-based approaches in which retailers try to communicate low prices with consumers in three ways: everyday low prices, high-low prices, and promotions. The second strategy is service-based: some consumers are likely to be more attracted to stores that provide high-quality products and a friendly and attractive shopping environment (Kahn & McAlister, Consumers' grocery shopping behaviour, 1997, pp. 94-97).

3.4.3 Planned, Unplanned, and Impulsive Purchases

After the consumer has decided where to grocery shop, the next decision involves the products they purchase. Some purchasing decisions are made in advance (planned purchases) in the shopping list before entering the store in which the consumer plans to buy a specific branded item (e.g., Coco Pops cereal), a specific product category (cereal), or a product line (processed breakfast grains).

Other decisions are made in the store (unplanned purchases) where the shopper's decision is influenced by in-store activities. Factors that may increase the likelihood of unplanned purchases are items that are lowered in price, placed in high traffic areas, accompanied by visual indicators (like large red tags), and easy to handle and store.

An impulse purchase occurs spontaneously when the consumer buys something without any reason. This type of purchase is made without much forethought, and in most cases, shoppers regret this purchasing decision. The main factor that drives impulse purchases is the product's location. Most retailers locate impulse products near the cashier area in order to increase the likelihood of an impulse purchase since the shopper spends more than eight minutes waiting to cash out. In some studies, positioning candy near the cash register area has increased the candy sales by 40% (Kahn & McAlister, How Do consumers decide what categories to buy?, 1997, pp. 117-121).

According to the Delphi survey round 1, PL experts have agreed that VI shoppers are able to carry out their planned purchases but will face some difficulties in unplanned and impulse purchases. The latter two present more difficulty because VI shoppers are less likely to be able to find sale items independently, and those products' prices and content (ingredients) are not readily or easily accessible for them. Lawrence Polyner, Dan Philip, and David Yehuda (PLs) have agreed that most VI shoppers do not change their planned decision when they do not find the products they need; rather, they look to customer service to help them find products. If the product is not available, they may return to buy it when it is available.

3.4.4 Factors That Affect Shoppers' Purchase Decisions

Researchers have found three main factors that affect whether the shoppers are likely to make unplanned decisions to purchase an item: the grocery store environment and familiarity with the store and the store's layout, the shopper's amount of time to do grocery shopping, and the influence of others in the purchase decision.

Familiarity with the grocery store. When shoppers are familiar with a grocery store's different zones and its layout, it helps them easily locate the products they need and gives them more time to check and browse the different brands for products they need in order to make price comparisons. When shoppers are not familiar with the grocery store, he or she will spend more time

trying to locate the product they need, so they are less likely to check other brands and do price comparisons; however, unfamiliar shoppers give more attention to the environment and in-store cues, so unplanned purchase decisions may be more likely to happen (Kahn & McAlister, Factors That Influence In-Store Purchase Decisions, 1997, p. 122).

Effect of time on shopping. The average amount of a shopping journey is 45 minutes. When shoppers don't have time to shop comfortably, they are less likely to make unplanned purchases because they are stressed. The lack of store knowledge may increase the unplanned purchase since the shopper is not familiar with the environment and may find difficulty in locating the desired section and the right product. When the shopper is familiar with the store, a time-pressured shopper is more likely to go with the exact purchase plan they had when he or she entered the store.

Influence by others in the purchase decisions. Fewer than half of shoppers shop alone. Most of the time, they are accompanied by children or family. In a New Zealand study, shoppers accompanied by children spent 11% more time on the shopping journey and $30 more per shopping trip than those unaccompanied by children. In another study conducted by the Simmons Market Research Bureau (Berkowitz, 1993), children's influence was greater in categories they had a vested interest (such as cookies, cereals, juice, pizzas and others) rather than other categories. Grocery stores tend to make some products

accessible to children. These products are located on lower shelves or at the checkout area. Some manufacturers have changed their package designs and use cartoon and TV characters to attract children (Kahn & McAlister, Factors That Influence In-Store Purchase Decisions, 1997, pp. 122-123).

3.4.5 Things That May Influence VI Shoppers to Make Impulse Purchases

According to the research, PL experts have agreed that the following factors may enhance unplanned and impulse shopping for VI shoppers:

- Creating a pleasant and multisensory environment
- Placing products near the cashier area
- Providing food sampling activities

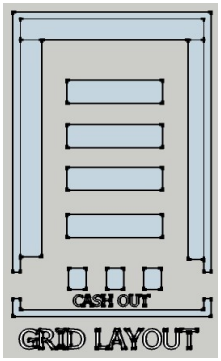
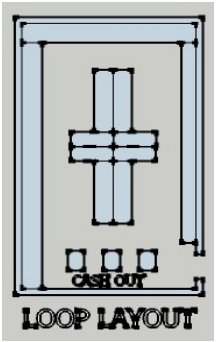
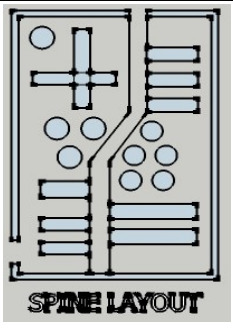
All PL experts agree that changing the location of products will make VI shoppers feel angry and frustrated and will detract from unplanned and impulse purchases.

3.4.6 Layout of Grocery Stores

Store layout and design can be used to create a store's image and atmosphere, as these elements serve as a way for retailers to communicate with shoppers. The store retailer's objective is to keep their customers in the store longer and to respond to the activities and promotions in the store. One way to do this is through the store's layout and atmosphere. Three main things that affect whether the shopper will buy certain products are (1) the layout of the store, (2) the way the product is arranged, and (3) the way the shelves are arranged

according to the different categories (Kahn & McAlister, Factors That Influence In-Store Purchase Decisions, 1997, pp. 124-125).

Table 7: Different types of layouts include grid, loop, free, and spine

Types of layouts	Definition and use
 **Figure 12:** Grid	• Most familiar for grocery stores, drug stores, and discount stores • Counters and fixtures are placed in long rows throughout the store • Can be confusing and frustrating since it is not an open space
 **Figure 13:** Loop layout	• Exposes shoppers to the greatest number of products • Usually shoppers move in a loop through the store where he or she enters and exits from the same door
 **Figure 14:** Spine Layout	• Combines grid, loop, and free layout design • Heavily used by specialty stores with 2,000–10,000 square feet; mostly in fashion stores • No products are displayed on the store's walls; all displays are away from walls (Bhutani, 2009)

The issue of shoppers' mental maps have been studied to learn more about product locations (Kahn & McAlister, 1997, pp. 126–127). In the study conducted in early 1980s by academic researchers where they studied two grocery stores in Davis and California (one national chain and one locally owned), participants from two different grocery stores were asked to recall the location for products in the two stores. Products located in the periphery aisles were recalled more accurately than items in the centre. One reason for the poor recollection is that the shoppers remember the first and last things that they see. Additionally, the central zone looks the same throughout; without any special or identifying characteristics in this area, shoppers have greater difficulty remembering it.

Most grocery stores try to separate perishable fresh sections from the grocery and nonfood aisles. Perishable sections include the deli, pizza, prepared food, meat, bakery, and floral sections. The new generation of Randalls stores in Houston, Texas, started using this concept in 1989 (Kahn & McAlister, Factors That Influence In-Store Purchase Decisions, 1997, pp. 126-127).

For LV shoppers, they agreed that the grid layout is the best type of layout for the aisles area. For VI shoppers, Dan Philip (PL) stated, "I am leaning toward the grid layout because that's how typical, traditional grocery stores design rather than reinvent the wheel, as people are used to it." Lawrence Polyner (PL) also mentioned that it is the best layout for VI shoppers.

3.4.7 Grocery Store Environment

Creating a pleasant, emotional, and sensory environment can serve several needs in grocery stores and can draw attention to the store and bring more customers. The store atmosphere is related to bright lights, colours, fragrances, in-store music, and store activities. These elements are very effective in making the customer stay longer and enjoy the shopping experience. It also helps other customers with special needs rely on the sensory environment to more easily and independently find the sections they need. Super Foodtown in New Jersey has changed the atmospheric environment of the store by using coloured displays, dramatic lighting in the fruits and vegetables zone, and wide aisles. The new atmosphere has encouraged browsing, and total sales have increased. Atmospherics can send a message or create a pleasant environment that makes people enjoy the space and the shopping journey; the shopper becomes part of the store, and it will enhance accessibility for people with special needs (Kahn & McAlister, Factors That Influence In-Store Purchase Decisions, 1997, pp. 133-139).

3.4.8 Effects of Sensory Factors on Shoppers' Behaviour

The primary human senses are smell, taste, hearing, touch, and sight. All these senses are important for processing environmental information (Peck & Childers, 2008).

Sense of smell. Ambient scent is the scent that is spread in the environment and does not emanate from a specific object. Various scents have been classified according to their pleasing quality, effect, and intensity. Some researchers examined the effect of scents on shoppers in two different stores; one store had no scent, and the other store had a pleasant scent. The participants spent more time in the store with pleasing scent than in the store with no scent.

During The Delphi study, store planners noted that creating multisensory environments would enhance the shopping experience not only for LV shoppers but also for sighted shoppers. The four in-store planning experts stated that a pleasant smell associated with each zone would be crucial in making shoppers spend more time in the grocery store while enjoying the shopping experience. LV experts agreed on the following points:

- A pleasant scent related to each zone would help VI shoppers find the needed zone easily, and it would positively affect their orientation and wayfinding techniques.
- To do their daily tasks, VI people rely on the sense of smell but not as much as they rely on the senses of hearing and touch.

Sense of hearing. Researchers have examined the effect of music on consumers' moods and found that the music in a store can influence a good or bad disposition towards the task of shopping, and it can affect how the consumer evaluates new products. Gorn, Goldberg, and Basu (1993) discovered that when

the subject is aware of the source of their mood (the music), it does not change their evaluation to a product; however, when the subject is not aware of the source of their mood, their mood biases their evaluation of the product. As a result, the product may be evaluated more favourably when the consumer is in a good mood compared to when they are in a bad mood.

Other researchers examined the fit of music, the message to the shoppers, and the shoppers' attention and found that music increases recall and recognition of products and brand names; when the music is not related to a product or the message they want to deliver, it pulls the shopper's attention away and negatively influences the shopper's recall and recognition.

Another study related to music and tempo (Milliaman, 1982, 1986) found that purchases increase in grocery stores when slow tempo music is used compared to fast tempo music. Slow tempo music makes the shoppers spend more time in the store and increases the store's sales.

According to the Delphi survey that was conducted to understand which sense VI people rely on the most to do their grocery shopping, LV experts reported that hearing is the most crucial sense after vision; on the other hand, designers have to be careful in how they use sound or music in the space, especially in grocery stores' open environments. Gordon Legge (LV expert) stated, "I would only agree if the music somehow would symbolize the area that you are in. If the song is about vegetable in the vegetable area, it would be like a

verbal announcement about it. But general music wouldn't be particularly helpful."

Sense of touch. The sense of touch, or haptics, is perhaps the least studied sense in the field of marketing. Products differ in the way they encourage the consumer to touch them before purchasing. These product categories are related more to each product's material properties such as texture, softness, temperature, and weight. McCabe, Browne, and Nowlis (2003) examined how evaluating a product by touch differed from evaluating it by a picture and text description. It was found that products that vary in texture and material are preferred to be placed in a physical shopping environment that allows a physical interaction with the products. Peck and Childer (2003) found that people's need for touch (NFT) is influenced by their desire to test the product and buy it when touch is the first dimension. NFT is also influenced by the shopper's desire for enjoyment and fun without any intention of buying. Peck and Childer also found in grocery stores that when shoppers are encouraged to touch a product indicated by signage, for instance, impulse and unplanned purchases increase compared to conditions where shoppers are not encouraged to touch a product (Peck & Childers, 2008, pp. 194-209).

According to the research survey conducted to understand the value of haptics, or the sense of touch, as a technique to help the VI shoppers do their grocery shopping, five of six experts in LV agreed that implementing design that

involved touch would help VI shoppers recall information about the space, orient themselves, and easily wayfind the different sections. They noted that VI individuals rely on touch more than smell but less than hearing so it would help them memorize the locations of products located.

3.5 Wayfinding

3.5.1 Definition

Wayfinding is a basic task in daily human activity where individuals navigate from one place to another in a built environment to reach the desired destination and to locate different zones and objects within a space. Wayfinding is the planning stage that precedes dynamic motion, where the navigation process is a combination of wayfinding (cognitive elements) and motion.

Spatial cognition relates to how people behave, navigate, and find their way in the space, while simple cognition is the mechanism of processing information in the brain; it varies from one person to another depending on mental function and intelligence. One element of cognition skills is spatial orientation, which is the ability to orient within a space in relation to other objects (Hajibabai, Delvar, Malek, & Frank, 2006).

Wayfinding is a process where the person behaves and orients within a built environment. It is the user's dynamic relation with space. Wayfinding is dynamic while spatial orientation is static. According to Passini and Aurthur (1992), wayfinding has three different processes:

1. Developing a plan and deciding where to go
2. Executing the plan moving to the right place
3. Processing information by understanding the perception of the environment

In order to accomplish that, the wayfinder should be able to

1. Orient
2. Know their destination
3. Know which route to select for the new destination
4. Follow the route
5. Know when to reach the new destination

A good wayfinding system assists the wayfinder's decision-making process. Tools of good wayfinding are components designed to assist spatial orientation and cognitive mapping. These tools can help people with different cognitive skills, including:

- Cognitive-focused users who rely on maps and written directions
- Visually based learners who respond to landmarks, art, graphics, and colours
- People who respond to verbal communication when someone explains direction to another

All of these include diverse people with different abilities (Huelat, AAHID, ASID, & IIDA, 2007)

3.5.2 Wayfinding Design Principle (AODA regulations)

Wayfinding is a model that helps solve spatial problems in a built environment. The mental map is developed by the information gained by the built environment's cues. Wayfinding in a built environment can be developed by using a combination of the following:

1. Develop a simple layout that is easy for no-/low-vision users to memorize
2. Add acoustic characteristics to the space
3. Use colour and bright contrasts
4. Provide tactile information
5. Use of signage
6. Use audible signs to provide information by hearing
7. Use lighting to differentiate between areas
8. Use texture and tactile to help shoppers' find direction

The design shall include identifications and marked spaces; the spaces should be linked and grouped, and this experience should be communicated to the user (AODA, 2010). Signage, audible signage, colours, contrasts, light, acoustic characters, texture, and materials should follow the AODA standards in order to be accessible by VI shoppers (AODA, 2010).

3.5.3 Acoustic Wayfinding

Acoustics in built environments can increase usability for people with no vision or LV. Pathways, open spaces, and functional spaces can be audibly detected by users from the different sounds of the space. Acoustic cues will help VI individuals orient and find their way in a space. Acoustic cues depend on the sound quality, echo design of the space, and the use of soft and hard surfaces.

1. Designed and constructed to use wayfinding. Acoustic finishes should define main corridors rather than secondary ones. Sound reflective, absorbent materials and different textures should be considered.
2. Lowered ceiling with textured walls. The floor finish (textured) material should be carefully selected so the occasional noise is not amplified.
3. Ceiling design should be designed in a way that eliminates the echo unless an acoustic treatment is used (Wikipedia, 2013).

3.5.4 Haptic Wayfinding

The sense of touch enables individuals to modify and manipulate his or her environment (McLaughlin, 2002). Users cannot change the environment around them with vision, hearing, or their sense of smell, but they can through touch. Moreover, the sense of touch may leave its mark on the body through touching materials with different temperatures or textures.

Architects and designers are able to create more inclusive environments if they give attention to nonvisual senses. This way, users with different sensory capacities are able to perceive access, navigate, and enjoy the built environment. According to a study about a blind sense of space (Herssen, n.d.), haptic design parameters were developed to help designers in their process. They found that material can be used as landmarks; for example, a tower can be used as a visual landmark, but changing the texture of the floor for that tower creates a haptic landmark. Translating all visual elements that help in wayfinding (such as landmarks, nodes, paths, edges, and boundaries) to haptic elements is an important concept. As they design physical environments, designers should be mindful of how body parts differ in haptic reactions and characteristics. For example, feeling with feet provides sensations and feedback different from feeling with arms, fingers, or a cane. According to Goldstein (2010), the lips and fingers are more sensitive when compared to the arms, legs, back, or shoulders. Hands are generally more sensitive than feet, so textures used on floors should have characteristics different from the materials to be touched by hands. According to Herssen (n.d.), haptic design parameters are described by material and spatial characteristics as well as the part of body that will touch those materials.

Material characteristics include temperature, texture, density, elasticity, light reflection, and permeability. Spatial characteristics consider the way in

which the material is being used in space: direction, size, and the composition of surfaces. Surfaces can be designed and built according to different angles and in relation to the user's body (Herssen).

3.5.5 Wayfinding and Technology for Low-Vision Shoppers: The GroZi Project

The GroZi project has been developed in the United States as a method to help VI people do their shopping independently. The GroZi is a handheld device that can "see," as it helps VI people independently navigate within stores and find their items easier and faster. This project focuses on using technology to help VI people in wayfinding within a grocery store and finding specific aisles and products. This product is still in its early stages and needs to be developed to be more accessible (Foo, 2009).

The GroZi project: Shopping stages. It is important to understand the stages of shopping to accurately help VI people through their shopping experiences. In the first stage, the user enters the grocery store with his or her list uploaded into the GroZi system; the shopper then goes through the store with the GroZi handheld device reading the signs out loud if it is reachable. In stage two, the user enters the desired aisle, and he or she pans the device over the shelves; the GroZi device will then make a sound or vibrate when it locates the desired shelf. In the third stage, the user stands in front of the shelf but needs to find the exact product's location; he or she moves the device over the products, and it will

beep or vibrate when the desired product is found. In the fourth stage, the user retrieves the product. In the final stage, the product is confirmed by scanning its bar code (Foo, 2009).

This device is a good tool to help VI people find items through the various shopping stages, but all users might not prefer it. Moreover, how will this device work in different grocery stores where the products are in different locations? Also, how will the user be able to reach the aisle signage so the device will read the information? This device is perhaps in its early stage and needs further development. According to the research in the data collection phase, some users are unfamiliar with smart devices, especially those that are touchscreen. The question becomes "What can we do to include all customers who are VI as they go through the grocery shopping experience?"

3.6 Conceptual Framework

The conceptual framework of the study has been developed based on the literature review and the Delphi survey. The literature review and Delphi survey for this study are based on the following contexts: the concept of vision impairment, the science of shopping and shopping behaviour, and wayfinding cues and techniques. The objective of this project is to create an inclusive and innovative wayfinding system for VI shoppers in grocery stores to enhance their shopping experience and to help them shop independently. The design is based on using effective wayfinding cues, creating a multisensory environment and

adjusting the current shelving system in the aisles area. The conceptual framework is based on the relationship between the environmental factors, the individual and social factors, and the organizational factors as introduced in Figure 1. Table 7 below presents the different factors, and they are embedded into the SEM in Figure 16.

Table 8: Social-ecological model in relation to the five main themes (inclusive approach)

Individual and social factors that influence the personal shopping experience such as the following:	**Organizational factors are in relation with individual factors and environmental factors such as the following:**
Demographics and health factors	**Organizational factors**
• Age	• Type of grocery store (premium grocery store)
• Gender	• Company policy
• Income	• Grocery image
• Vision impairment	• Market focus
• Other disabilities	• Flexibility in design
Social Factors	• Products and products on sale
• Help from friends and family	• Furniture (shelving system)
Behaviour factors	
• Coping with vision loss	
Environmental factors (digital/nondigital) for inclusive design	
Appeal/Comfort	
Accessibility	
Convenience	
Legibility	
Safety	

Figure 15: Expanded social-ecological model

4 Chapter 4: Delphi Survey Round 1 Analysis and Results

The research study used a Delphi study survey of six experts in LV accessibility and four experts in grocery store planning to identify the most probable concepts and operationalized variables of the physical environment of grocery stores that accommodate independent grocery shopping for LV individuals. Two surveys were developed, one for each of the expert areas, that would collect data from the experts about what physical features derived from the socio-ecological framework would address the five concepts for independent use of grocery stores by VI individuals relative to the other set of factors associated with their expertise. As such, LV experts addressed issues that linked individual factors of LV with physical environmental factors of shopping, and store planners addressed issues that linked organizational factors of grocery stores with physical environmental factors of shopping. The survey, provided in Appendix A, was provided in written format to the experts with follow-up interviews by phone or in person and utilized check-box, Likert scale answers along with open-ended answers.

This section presents the results of the preliminary results from the survey using descriptive statistical analysis. The survey analysis provided applicable information for advancing the environmental factors and features of the SEM for LV grocery store shopping relative to the five main themes: appeal/comfort, accessibility, convenience, legibility, and safety. For the purpose of this analysis,

the survey design, data, and analysis focused on three contexts: (1) shopper experience, (2) wayfinding within the grocery store, and (3) product identification and information by adjusting the current shelving system in the aisles area.

4.1 Results for the Relationship between the Senses and Perceptions of the Built Environment

Through the quantitative survey conducted with experts in store planning and experts in vision impairment, several important points emerged, as detailed below.

4.1.1 Smell

Store planners noted that creating multisensory environments would enhance the shopping experience not only for VI shoppers but also for sighted shoppers. The four experts in store planning stated that a pleasant smell associated with each zone would be crucial in making shoppers spend more time in the grocery store while enjoying the shopping experience. The LV experts agreed on the following points:

- A pleasant scent related to each zone would help VI shoppers find the needed zone easily, and it would positively affect their orientation and wayfinding techniques.
- To do their daily tasks, VI people rely on the smell sense but not as much as on the hearing and touch senses.

4.1.2 Touch

Five experts in LV agreed that the touch sense would help VI shoppers to recall information about the space, while orienting themselves and wayfinding the different sections easily. They noted that people with vision impairment rely on the touch sense more than the smell sense and less than the hearing sense. The three LV experts also agreed that shoppers with vision impairment prefer to do their grocery shopping in a physical environment rather than online. As Gordon Legge (LV expert) put it, "With online shopping, usually people know what they want, so they buy familiar things, so it is easy to buy canned soup online. For unfamiliar things, it is very important to be able to touch them."

4.1.3 Hearing

For people with vision impairment, hearing is considered to be the most used sense after vision. LV experts asserted that hearing is the most crucial sense after vision; on the other hand, designers have to be careful in how they use sound or music in the space, especially in grocery stores' open environment. Gordon Legge (LV expert) stated, "I would only agree if the music somehow would symbolize the area that you are in. If the song is about vegetable in the vegetable area, it would be like a verbal announcement about it. But general music wouldn't be particularly helpful."

PL experts agreed on the following:

- Music in grocery stores has a positive effect on the store atmosphere and increases the shoppers' intention to make purchases.
- Music positively affects the time perception for grocery stores.
- Sounds and music in the different zones would help in orientation, wayfinding, and recall information about the space as well as the products.

The relationship between human senses and perceptions of the built environment has been examined in terms of five main environmental factors: appeal/comfort, accessibility, convenience, legibility, and safety as follows:

Table 9: Human senses and perceptions of the built environment has been examined in terms of five main environmental factors (Nicoll, 2006)

Building environment factors (digital/nondigital)	**Experts**		**Five main themes**				
Humans senses (smell, touch, and hearing)	**PLs experts**	**LV experts**	**Appeal Comfort**	**Accessibility**	**Convenience**	**Legibility**	**Safety**
Smell							
• Enjoy the shopping experience	100%		■				
• Ease to find the needed zone		76%				■	
• Positively affect the wayfinding		100%	■		■		
• Users rely on this sense to do daily activities		61%	■		■		
• Retailors are willing to provide multisensory environment	100%			■			
Touch							
• Helps in recalling information and wayfinding		66%	■			■	

• Users rely on this sense to do daily activities		76%					
• Retailors are willing to provide multisensory environment	100%						
Hearing							
• Users rely on this sense to do daily activities		83%					
• Different types of music will be used as a cue to identify the different zones		55%					
• Intensity of music will help in recalling information and wayfinding		50%					
• Music positively affects the store atmosphere	87.5%						
• Music positively affects the time perception for the shoppers	87.5%						
• Use of different type of music in the different zones	37.5%						
• Music as key for orientation and wayfinding	87.5%						

Table 10: Legend to explain the results for human senses

Legend to explain the results	**Highlighted text**	**Hatch**
Disagreement between experts (average is 55% and below)		
The proposed idea is meeting one or more of the five main themes		

4.2 Results for the Importance of Wayfinding Cues in the Built Environment for VI Shoppers

It is very important that we assist the aging population and people with vision impairment in creating a mental map of the built environment. Such a map will help them in orientation, deciding where to go, and taking action to move from one place to another; this map is based on information obtained from the built environment known as orientation cues. Orientation cues includes spatial form, layout, signage, lighting, colour, texture, sound, information system, and tactile maps. In this research, we examine the following orientation cues: light, colour, signage, layout, texture and material, and contrast.

4.2.1 Light

According to Chapman (2001), there are different techniques that VI people use to cope with their vision loss, one of which is the use of light. Chapman (2001) notes that proper use of light is 100% effective for anyone with one of the five different vision impairments. According to the survey, four LV experts agree that the use of light would be very effective in assisting with wayfinding techniques, but designers should study light intensity through their design; they also agreed that using coloured light may not be effective.

Two PL experts agreed on the importance of using light as a wayfinding technique for shoppers with vision impairment. According to Lawrence Polyner (PL expert), “Retailors are less likely to invest in something that is permanent in

relation to product location and identification. For example, using a coloured light to be projected on the floor tile is more convenient to retailors than ripping up the floor tile."

As noted in this example, retailers' main concern is to use elements of design that are economical and impermanent in the space because the product category may increase or decrease with time. Dan Philip (PL expert) also pointed out that profit margin of grocery stores is very small (3% to 5% of sales). This low profit margin is one major reason they prefer economical features and techniques.

4.2.2 Colour

LV and PL experts agree that the use of colour would enhance orientation and wayfinding in the store. Grocery store experts share a concern that the way the colours are used does not affect the store's image or impact other shoppers negatively.

4.2.3 Signage

Signage is one of the most important key elements allowing VI shoppers to find the different zones, the centre aisle, the sections, and the needed products. Designers have to follow AODA regulations for designing and locating signage in any space. According to round 1 of the survey, both groups believe that signage is a very important element in the wayfinding system. They also share the belief that the best location for signage is at eye level for VI shoppers.

4.2.4 Layout

The circulation system in any building is a key element that organizes and connects different spaces. People use this system to develop a mental map of the building's interior space. In grocery stores, there are different types of layouts depending on the store area and its departments. Based on a previous survey conducted by my group, I realized that the pathways in the aisles area were filled with freestanding displays that our VI participant bumped into several times while he was shopping in the centre aisle. In the first round of the Delphi survey, both groups of experts recommended the removal of all freestanding displays, which would increase the safety of all VI shoppers. PL experts also recommended increasing the width of the aisles and maintaining a grid system for that zone because it is the strategy for wayfinding; for their part, LV experts asserted that the aisles were wide enough, and there was no need to increase their width.

4.2.5 Texture and Material

According to the survey, the two groups agreed that different textures and materials would improve wayfinding techniques for VI shoppers.

4.2.6 Contrast

The AODA has regulated that the colour contrast should be at least 70% in relation to the background colour for VI users. According to the first survey,

the two groups of experts agreed that enhancing the contrast would improve the wayfinding and information accessibility for VI users.

Wayfinding cues have been examined according to the five main themes of appeal/comfort, accessibility, convenience, legibility, and safety as follows:

Table 11: Wayfinding cues have been examined according to the five main environmental factors (Nicoll, 2006)

Building environment factors (digital/nondigital)	**Experts**		**Five main themes**				
Wayfinding cues	**PLs**	**LV experts**	**Appeal/comfort**	**Accessibility**	**convenience**	**Legibility**	**safety**
Lighting							
• Lighting as an element for wayfinding	55%	63.3 %	■		■	■	
• Lighting intensity to support wayfinding		56.6 %	■				
Colour							
• Create different colours in the grocery store pathways to identify the different zones	72.5 %	85%	■			■	
• Create different colours for the pathway area in the center zone and one colour for the shelving	67.5 %	70%	■			■	
• Create different colours for the different sections in the shelving system	45%	70%	■			■	
• Create different colours for the shelves in the shelving system and one colour for the floor	50%	66.6 %	■			■	
• The best wayfinding is based on colours	75%	78%		■		■	
Signage							
• Signage to be located within the eye level		83%		■	■	■	
• Information signage to be within the eye level	30%	90%		■	■	■	
• The best wayfinding is based on signage	93%	86%				■	
Layout design							
• Remove all freestanding displays from the pathways in the center zone	67.5 %	75%					■

• Increase the width of the aisles	72.5 %	50%					
• Maintain the grid layout design for the aisles area	95%						
Texture and materials							
• Use of different textures in grocery store pathway to identify the different zones	95%	85%					
• The best wayfinding is based on texture and materials	57.5 %	71%					
Contrast							
• Contrast enhancement is a key element for way finding		90%					
• Use of large floor numbers with high contrast	65%	78%					

Table 12: Legend to explain the results for wayfinding cues

Legend to explain the results	**Highlighted text**	**Hatch**
Disagreement between experts (average difference between both groups is 20% and more)		
The proposed idea is meeting one or more of the five main themes		

4.3 Results Suggesting Adjustments to Current Shelving System in the Aisles Area

The centre zone is one of the most difficult areas to wayfinding for the aging population and VI shoppers. VI Shoppers often have problems finding the needed zone and section because of their LV and limited ability to build a mental map of the space. Therefore, they are often challenged to find the needed aisle,

the correct section and shelf within the aisle, and the right product. Through the first survey, the two expert groups were to rank the designers' suggestions about adjusting the shelving system. The two groups agreed on the following:

- Redesign the strip bar on the shelf that contains the product price and brand.
- Redesign the shelving system by adding dividers between the different sections. PL experts had some concerns about this adjustment and suggested that the dividers should be small or impermanent.
- Use markers (visual or tactile markers) to determine where the aisle begins and ends.
- Use tactile markers in the different sections of the shelves within the aisle zone.

Adjusting the shelving system has been examined according to the five main themes of appeal/comfort, accessibility, convenience, legibility and safety as follows:

Table 13: Adjusting the shelving system has been examined according to the five main themes

Building environment factors (digital/non-digital)	**Experts**		**Five main themes**				
Furniture design (Redesigning the shelving system)	**PLs experts**	**LV experts**	**Appeal/comfort**	**Accessibility**	**convenience**	**Legibility**	**safety**
• Redesign the strip bar on the shelf that contains the product bar code and price	66.25%	76.66%					
• Adding dividers between the different sections in the shelving system	55%	77.60%					
• Add tactile markers to determine the two ends of the aisle	60%	56.60%					
• Use tactile markers within the shelving system to identify the different products	81.25%	50%					

Table 14: Legend to explain the results for wayfinding cues

Legend to explain the results	**Highlighted text**	**Hatch**
Disagreement between experts (average difference between both groups is 20% and more)		
The proposed idea is meeting one or more of the five main themes		

After analyzing the collected data and finding these outcomes, a 3-D design will be developed for the aisles zones. This design will be sent to each participant in

both groups for their detailed feedback. A detailed explanation of the results is available in Appendix C.

5 Chapter 5: Design Model

5.1 Human-Centered Design

The research considered HCD for the interior design model that will be used to create the wayfinding experience. HCD is about empathy and understanding people's tasks, goals, and ways to approach challenges. HCD can be used in the design of products, spaces, services, and systems. Physical environments give people cues on how to behave and feel; by rethinking the design of any space, we can create an experience and provide cues for the user when interacting with his or her physical building environment. HCD is one of

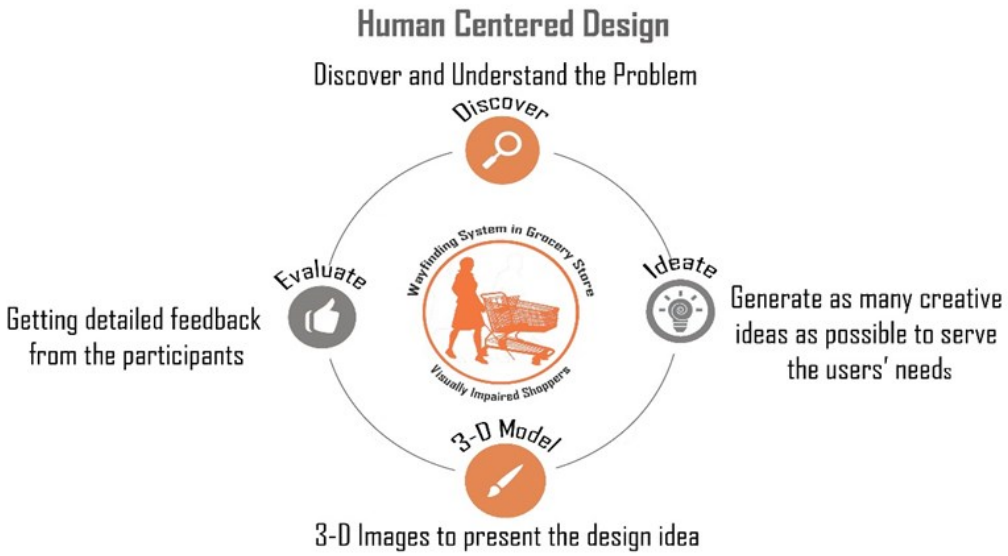


Figure 16: Human-centered design

the methods for creating barrier-free spaces (Greenhouse & Semsie, n.d.).

5.1.1 Design Process

HCD has different stages. For this research, the design process consists of four main stages: discovery, ideation, 3-D modeling, and evaluation.

Discovery. Different methods can be used to discover and understand problems, and these methods also have differing strengths and weaknesses. The ethnography has been developed from previous research (Khattab, 2015), literature reviews, Delphi surveys, and conversational interviews. These methods were used to understand users, their needs, the barriers they face, and the contexts and purposes they use the system for. These methods resulted in qualitative and quantitative data (Lindstrom & Malmsten, 2008).

Ideation. Ideation identifies the end users' needs and generates as many creative ideas as possible to serve these needs. The goal of the ideation phase of this research was to provide solutions for the problem presented in the first Delphi survey and to check whether or not the participants agree on the suggested ideas. After getting the participants' feedback, a 3-D model was presented to create better communication and to help in the final evaluation (Dorta, 2008).

3-D Modeling. Using 3-D images is a fast and efficient way to present a design idea; this approach will help participants make firm decisions about the design, give detailed feedback, and add different options.

Evaluation. The design model will be evaluated by getting detailed feedback from participants, LV experts, and PLs. The 3-D model will be submitted for both groups in the second Delphi survey to get their opinion about the design to decide whether the eight elements of design are applicable by grocery stores and whether this design will enhance VI shoppers' independent shopping experiences.

The essential elements of HCD are the consideration of appeal/comfort, accessibility, convenience, legibility, and safety for the users in the design model.

Appeal/comfort. "Appeal/comfort" will be used in this study to describe the physical and digital elements in building environments that provide visual and sensory appeal as well as comfort.

Accessibility. "Accessibility" for the physical environment is defined as the presence of zones that can be easily entered and exited (width, height, and spatial orientation), have reachable shelving (height, size, and locating the needed shelf), and have easily available wayfinding cues (location and usability). For the digital environment, "accessibility" refers to the customers' ease of identifying aisles, sections, and shelves by using digital factors including sound or light.

Convenience. "Convenience" relates to three factors: (1) the simplicity of the layout to navigate the center zone, (2) the minimal physical effort and time required to locate the desired aisle, section, and product, and (3) the information can be accessed by LV individuals.

Legibility. Legibility in a space provide an understanding through helping create cognitive maps and wayfinding. Legibility relates to (1) perception (zone, aisles, and pathways), (2) usability of wayfinding cues in relation to users, and (3) intelligence of wayfinding cues.

Safety. The objective of the safety factor is to provide a secure environment for VI shoppers in grocery stores in the aisles area, and that will be achieved by removing all physical factors that may cause injuries while shopping due to unseen elements. The detailed SEM below will present the five main themes:

Table 15: Design limitation for the five inclusive themes

	Appeal Comfort	Accessibility	Convenience	Legibility	Safety
	Interior design	Accessible	Proximity	Perception	Fall prevention
Physical Environmental Factors (non-digital)	**1.** Colour (range, contrast) **2.** Lighting (intensity) **3.** Material (texture) **4.** Furniture (style and colour)	**1.**Transportation (walking, wheel transit) **2.**Entrance (size, operation type) **3.**Zone (perception and spatial orientation) **4.**Shelf (locating the needed shelf) **5.**Wayfinding cues (location and usability)	**1.**Travel distance (home to store) (between the different zones)	**1.** Discernable (aisle, section, shelf, and info.)	**1.** Floor material (slippery)
			Arrangement	Usability	Bump prevention
	Sensory appeal		**1.** Products (location) **2.** Layout (grid)	**1.**Wayfinding cues	**1.** Clear pathways
	1.Sight (colour, contrast, glare, and size) **2.**Smell/Taste (Quality) **3.**Touch (soft, rough, and temperature) 4.Sound (type, quality, tempo, and loudness)			Intelligence	Error tolerant
			Less effort	**1.**Wayfinding journey (consistency and number of turns)	**1.** No Injury
			1.Physical (reach range) **2**.Vision (vison range)		
	Interior design	Navigation	Less effort	Intelligence	Bump prevention
Physical Factors (digital)	1.Sound **2.** Lighting	**1.** Identifiable (shelf/zone) 2.Sound **3.**Lighting	**1.** Finding (aisle, section, and shelf)	**1.** Navigation (aisle,section, and shelf) **2.**Accuracy (locating)	1.Warning signals (sound and vibration)
	Sensory appeal				
	1. Sound 2. Lighting				

	Device	Device	Device	Device	Device
Digital Factors	1. Shape/form (easy to hold and control)	1.Accessible Interface (human factors)	1. Availability 2. Training	1. Readability **2.** Navigation (ease) 3.Flexibility	1.Warning option (sound and vibration)

Note: The context in gray colour is not part of the study

5.1.2 Dual-Sensory Environment

The design proposes creating a dual-sensory environment that incorporates visual and haptic elements. For this dual-sensory environment, eight elements related to individual and organizational physical environmental factors for shoppers with VI will be presented. The wayfinding model consists of eight design features:

1. Aisle signage
2. Product signage
3. Metal transition stripes at the two ends of each aisle
4. Light-projected floor numbers
5. Coloured flags
6. Raised texts and numbers
7. Red clip to code products on sale
8. Clear pathways

Figure 17 presents the 3-D wayfinding model with these eight components. The image presents five aisles. The shelving system is gray, and the

product signage and the shelves' skirting is white. In addition, it uses vertical metal dividers to create different sections in each aisle. The floor for this design is light gray colour in which it will create a colour contrast with the white skirt and the dark grey shelves, with stainless steel floor stripes at both ends of the aisles. The lighting system consists of two types of lighting fixtures: general lighting fixtures and projected light (which will project the aisle's number on the floor when the grocery store identifies VI shoppers in the store). Also, an image for an existing grocery store will be presented to compare the design model to an existing grocery store model.

Figure 17: Center zone (aisles) with eight design features

Figure 18: Center zone (aisles) for an existing grocery store

5.1.3 Aisle Signage

Figure 19: Aisle signage

Figure 20: Aisle signage for an Existing store

The design proposes changes to the aisle signage by providing two numbers for each aisle; each number will identify the side of the aisle so it will be more convenient for the shoppers and VI shoppers to orient themselves and to know the products in relation to the aisle number. For example, if the VI shopper is passing in aisle 4, the aisle signage to the right side will show the aisle number (which is the number 4), and the types of products will be displayed on the right side of the aisle. The left side of the aisle's signage will not only show the aisle number (which is also the number 4) but also display the types of products on the left side of the aisle.

In addition, the design proposes changing the location of the signage to be over the end cap and within the eye level (180 cm [70 inch] to 220 cm [86 inch]). The aisle numbers will be displayed in white on a green background. The aisle text

(types of products contained within each aisle) will be displayed in white on a black background.

5.1.4 Product Signage

Figure 21: Product's signage

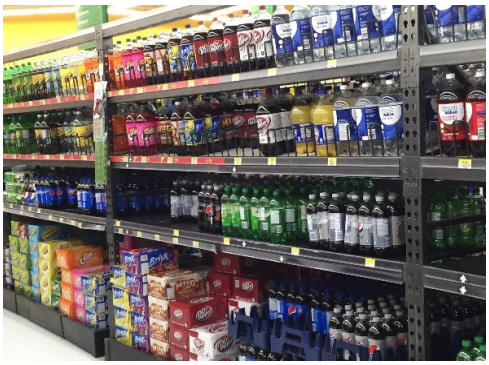


Figure 22: Products with no signage

The design proposes adding product signage over each section in each aisle, and this signage has an angle (30 degree); the signage will be located at the top end of each aisle. The text will be in black, and the background will be in white.

5.1.5 Metal Transition Stripes

Figure 23: Metal transition stripes

Figure 24: Center aisle flooring (Existing store)

It is very important for VI shoppers to know when the aisle starts and ends. To aid VI shoppers, the design proposes using a metal transition stripes on the floor before entering and exiting from the aisles area, as per the 3-D image. The floor's metal transition will function as a haptic wayfinding cue and a haptic landmark. VI shoppers will feel the floor's metal transition by either stepping on it or moving their carts over it. This will serve as an indicator that they are entering or exiting the aisles' section.

5.1.6 Light-Projected Floor Numbers

Figure 25: Light-projected floor numbers

Using ceiling light to project aisle numbers on the floor is a digital element in the grocery store building environment. When a grocery store identifies that a VI shopper is in the store, a light from the ceiling will project numbers on the floor for each aisle so the shopper will get to know which aisle they are in, and by that time, they will get to know what products are available in each aisle.

5.1.7 Using Flags to Colour-Code Sections and Products

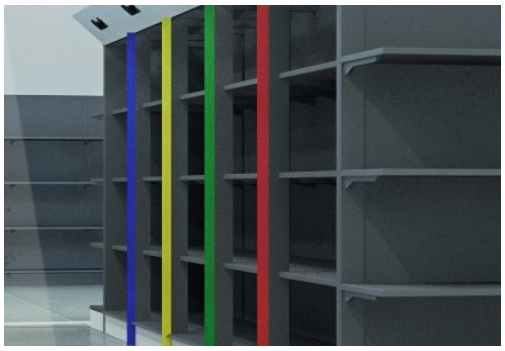


Figure 26: Colored flags

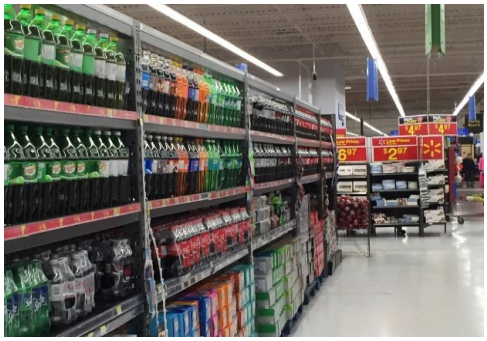
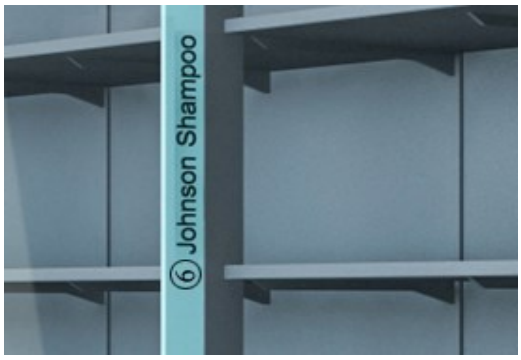


Figure 27: Center aisles

The design proposes using flags to colour-code the aisles and some sections. These flags will be on the vertical dividers of the shelving system and 2” wide. Their purpose is to colour-code the products and aisles. For instance, baby blue flags are used in some sections to mark baby products in aisle number 6. International food will have different colours in the same aisle so when the shopper passes by different colours in the same section, he or she will get to know that the aisle presents international food.

5.1.8 Raised Text and Numbers

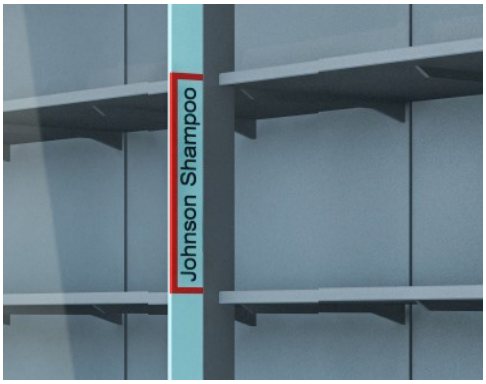


The design suggested adding the product’s name and aisle number on the coloured flags beside each shelf; the print will also be raised to be convenient and legible for VI shoppers

Figure 28: Raised text and numbers

and will be depicted in the 3-D model. Also, it will work as a haptic wayfinding technique.

5.1.9 Coding products on sale



VI shoppers are not able to find the products on sale easily; the design model suggests designing a red clip to be clipped on the coloured flag beside the shelf that has products on sale.

Figure 29: Coding products on sale

5.1.10 Removing the freestanding displays and columns

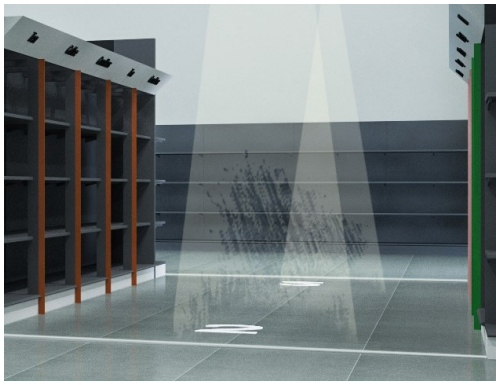


Figure 30: Clear pathways

Figure 31: Column in a middle of the Pathway

Safety is one of the main factors that should be considered while designing the building environment. Most grocery stores use freestanding displays in the pathways between different aisles or have a structural column in the middle of the pathway; as per a previous ethnography to a VI shopper doing

the grocery shopping, the shopper bumped the cart many times on freestanding displays, and that made him feel unsafe in his shopping journey. Providing clear pathways with no freestanding displays or columns in the shopper's pathway in the aisles is very important.

The 3-D wayfinding model that incorporates the eight different components will be assessed by the two groups of experts in the second Delphi survey. This survey will aid in checking whether the suggested changes will enhance the shopping experience for VI shoppers and if these elements are applicable by grocery store organizations

6 Chapter 6: Delphi Survey Round 2 Results

The aim behind the second round was to gather experts' comments and feedback about the design model. Two surveys were developed. Each group of experts had received a copy of the design model, along with a second questionnaire intended to gather more detailed information about the physical features that would enhance the shopping experience for VI shoppers. The second survey, provided in Appendix B, was provided in written format to the experts with follow-up interviews by phone or in person and utilized check-box, Likert scale (1–10: 10 is very important; 1 is not) answers along with open-ended answers.

PLs had agreed on six design features that would enhance the shopping experience for LV shoppers, which are aisle signage, product signage, light-projected floor numbers, raised text, coding products on sale using red clip, and remove all freestanding elements in the center aisle, but their main concern was the cost, as per Lawrence Polyner "A 'decor' package such as this would be costly and would need to be able to flex with seasonal and economical changes in order for the business owner to make it work for their purposes." On the other hand, PLs have agreed that aisle signage, using coloured flags, raised text, and red clip to code products on sale are the most applicable elements of design by grocery store organization. Also, they have ensured that most of the physical features would not affect the general shoppers, but it will enhance their shopping

experience. As per Dan Philips and Lawrence Polyner, using product signage would significantly increase the legibility for the shopping experience for the general population. Also, Lawrence Polyner and David Yehuda have ensured that using the red clip to code products on sale will help LV shoppers as well as the general population to find products on sale easily and would increase the unplanned and impulsive purchase for the LV shoppers.

LV experts agreed on seven design features, which are aisle signage, product signage, metal transition stripes, light-projected floor numbers, raised text, coding products on sale using a red clip, and removal of all freestanding elements in the center aisle. LV experts ensured that aisle signage and the removal of freestanding elements are the most important features since they would provide comfort, accessibility, convenience, legibility, and safety in the shopping journey; also, they ensured that these two features are usable for all types of shoppers with different vision impairments.

The tables below will present the average results of the second survey using descriptive statistical analysis for both groups of experts. For PLs and LV experts, the analysis will focus on the environmental factors and features of the SEM for LV grocery store shopping relative to the five main themes: appeal/comfort, accessibility, convenience, legibility, and safety. Also, it will present whether the proposed environmental factors and features are applicable to

grocery store organizations or not and the usability of the different features with different types of shoppers with different vision impairment.

Table 16: Survey analysis (2) for (grocery store planners)

The wayfinding model with eight different components	Appeal Comfort	Accessibility	Convenience	Legibility	Safety	Applicability
1. Aisle signage						**9.5**
1.1 Aisle signage (Design) ➢know the aisle				**8.75**		
1.2 Aisle signage (Location) ➢within eye level		**8.75**	**8.75**			
1.3 Aisle signage (Colour contrast)	**8.75**					
2. Product Signage						**5.25**
2.1 Product signage (Design) ➢Find the section				**8.125**		
2.2 Product signage (Colour contrast)		**6.875**		**6.875**		
2.3 Product signage (Angel) ➢Reduce vision effort			**8.125**			
3. Metal Transition Stripe						**3**
3.1 Metal transition stripe (Design) ➢ Identify the two end of the aisles				**5.625**		
4. Light-Projected Floor Number						**5.25**
4.1 Light-projected floor number (Design) ➢ Create intelligence wayfinding journey				**8.75**		
5. Using Coloured Flags						**6.75**
5.1 Using coloured flags (Design) ➢ Identify the different sections				**5**		
5.2 Using coloured flags (Colours) ➢ Create intelligence wayfinding journey				**5**		
6. Raised Text						**7**
6.1 Raised text (Design idea) ➢ Identify the different products				**8.75**		
7. Coding Products on Sale						**6.5**
7.1 Coding products on sale (Design) ➢ Find products on sale/enhance purchase		**6.25**	**6.25**	**6.875**		

decision /increase unplanned and impulsive purchase						
8. Removing the Freestanding Displays						**5.5**
8.1 Removing the freestanding displays (Idea)					**8.75**	

Table 17: Survey analysis (2) for (LV experts)

The wayfinding model with eight different components	**Appeal/Comfort**	**Accessibility**	**Convenience**	**Legibility**	**Safety**	**Usability for all types of VI**
1. Aisle signage						**All**
1.1 Aisle signage (Location) » Usability				**8**		
1.2 Aisle signage (Location) » Less vision effort			**8.5**			
1.3 Aisle signage (Location) » Accessibility		**9**				
1.4 Aisle signage (Colour contrast)	**8.5**					
1.5 Aisle signage (Colour Contrast) » Less vision effort			**9**			
1.6 Aisle signage (Colour Contrast) » Usability				**8.5**		
1.7 Aisle signage (Colour contrast) » Less time			**8**			
2. Product Signage						**All**
2.1 Product signage (Design) » Finding the Section				**9.5**		
2.2 Product signage (Colour Contrast) »Accessible information		**8**				
2.3 Product signage (Proposed angle) »less vision effort			**8**			
3. Metal Transition Stripe						**All**

3.1 Metal Transition Stripe (Design) » Haptic wayfinding cue				**8**		
3.2 Metal Transition Stripe (Design) » Haptic Landmark				**7.5**		
4. Light-Projected Floor Number						
4.1 Light-Projected Floor Number (Design) » Identify which aisle they are in (perception)				**6.5**		
4.2 Light-Projected Floor Number (Design) »Accuracy in finding the needed aisle				**7**		
5. Using Coloured Flags						
5.1 Using Coloured Flags (Design) » Identify the different sections				**5.5**		
5.2 Using Coloured Flags (Colours) » Usability as a wayfinding cue				**6.5**		
6. Raised Text						
6.1 Raised Text (Design Idea) » Identify the needed shelf				**7.5**		
6.2 Raised Text (Design Idea) » Accessible information		**7.5**				
6.3 Raised Text (Design Idea) » Usable as a haptic wayfinding				**7**		
7. Coding Products on Sale						
7.1 Coding Products on Sale (Design) » Find products on sale				**7**		
7.2 Coding Products on Sale (Design) » Enhance the shopping experience				**7**		
7.3 Coding Products on Sale (Design) » Increase the unplanned and impulsive purchase				**6.5**		
8. Removing the Freestanding Displays						**All**
8.1 Removing the Freestanding Displays (Idea)					**10**	

LV experts have disagreed on which types of vision impairment the light-projected floor number feature will serve, on the other hand, four out of five LV

experts agreed on using coloured flags since it will serve all types of shoppers with vision impairment; three experts have agreed that the raised text and the red clip to code products on sale will serve all shoppers with different vision impairment, while two experts mentioned that the two features will serve only shoppers with glaucoma, MD, and RP.

Gordon Legge, a director of the Minnesota Laboratory for Low-Vision Research, has recommended for the aisle signage to be placed lower so that it can be read face-on. Also, for the product signage, he suggested to use bright colours for the text on black background. Sumreen, a living specialist from the CNIB, suggested that the coloured flags should be in brighter colours, as they will make it much easier for people with visual impairments to see. Sumreen said, “Light coloured flags may be missed altogether.”

Finally, the analysis for the second survey presented that the two groups of experts have agreed on six design features that would enhance the shopping experience for VI shoppers, which are aisle signage, product signage, light-projected floor numbers, raised text, coding products on sale using red clip, and remove all freestanding elements in the center aisle. The table below will present the six design features that were agreed on, the applicability of these elements by grocery store organizations, and the usability by different shoppers with vision impairment,

Table 18: Final results, agreement between both groups of experts on the design features, applicability, and usability

Design features	Applicability by grocery stores	Usability by shoppers with different vison Impairment
1. Aisle Signage	9.5	Usable for all types
2. Product Signage	5.25	Usable for all types
3. Light-Projected Floor Number	5.25	three experts agreed on all, one expert agreed on RP only,
4. Raised Text	7	three experts agreed on all, 2 experts agreed on Glaucoma, MD, RP
5. Coding Products on Sale	6.5	three experts agreed on all, 2 experts agreed on Glaucoma, MD, RP
6. Removing the Freestanding Displays	5.5	Usable for all types

7 Chapter 7: Discussion

The objective of this research was to identify physical environment wayfinding features for VI shoppers. The parameters of this research study was to consider elements of an inclusive wayfinding system that would enhance the independent shopping experience in the center zone (aisles) of premium grocery stores for VI shoppers, which will not adversely affect the general shoppers, and check the applicability of the physical environmental features by grocery stores organisations.

The eight features that were developed in the design were based on the information gained from the literature review and the first Delphi survey. According to the literature review, the design was developed with the information provided by the AODA regulations for wayfinding in the built environment and the information gained about the need for creating a multisensory environment in grocery stores that would enhance the shopping experience for VI shoppers. In order to provide an inclusive wayfinding system, the design should be developed using a combination of a simple layout, the grid layout in the center zone, colour and bright contrasts in the signage design and coloured flags, tactile information in the raised text, the aisle signage and product signage, lighting in the floor projected floor numbers, and texture and tactile to help shoppers find direction in the metal transition stripes. According to the Vision Impairment and Sensory Compensation, “People rely on their different senses to understand and

experience their environments. One of neuroscience's important findings is that vision impairment and vision loss sharpens the other senses (especially hearing and touch) in order to cope with the loss of sight" (Catteneo & Vecchi, 2011, p. 11).

In round 1 of the Delphi survey, the design focused on the information gained from the analysis of the survey, which concentrated on three main contexts: the shoppers' experience in relation to human senses, the wayfinding cues within the building environment, and the redesign of the shelving system. First, human senses and perceptions of the built environment have been examined in terms of five main environmental factors: appeal/comfort, accessibility, convenience, legibility, and safety. The results present that VI shoppers rely on the touch and hearing senses the most to perceive the built environment. Second, the two groups of experts agreed that the best wayfinding system should be based on colour, colour contrast, signage, simple layout (grid layout), texture, and material. PLs did not agree about locating the signage at the eye level of the shoppers. After proposing the design of the aisle signage, it was not expected that both groups would agree on the design since there was disagreement in the first survey. Third, both groups have agreed on adding dividers between the different sections, on using markers to determine the two ends of the aisles, and on employing tactile markers within the shelving system.

7.1 Explanation of the Results

PLs and LV experts have agreed on six design features out of eight that would improve the shopping experience for LV shoppers: (1) aisle signage, (2) product signage, (3) light-projected floor numbers, (4) raised text, (5) coding products on sale using red clips, and (6) removing all freestanding elements in the center aisles. Both group of experts did not agree on using (7) metal transition stripes (8) and coloured flags.

7.1.1 Aisle Signage: Removing All Freestanding and Fixed Elements from the Pathways

Both sets of experts have agreed that aisle signage and removing all freestanding and fixed elements from the pathways in the center aisles are the most effective features in relation to the five main themes: (1) appeal/comfort, (2) accessibility, (3) convenience, (4) legibility, and (5) safety. PLs have agreed that the aisle signage design feature is highly applicable by grocery store organization; also, LV experts have ensured that the design feature is usable for different shoppers with different vision impairment. Both experts have agreed that removing the freestanding displays and the fixed elements (columns) from the aisles area would increase the safety factor for all shoppers especially when they need to escape for emergency issue, PLs' main concern is that they use the freestanding displays to display product's on sale and removing them may affect their profit.

7.1.2 Product Signage

PLs agreed that product signage design and colour contrast will be really effective for finding the needed section within the aisles area; also, they ensured that the proposed angel will reduce the vision effort needed for VI shoppers. Michael Farquhar from Loblaws stated, “Product signage will block the light from hitting products on shelves making it harder to see for all.” Gordon Legge (LV expert) suggested to use bright letters on black background since it will be more accessible to read for shoppers with advanced cataracts.

7.1.3 Metal Transition Strips

PLs did not agree on the metal transition strips. Dan Philip is the only PL who strongly agreed on this design feature, and he mentioned that this element would work as a wayfinding cue to identify the two ends of the center zone. It also would work as a haptic wayfinding landmark. Moreover, it would not affect the legibility of the shopping experience for the general shoppers. According to Gordon Legge (LV expert), “VI shoppers are able to read the aisle signage, and this feature will identify the two the ends of the aisle without the haptic stripe, but this strip maybe helpful for blind and severely VI shoppers, but it is narrow enough that it might be missed.” The metal strip is a feature that may be considered or redesigned to enhance the shopping experience for blind shoppers, which is a population that was not considered in the original design.

7.1.4 Light-Projected Floor Numbers

Both group of experts agreed that the light-projected floor numbers will help VI shoppers identify which aisle they are in; also, it will provide accuracy in navigation. Three LV experts agreed that this design feature will serve all types of shoppers with different vision impairment.

7.1.5 Coloured Flags to Code Sections and Products

David Yehuda and Dan Philip (PLs) did not agree on using coloured flags to code sections and products. Yehuda mentioned that this design feature might annoy the general shoppers. On the other hand, Gordon Legge, who is a LV expert and a specialist in wayfinding, stated “These flags maybe useful as a landmark for shoppers who become familiar with them, but we have to keep in mind that many VI people do not have good color discrimination.” Sumreen Siddiqui, a LV expert from the CNIB stated, “It’s important for the proposed flags to be in bright colours, as these will be much easier for people with visual impairments to see. Light coloured flags may be missed altogether.”

7.1.6 Raised Text as a Design Feature

Both groups have agreed on using raised text as a design feature, but Gordon Legge was concerned about this design feature and stated that “this design feature will require reading vertical text, and this maybe effortful for VI shoppers and may require more time.”

Finally, Lawrence Polyner, a PL, stated the following, “Grocery resets are one of the biggest obstacles for a VI customer. The aisle signage, colored flags, and product signage are excellent solutions to keep this VI customer independent, but these elements would need to be designed to be flexible to ensure that the grocery could easily and accurately relocate ‘inserts’ or flags when their business model changes and they are required to do some type of reset. Also, I don’t feel that completely removing cross merchandising (freestanding displays) opportunity via spot merchandisers is the answer. They could be reduced and placed in locations that allow adequate flow but I believe that they too could be signed correctly.”

8 Chapter 8: Conclusion and Recommendations

In conclusion, wayfinding is about effective communication, and it relies on successful communication cues delivered to our sensory system. Wayfinding is the ability to know where you are, where you are heading, how to reach your destination, and how to find your way independently and safely. The effectiveness of the wayfinding system is measured by the users' experience in the environment and how they communicate with the cues that take them from A to B (Innovation, 2007). The wayfinding system should provide comfort, accessibility, convenience, legibility, and safety for the user. According to Innovation's (2007) table, a successful wayfinding system should provide information for users to

Table 19: Inclusive wayfinding system

Inclusive Wayfinding System Should Provide Information for Users	**Design Feature**
1. The start and finish of the wayfinding journey	Metal transition strips and aisle signage
2. Identify their location	Aisle signage, light-projected floor numbers, and product signage
3. Ensure they are travelling in the right direction	Aisle signage and light-projected floor numbers
4. Orient themselves within the space	Aisle signage, light-projected floor numbers,product signage, and metal transition strips
5. Identify their destination on arrival	Product signage and raised text
6. Escape safely in an emergency	Remove all freestanding and fixed elements from the center aisles

Providing proper accommodations for a group of customers (VI shoppers) not only conforms to inclusive design principles, but it will improve the quality of life for people with vision impairment and will enhance the legibility general shoppers' shopping experience. When the grocery store building environment is designed with reasonable consideration of people with vision impairments' needs, it will provide equal rights and opportunities for everyone to access their facilities and services. Removing barriers makes good business sense to the service provider. Based on the Delphi study and the literature review, the study proposes the following recommendations be adopted by grocery store organisations in the center zone to accommodate the needs of VI shoppers: the layout, aisle signage, product signage, haptic landmarks, light-projected floor lights, raised text and numbers, coding products on sale, and removing the freestanding displays and columns.

8.1 Grocery Store Building Environment (Center Aisles)

This research study supports that a combination of the following design principles will support the wayfinding system for LV people in grocery stores and other aisle-based spaces, such as libraries, retail stores, convenience stores, and pharmacies.

8.1.1 Layout

The circulation system is the key organising element in a building for people to build a mental map of the space. The center zone (aisles area) layout in

a grocery store should be simple enough to be memorised by VI shoppers. Grocery store experts have agreed that the grid layout will provide wayfinding comfort and ease for VI shoppers, and grocery stores should maintain the grid layout for the center zone.

8.1.2 Aisle Signage

It is recommended to redesign the aisle signage by providing two numbers for each aisle; each number will identify the side of the aisle so it will be more convenient for the shoppers and VI shoppers to orient themselves and to know the products in relation to the aisle number. In addition, it is recommended to change the location of the signage to be over the end cap and within the eye level (180 cm [70 inch] to 220 cm [86 inch]). The colour of numbers, text, and backgrounds should follow the AODA regulation in terms of colour contrast. Colour contrast should be at least 70% between the text colour and its background.

8.1.3 Product Signage

Product signage should be added over each section in each aisle. This signage should have an angle of 30 degrees because it would be more convenient for VI shoppers to read the information. The signage should be located at the top end of each aisle with the text in black or with bright letters with a dark background in order to accommodate different shoppers with different vision impairment.

8.1.4 Haptic Landmarks (both ends of the aisle)

It is important for VI persons to know where the aisle starts and ends. To aid VI persons, it is recommended to use floor stripes, floor grooving, or different floor material because it will work as a haptic wayfinding cue and a haptic landmark. VI people will feel the floor haptic mark by either stepping on it or moving their carts over it. This will serve as an indicator that they are entering or exiting the aisle section.

8.1.5 Light-Projected Floor Numbers

It is recommended to use light-projected floor numbers to identify the different aisles. Different coloured lights can be used depending on the floor colour. A light from the ceiling will project numbers on the floor for each aisle, so the shopper will learn to know which aisle they are on. In time, they will get to know what products are available on each aisle.

8.1.6 Raised Text and Numbers

The benefit of using raised text is it will increase the convenience and legibility in the shopping journey. The raised text will help the VI shopper identify and confirm the different types of products for each shelf. It will also enable touch reading for shoppers who are blind and touch enhancement for shoppers who are VI. It is recommended to position the text horizontally, not vertically, to be more convenient for VI shoppers.

8.1.7 Coding Products on Sale

VI shoppers can use a barcode reader to know if the product they are planning to buy is on sale, but this reader will not help them with unplanned and impulsive purchases. Using a red clip to code products on sale is one way to enhance the impulsive and unplanned purchase decisions.

8.1.8 Remove the Freestanding Displays and Columns

Safety is a main factor that should be considered when designing the building environment. Most grocery stores use freestanding displays (cross merchandise) in the pathways between different aisles or have structural columns in the middle of the pathway. VI shoppers and blind shoppers may bump their carts into the freestanding displays and columns. It is not safe for emergency escapes for all shoppers.

8.2 Limitations and Future Research

The findings of this study were based on the literature review and two rounds of Delphi survey, according to C. C. Hsu and B. A. Sandford (2007). Ten to 15 subjects will be sufficient for the Delphi survey, but most Delphi studies have used 15 to 20 participants. In future studies, it is recommended to involve a larger group of experts in the study or to use a new research method. It is recommended to use more statistical power in analyzing the data. It is also recommended to test the design model with different shoppers who have different types of vision impairments. Finally, empirical research is recommended for

future study; empirical research by using a mock-up in actual spaces will facilitate and support the decision-making process.

Finally, the purpose of the study is to provide an inclusive wayfinding system that aims to remove all of the barriers that create unreasonable effort and separation. An inclusive design should enable people with different disabilities to participate independently in everyday activities.

References

AODA. (2010, July). *Final proposed accessible built environment standard.* Retrieved from http://www.cou.on.ca/policy-advocacy/accessibility/legislation---regulation/l-r-pdfs/final-proposed-accessible-built-environment-standa

Arditi, A., & Rosenthal, B. (1996). Developing an objective definition of visual impairment. *Vision, 96*, 331–334.

Bhutani, B. (2009, April). *Presentation on store layout and circulation pattern.* Retrieved from Slide Share: http://www.slideshare.net/bharti_bhutani87/store-layout

Canada, E. A. (2014, 10 19). *Canadians in context - Aging population*. Retrieved from http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=33

Catteneo, Z., & Vecchi, T. (2011). Blurred vision. In Z. Catteneo & T. Vecchi (Eds.), *Blind Vision* (pp. 11–12). Cambridge, MA: The MIT Press. Retrieved August 2014.

Cattaneo, Z., & Vecchi, T. (2011). Sensory compensation. In Z. Cattaneo & T. Vecchi, *Blind Vision* (pp. 138–141). Cambridge: The Mit Press.

Cattaneo, Z., & Vecchi, T. (2011). Spatial cognition. In Z. Cattaneo & T. Vecchi, *Blind Vision* (p. 268). Cambridge: The Mit Press.

Catteneo, Z., & Vecchi, T. (2011). Blurred vision. In Z. Catteneo & T. Vecchi, *Blind Vision* (pp. 11–12). Cambridge: The Mit Press. Retrieved August 2014

Centre, B. D. (2008, Jan 1). *Accessibility in Ontario*. Retrieved from http://www.oboa.on.ca/events/2010/sessions/files/510.pdf

Cerella, J. (1990). Aging and information processing rate. In J. B. In & K. Schaie, *The Handbook of Cognitive Aging* (pp. 201–221). New York: Academic Press.

Chapman, B. (2001). Major causes of vision loss. In B. Chapman (ed.), *Coping with Vision Loss* (p. 282). California: Hunter House.

Chapman, B. (2001). A visual disability scale. In B. Chapman, *Coping with Vision Loss* (p. 282). California: Hunter House.

Chapman, B. (2001). Coping techniques and equipment. In B. Chapman, *Coping with Vision Loss* (p. 282). California: Hunter House.

Chapman, B. (2001). Major causes of vision loss. In B. Chapman, *Coping with Vision Loss* (p. 282). California: Hunter House.

Chapman, B. (2001). Vision and the human eye. In B. Chapman, *Coping with Vision Loss* (pp. 139-157). California: Hunter House. Retrieved August 2014.

Chien Hsu, C. (2007). The Delphi technique: Making sense of consensus. Practical assessment, research & evaluation. Retrieved from http://pareonline.net/pdf/v12n10.pdf

Craik, F., & Jennings, J. (1992). Human memory. In F. I. Craik & S. T. A., *The Handbook of Aging and Cognition* (pp. 51–110). Hillsdale, NJ: Erlbaum.

Delbecq, A. L., Van de Ven, A. H., & Gustafson, D. H. (1975). Group techniques for program planning. Glenview, IL: Scott, Foresman, and Co.

Dorta, T. S. (2008). Design flow and ideation. *International Journal of Architectural Computing*, *6*(3), 299–316.

Fozard, J., & Gordon, S. (2001). Sensory and perceptual changes with aging. In B. J. In & K. Schaie, *Handbook of the Psychology of Aging* (pp. 241–266). San Diego: Academic Press.

Greenhouse, E. S. Human-centered design.

Gunaydin, H.M. (n.d.). The Delphi method. Retrieved from http://web.iyte.edu.tr/~muratgunaydin/delphi.htm

Hajibabai, L., Delvar, M., Malek, M., & Frank, A. (2006). *Spatial cognition and wayfinding strategy during building fire.* Retrieved from http://www.icsc-rome.org/archive/2006/Abstracts/Extended_Abstracts/E_Hajibabai.pdf

Herssen, J. (n.d.). *Haptic design research: A blind sense of place.* Retrieved from http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aiab087187.pdf

Hofstee, E. (2006). *Constructing a good dissertation*. Retrieved from www.exactica.co.za/dn/exactica-book-literature-review.pdf

Huelat, B. J. (2007, October). *Wayfinding: Design for understanding.* Retrieved from https://www.healthdesign.org/sites/default/files/WayfindingPositionPaper.pdf

Humphery, K. (1998). *Shelf life: Supermarkets and the changing cultures of consumption*. Cambridge: Cambridge University Press.

Hsu, C. C., & Sandford, B. A. (2007). The Delphi technique: Making sense of consensus. *Practical Assessment, Research & Evaluation*, *12*(10), 1–8.

Innovation, C. R. (2007). Wayfinding design guidelines. Retrieved from *Construction-Innovation*. http://www.construction innovation.info/images/pdfs/Publications/Industry_publications/CRC0002_CRC_Wayfinding_Guidelines.pdf

Julius. (2010, 12 09). *Electronic mobility devices for persons who are blind or visually impaired*. Retrieved from http://evengrounds.com/blog/electronic-mobility-devices-for-persons-who-are-blind-or-visually-impaired

Kahn, B., & McAlister, L. (1997). Consumers' grocery shopping behaviour. In B. Kahn & L. McAlister, *Grocery Revolution* (pp. 89–94). United States: Addison Wesly.

Kahn, B., & McAlister, L. (1997). Factors that influence in-store purchase decisions. In B. Kahn & L. McAlister, *Grocery Revolution* (pp. 122–139). United States: Addison Wesley.

Kahn, B., & McAlister, L. (1997). How do consumers decide what categories to buy? In B. Kahn & L. McAlister, *Grocery Revolution* (pp. 117–121). United States: Addison Wesley.

Kausler, D. (1994). *Learning and memory in normal aging.* San Diego, CA: Academic Press.

Kahn, B., & McAlister, L. (1997). Factors that influence in-store purchase decisions. In B. Kahn & L. McAlister (Eds.), *Grocery Revolution* (pp. 122–139). Boston, MA: Addison Wesley.

Lindstrom, H., & Malmsten, M. (2008). User-centred design and agile development: Rebuilding the Swedish national union catalogue. *Code4Lib Journal*, *5*.

Herr, M., & Kardes, F.R. *Handbook of consumer psychology* (pp. 247–264). United States: Psychology Press.

Nicoll, G. (2006). *Taking the stairs: Environmental features that predict stair use in 3 to 4 story academic workplace buildings* (PhD dissertation). Retrieved from SmartTech: https://smartech.gatech.edu/handle/1853/11481.

Nicoll, G. (2006, August). *Taking the stairs: Environmental features that predict stair use in 3 to 4 story academic workplace buildings.* Retrieved from SmartTech: https://smartech.gatech.edu/handle/1853/11481

Peck, J., & Childers, T. (2008). Effects of sensory factors on consumer behavior. In C. Haugtvedt, P. Herr, & F. Kardes, *Consumer Psychology.* New York: Psychology Press.

Reports, c. (1993). Survival guide to the supermarket. *Consumer Reports*, 559–570.

Schaie, K. (2005). *Developmental influence on adult intelligence: The Seattle longitudinal study.* New York: Oxford University Press.

Shove, E., & Southerton, D. (2000). Defrosting the freezer: From novelty to convenience a narrative of normalization. *Journal of Material Culture*, *5*(3), 301–319.

Wikipedia. (2013). *Acoustic wayfinding.* Retrieved September 9, 2013, from http://en.wikipedia.org/wiki/Acoustic_wayfinding on

Yoon, C., & Cole, C. A. (2008). Aging and consumer behavior. In C. Haugtvedt, P. Herr, & F. Kardes (Eds.), *The Handbook of Consumer Psychology. New York: Lawrence Erlbaum Associates*, 247–272.

Appendix A: Delphi Survey Round 1

Research Title: Wayfinding system for visually impaired shoppers in grocery store
(Delphi Study)

Round 1 (Low vision experts)

Many visually impaired people face considerable barriers while shopping in grocery stores. One such barrier is that they cannot find their way around easily; especially when they visit the grocery store for the first time and have not yet built a cognitive map in their memory. They may also experience delays in finding the right product or waiting for assistance from store employees, thus leading them to rely on family, friends, relatives, or volunteers to help them with their shopping. The problems start when these people are not available, in which case the individual is forced to cancel their visit to the grocery store and reschedule the trip.

Grocery stores include many different zones and services, the aisles area being one of the main barriers to access for people with vision impairment. This area features many different sections such as canned goods, dry packaged goods, spices, drinks and snacks, baking supplies, baby items, cereals, cleaning products, pet supplies, and health and beauty items. For visually impaired individuals, however, it can be hard to reach these various sections and to find the relevant products.

The purpose of this paper is to design an inclusive and innovative wayfinding system in grocery stores for visually impaired shoppers in order to help them find the center zone, orient between the different aisles, decide where to go, move easily between the different sections, and select products with ease.This design proposes various adjustments to the current shelving system, as well as the flooring design, lighting, and signage. It therefore puts forward a model whereby visually impaired individuals can navigate the zone independently, find the section that they are looking for, the needed shelf and select products with ease.

Section 1: General Questions about grocery shopping

1. Where do people with disabilities do typically their grocery shopping?

   ☐ Specialty store
   ☐ Retail Store
   ☐ Online Grocery stores

2. How do visually impaired shoppers go to grocery stores?

   ☐ With a friend
   ☐ With family
   ☐ Alone

3. How do Visually impaired shoppers reach the grocery store?

   ☐ By car,
   ☐ Bus
   ☐ Walking
   ☐ Others

4. Are grocery stores designed as an accessible environment for low vision shoppers? If yes, please rank from 1-10, 10 is very accessible, 1 it is not

   ☐ Yes
   ☐ No

5. What do visually impaired shopper make sure they have when they go shopping?

   ☐ Shopping List
   ☐ Magnifier
   ☐ White Cane
   ☐ Smart phone
   ☐ Others

Section 2: The Science of Shopping and the Science of Vision

1. Researchers found that the most common factor that affect choosing the grocery store is location, but What about low vision shoppers please check box and rank each of the following items from 1-10 according to their importance for low vision shoppers in choosing grocery stores, 10 is very important 1 it is not important, if you select others please specify,

☐ Familiarity with grocery store
☐ Product Variety
☐ Product Quality
☐ Price
☐ Location
☐ Atmosphere
☐ Accessibility
☐ Others

2. Some grocery stores are quite creative in bringing shoppers into their store. Shoppers are attracted to different things such as (1) low pricing (but less customer service) (2*)* customer service with good accessibility and (3) quality of products (but higher pricing). Which strategy is more effective for each of the groups below? Please check the box for the most applicable answer.

Aging population

☐ Low pricing (but less customer service)
☐ Customer service with good accessibility
☐ Quality of products (but higher pricing)

People with disabilities

☐ Low pricing (but less customer service)
☐ Customer service with good accessibility
☐ Quality of products (but higher pricing)

Shoppers with an average age between 18 and 60

☐ Low pricing (but less customer service)
☐ Customer service with good accessibility
☐ Quality of products (but higher pricing)

3. Visually impaired people rely on a combination of their vision and other senses to do their daily tasks. Vision loss comes in many different types. Which one of the following vision loss types is not treatable? Please check the box for the most applicable answer and specify whether the type has a travel vision loss or object vision loss, or both.

☐ Cataracts
☐ Diabetic Retinopathy
☐ Glaucoma
☐ Macular Degeneration
☐ Retinitis Pigmentosa(RP)

4. Which one of the following vision loss types lets visually impaired people still rely on some of their vision so they can do grocery shopping independently? Please check the box and rank each of the following items from 1-10 according to the VI person's ability (10 is very able, 1 is not able).

☐ Cataracts
☐ Diabetic Retinopathy
☐ Glaucoma
☐ Macular Degeneration
☐ Retinitis Pigmentosa(RP

5. Which one of the following vision loss types keeps the visually impaired person from doing grocery shopping independently? Please check the box.

☐ Cataracts
☐ Diabetic Retinopathy
☐ Glaucoma
☐ Macular Degeneration
☐ Retinitis Pigmentosa(RP)

6. Which sense do visually impaired people rely on the most to do their daily tasks? Please check the box and rank each of the following items from 1-10 according to their importance (10 is very important, 1 is not).

☐ Hearing
☐ Touching
☐ Smell

7. What is the most effective technique for visually impaired shoppers to use while they do their grocery shopping independently? Please check the box and rank each of the following items from 1-10 according to their importance (10 is very important, 1 is not).

☐ Getting Closer
☐ Eccentric viewing
☐ Use of strong Light
☐ Use of colored Light
☐ Contrast enhancement
☐ Wayfinding cues to be within the eye level
☐ Others

8. Grocery store sensory environment, the human senses consist of smell, taste, hearing, touch and sight, each of the senses is important to process the information. In cognitive science, perception is how we organize, identify, and translate the sensory information that we get from the environment that surround us.

- Is the pleasant scent that relates to each zone will help people with vision loss to find the zone they are looking for more easily? If yes, Please rank from 1-10 according to their importance, 10 is very important, 1 is not

☐ Yes
☐ No

- Is it going to affect positively their orientation and wayfinding technique especially if they have low vision?

☐ Yes
☐ No

- Is the different type of music in each zone is considered to be a cue for low vision shoppers to find the different zones easily?

  ☐ Strongly agree
  ☐ Agree
  ☐ Neutral
  ☐ Disagree
  ☐ Strongly disagree

- Is the intense of music in the different zones will help visually impaired shoppers to recall some information about the space, orient, and wayfind the different sections in the zone?

  ☐ Strongly agree
  ☐ Agree
  ☐ Neutral
  ☐ Disagree
  ☐ Strongly disagree

9. Sense of touch or the haptic (touch with hands) will help in understanding the product`s quality in term of Texture, softness, size, and temperature, and it will encourage in the purchase decision. Products are categorized differently but most studies ensured that the product that vary in the diagnosticity of touch is most likely to be preferred in a shopping environment where the shopper can physically inspect it.

- Is the touch sense (not related to products) helps visually impaired shoppers to recall some information about the space, orient, and wayfind the different sections in the zone easily?

  ☐ Strongly agree
  ☐ Agree
  ☐ Neutral
  ☐ Disagree
  ☐ Strongly disagree

- Do visually impaired shoppers are likely to shop their grocery where they can`t touch such as online shopping? If no, what are the challenges?

☐ Yes
☐ No

Section 3: Wayfinding in grocery stores

It is very important to help in creating mental map for the aging population and people with vision impairment to help them in orientation, deciding where to go, and take an action and move from one place to another, this map is based on information obtained from the building environment and it is called orientation cues. Orientation cues includes the spatial form, layout, signage, lighting, colour, texture, sound, information system and tactile maps

- If the grocery stores pathways have different colours and different materials for the different zones, will that improve the wayfinding for the low vision shoppers and the aging population? If yes, Please rank according to their importance from 1 to 10 (1 = not important, 10 = very important).

☐ Yes
☐ No

10. The centre zone is being one of the most difficult areas to wayfind for the aging population and visually impaired shoppers (since they have problems finding the needed zone and section because of their limited ability in building a mental map of the space and their low vision) to find the needed aisle, the section within the aisle, the shelf, and the right product

- Please check box and rank from out of **10** how designers can improve the wayfinding and product finding for shoppers with limited abilities

☐ Remove all the free standing displays in the pathway between the different aisles
☐ Use different flooring colors for the different aisles one color for each Aisle
☐ Use different colors in the same aisle to identify the different sections
☐ Use different colors for the shelving system and use one light color for the floor
☐ Use information signage and to be at the eye level

☐ Redesign the shelf talkers which contains the product price and brand
☐ Redesign the shelving system by adding dividers between the different sections
☐ Use light as a wayfinding technique
☐ Use markers to determine that the aisle begins and ends
☐ Increase the width of the aisles
☐ Use large floor numbers and high contrast colors
☐ Use Scent, Music, and a raised text, as a wayfinding technique
☐ Use a tactile marker in the different sections in the shelves within the aisle zone
☐ Use a graphic information as a wayfinding technique
☐ Others

Acoustic Wayfinding, acoustic wayfinding is how to use the auditory system to help visually impaired shoppers in orienting, and navigating within the different zones in the store. It will help the visually impaired to retain their mobility without relying on the visual cues.

Haptic wayfinding, haptic perception is the connection between the dynamic movement and the sense of touch, it is a way that the person is connected physically with the building environment where he/she can modify or manipulate the world around,

11. Which one of the following wayfinding sensory is more reliable to visually impaired shoppers? Please rank them according to their importance from 1 to 10 (1 = not important, 10 = very important).

☐ Haptic wayfinding
☐ Acoustic wayfinding
☐ All wayfinding sensory

12. The best wayfinding is to be based on, Please rank them according to their importance from 1 to 10 (1 = not important, 10 = very important).

Environmental cues

☐ Signage
☐ Visual display system
☐ Texture& materials

☐ Colour
☐ Map

Devices to help in wayfinding

☐ Smart Phone
☐ Laser cane
☐ Devices to support navigation

Section 4: Lastly questions about you

1. What is your age?

   ☐ 25-34 years
   ☐ 35-44 years
   ☐ 45-54 years
   ☐ 55-64 years
   ☐ 65+ years

2. What is your gender?

   ☐ Female
   ☐ Male
   ☐ Others

3. Are you considered a person with vision impairment?

   ☐ Yes
   ☐ No

4. What is the highest level of education you have completed?

   ☐ High school Diploma
   ☐ Bachelor's degree
   ☐ Master's degree
   ☐ Professional degree
   ☐ Doctorate degree
   ☐ Other

5. What is your position title?
6. Please add anything else as a recommendation

Closing

Thank you for all of your valuable information

If you have questions or concerns about the Survey or the evaluation please do not hesitate to contact me or my supervisor

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Thank you for supporting this initiative

Research Title: Wayfinding system for visually impaired shoppers in grocery store

(Delphi Study)

Round 1 (Grocery store experts)

Many people with disabilities face considerable barriers while shopping in grocery stores. One such barrier is that they cannot find their way around easily; especially when they visit the grocery store for the first time and have not yet built a cognitive map in their memory. They may also experience delays in finding the right product or waiting for assistance from store employees, thus leading them to rely on family, friends, relatives, or volunteers to help them with their shopping. The problems start when these people are not available, in which case the individual is forced to cancel their visit to the grocery store and reschedule the trip.

Grocery stores include many different zones and services, the aisles area being one of the main barriers to access for people with different disabilities. This area features many different sections such as canned goods, dry packaged goods, spices, drinks and snacks, baking supplies, baby items, cereals, cleaning products, pet supplies, and health and beauty items. For visually impaired individuals, however, it can be hard to reach these various sections and to find the relevant products.

The purpose of this paper is to reduce the anger and frustration that people with disabilities experience while shopping in the center zone (aisles area), by creating an innovative and accessible model for the aisles zone. This design proposes various adjustments to the current shelving system, as well as the flooring design, lighting, and signage. It therefore puts forward a model whereby visually impaired individuals can navigate the zone independently, find the section that they are looking for, the needed shelf and select products with ease.

Section 1: General Questions about grocery shopping

13. Grocery stores are designed for the following populations. Please rank them according to their importance from 1 to 10 (1 = not important, 10 = very important).

According to their gender

☐ Single women
☐ Married women
☐ Single men
☐ Married men
☐ Other

According to their disabilities

☐ Physical disabilities
☐ Visual disabilities
☐ Hearing disabilities
☐ Mental health disabilities
☐ Other

14. Are grocery stores designed as an accessible environment?

☐ Yes
☐ No

15. To what standard you design the accessibility in your grocery store? Please clarify

☐ Ontario Building Code standards
☐ AODA standards
☐ Human right standards
☐ Store planning guideline manual
☐ Other

16. Which group or groups of people do they consider in their design? Please rank them according to their importance from 1 to 10 (1 = not important, 10 = very important).

☐ Physical disabilities
☐ Mental Disabilities
☐ Sensory disabilities
☐ All

Section 2: The Science of Shopping

1. Researchers found that the most common factor for people choosing a grocery store is location. But what about for shoppers with low vision? In each box below, please assign a number from 1 to 10 that ranks the importance for shoppers with low vision when they are choosing a grocery store (1 = not important, 10 = very important). If you select "Others," please specify.

☐ Familiarity with grocery store
☐ Product Variety
☐ Product Quality
☐ Price
☐ Location
☐ Atmosphere
☐ Accessibility
☐ Others

2. Some grocery stores are quite creative in bringing shoppers into their store. **S**hoppers are attracted to different things such as (1) low pricing (but less customer service) (2) customer service with good accessibility and (3) quality of products (but higher pricing). Which strategy is more effective for each of the groups below? Please check the box for the most applicable answer.

Aging population

☐ Low pricing (but less customer service)
☐ Customer service with good accessibility
☐ Quality of products (but higher pricing)

People with disabilities

☐ Low pricing (but less customer service)
☐ Customer service with good accessibility
☐ Quality of products (but higher pricing)

Shoppers with an average age between 18 and 60

☐ Low pricing (but less customer service)
☐ Customer service with good accessibility
☐ Quality of products (but higher pricing)

3. Shoppers' decision making: When shoppers have decided which grocery store to go to, they have already made some of their purchasing decisions by creating a shopping list (planned purchase). They also decide on which products to buy while in the store (unplanned purchase), and they even buy other products without any reason (impulse purchase). In each box below, please assign a number from 1 to 10 that ranks the ability for shoppers with low vision regarding their purchasing decisions while they shop independently (1 = not important, 10 = very important).

☐ Planned purchase
☐ Unplanned purchase
☐ Impulse purchase

- Planned purchase: The more the shoppers are specific with a brand, the less likely they are to be attracted to in-store activities. However, there are still some factors that may affect their planned purchase decisions, such as a product not being in stock, increased prices, and being unable to find the product. In each box below, please assign a number from 1 to 10 that ranks the importance for shoppers with low vision regarding factors that may affect their planned purchase decisions (1 = not important, 10 = very important).

☐ Unable to find the product
☐ Unable to read the price and the contents
☐ High price
☐ Product not in stock
☐ Others (specify)

- Unplanned purchase: Unplanned purchases result when shoppers intend to buy a specific brand but end up buying a different brand. Such decisions may be related to a brand's size, flavour, placement in a high-traffic area of the store, portability, and storage capacity at home or because the brand is on sale. In each box below, please assign a number from 1 to 10 that ranks the importance for shoppers with low vision regarding factors that may affect unplanned purchases (1 = not important, 10 = very important).

  ☐ Ability to find an on-sale brand for the same product
  ☐ Ability to access the different brands, prices, and contents
  ☐ Ability to hold, carry, and store the item at home
  ☐ They don't change their planned decisions
  ☐ Others

- Impulse purchase: Impulse purchases are products that the shoppers buy even though they know they don't need them. Most of the time, shoppers do not put much thought into impulse purchasing and may later regret their decision. Usually the location of the product encourages the impulse purchase; one of the best locations is the exit aisle near the cashier area, where shoppers spend an average of 8 minutes waiting to cash out. In each box below, please assign a number from 1 to 10 that ranks the importance for the aging population and people with disabilities regarding how grocery stores encourage impulsive purchases (1 = not important, 10 = very important).

  ☐ Pleasant, emotional, and sensory grocery environment
  ☐ Product location near the cashier
  ☐ Changing product location
  ☐ Food sampling activities
  ☐ Others

4. Grocery store sensory environment: Each of the human senses—smell, taste, hearing, touch, and sight—is important in processing information. In cognitive science, perception is how we organize, identify, and translate the sensory information that we get from the environment that surrounds us.

5. Sense of smell: Ambient scent is the scent that is in the environment but not emanating from a particular object. In grocery stores, is the pleasant scent that relates to each zone crucial in making shoppers spend more time in grocery stores and enjoy the shopping experience?

☐ Yes, if yes what zones
☐ No

Sense of hearing: The music in grocery stores has a positive effect on the store atmosphere and increases the shoppers' intention to purchase in grocery stores.

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly disagree

- Music positively affects the time perception for grocery store shoppers.

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly disagree

- We can have each zone of the grocery store use a different type of music in a way that all the music will not be blended together.
  ☐ Strongly agree
  ☐ Agree
  ☐ Neutral
  ☐ Disagree
  ☐ Strongly disagree

- For shoppers who have a disability or are from the aging population, the music in the different zones will help them orient themselves, recall some information about the space, and find the different sections in the zones.
  ☐ Strongly agree
  ☐ Agree
  ☐ Neutral
  ☐ Disagree
  ☐ Strongly disagree

Sense of touch: The sense of touch (or haptic perception) helps shoppers understand a product's quality in terms of texture, softness, size, and temperature, and it will encourage the shoppers' purchase decision. Products are categorized differently, but most studies ensure that the product that varies in the diagnosticity of touch is most likely to be preferred in a shopping environment where the shoppers can physically inspect it.

- Are shoppers who have vision impairment likely to shop for groceries where they can't touch, such as online shopping?

  ☐ Yes
  ☐ No

- Are shoppers who have vision impairment more likely to make impulse purchase decisions while shopping online?

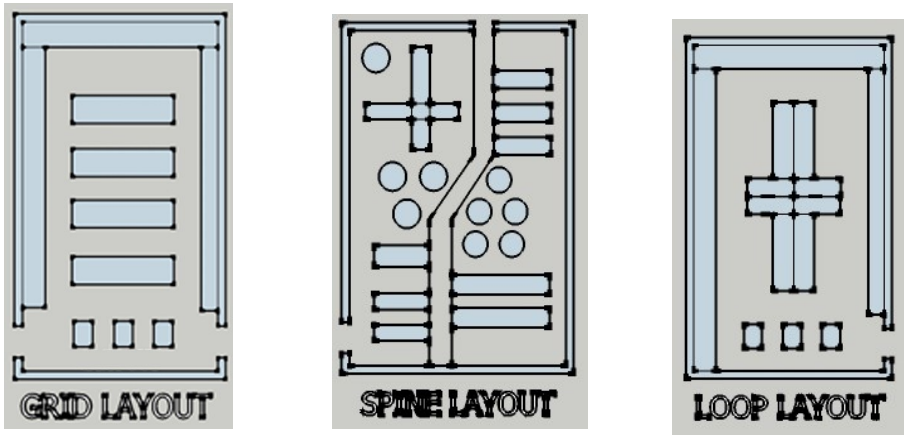
  ☐ Yes
  ☐ No

Section 3: Wayfinding in grocery stores

It is very important to help shoppers who have a disability or are from the aging population create a mental map that helps them orient themselves, decide where to go, and take an action and move from one place to another. This map consists of orientation cues that are based on information obtained from the building's environment. Orientation cues include spatial form, layout, signage, lighting, color, texture, sound, information system, and tactile maps.

1. The circulation system in any building is a key element that organizes and connects the different spaces. People use this system to develop a mental map of the interior space of the building. In each box below, please assign a number from 1 to 10 that ranks the importance for shoppers regarding layout design and how shoppers can easily find their way through a grocery store (1= not important, 10 = very important).

Grid **Loop** **Spine**



- If a shopper has low vision, what is the best layout to help in his or her wayfinding?

  ☐ Grid
  ☐ Loop (centralized)
  ☐ Spine layout (combination of the three)

2. If the grocery store's pathways have different colors and different material for the different zones, will that improve the wayfinding for the shoppers?

  ☐ Yes
  ☐ No

3. The centre zone is one of the most difficult areas for the aging population. They have difficulty finding the centre zone because of their limited ability to build a mental map of the space and their low vision. Thus, they often cannot find the needed aisle, the section within the aisle, the shelf, or the right product.
In each box below, please assign a number from 1 to 10 that ranks the importance regarding how designers can improve the wayfinding and product finding for shoppers with limited abilities (1= not important, 100 = very important).

☐ Remove all the free standing displays in the different aisles.
☐ Use different flooring colors for the different aisles, with one color for each aisle.
☐ Use different colors in the same aisle to identify the different sections.
☐Use different colors for the shelving system, and use one light color for the floor.
☐ Use category signage at eye level.
☐ Redesign the shelf talkers which contains the product price and brand
☐ Redesign the shelving system by adding dividers between the different sections.
☐ Use light as a wayfinding technique.
☐ Use markers to determine where the aisle begins and ends.
☐ Increase the width of the aisles.
☐ Use large floor numbers and high-contrast colors.
☐ Use scent, music, and raised text as wayfinding techniques.
☐ Use a tactile marker in the different sections in the shelves within the aisle zone.
☐ Use graphic information as a wayfinding technique.
☐ Others

4. Acoustic wayfinding: Acoustic wayfinding consists of the store using different auditory materials for the floors to help visually impaired shoppers orient themselves and navigate within the different zones. It helps these shoppers retain their mobility without relying on visual cues.

- Is it possible for retailors to provide an acoustic wayfinding system for the visually impaired shoppers in grocery stores?

☐ Yes
☐ No

5. Haptic wayfinding: Haptic perception is the connection between dynamic movement and the sense of touch. It is a way in which shoppers are connected physically with the building's environment where they can modify or manipulate the world around them.

Is it possible for the retailors to provide a multi-sensory environment within the grocery store to enhance the shopping experience for all shoppers?

☐ Yes, how?
☐ No

6. The best shopping environment is based on, Please rank them according to their importance from 1 to 10 (1 = not important, 10 = very important).

☐ One sensory environment
☐ Multi-sensory environment

7. The best wayfinding technique is to be based on, Please rank the followings according to their importance from 1 to 10 (1 = not important, 10 = very important).

- **Environmental cues**

☐ Signage
☐ Visual display system
☐ Texture& materials
☐ Colour
☐ Map

- **Devices to help in wayfinding**

☐ Smart Phone
☐ Laser cane
☐ Devices to support navigation

Section 4: Lastly some questions about you

7. What is your age?

☐ 25-34 years
☐ 35-44 years
☐ 45-54 years
☐ 55-64 years
☐ 65+ years

8. What is your gender?

   ☐ Female
   ☐ Male

9. What is the highest level of education you have completed?

   ☐ High school Diploma
   ☐ Bachelor's degree
   ☐ Master's degree
   ☐ Professional degree
   ☐ Doctorate degree
   ☐ Other

10. What is your position title?
11. Do you consider yourself a person with vision impairment?
12. Where did you acquire your knowledge about planning grocery stores?
13. Please add anything else as a recommendation

Closing

Thank you for all of your valuable information,

If you have questions or concerns about the Survey or the evaluation please do not hesitate to contact me or my supervisor

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Appendix B: Delphi Survey Round 2

Delphi Study Survey 2
Low vision experts

The design was developed based on the data collected from the literature review and the Delphi study survey round one. The literature review discussed the following contexts: the science of vision impairment, the science of shopping and shopping behaviour, and wayfinding cues and techniques for visually impaired (VI) individuals. The Delphi study survey consists of six experts in low vision accessibility and four experts in grocery store planning. Each group is to identify the most probable concepts and operationalized variables of the physical environments of grocery stores that accommodate independent grocery shopping for visually impaired individuals. Two surveys were developed (one for each group of experts) to determine which physical features derived from the socio-ecological framework would address the five concepts for independent use of grocery stores by different levels of visually impaired individuals; these concepts would then be compared to the other set of factors associated with low-vision individuals'; expertise. Low vision experts addressed issues that linked individual factors of low vision with the physical environmental factors of shopping and store planners addressed issues that linked organizational factors of grocery stores with the physical environmental factors of shopping.

The design will present the environmental factors and features of the social ecological model (SEM) for visual impaired grocery store shopping relative to the five main themes: appeal/comfort, accessibility, convenience, legibility and safety. The proposed design was developed to be applicable for VI shoppers and their different range of vision Impairment.

The objective of the wayfinding model is to assist the wayfinder`s decision making process to navigate the center zone, find the needed aisle,

section, and the required shelf. The wayfinding model consists of 8 components as follow,

1. Aisle signage
2. Product signage
3. Metal transition stripes at the two ends of each aisle
4. Light projected floor numbers
5. Colored flags
6. Raised texts and numbers
7. Red Clip to code products on sale
8. Clear path ways

Figure 1 presents the 3D wayfinding model with these eight components. The image presents five aisles. The shelving system is gray and the product signage and the shelves' skirting is white. In addition, it uses vertical metal dividers to create different sections in each aisle. The floor for this design is light gray color with stainless steel floor stripes at both ends of the aisles. The lighting system consists of two types of lighting fixtures: general lighting fixtures and projected light (which will project the aisle`s number on the floor when the grocery store identifies VI shoppers in the store).

Figure 1: Center zone (aisles) with eight elements of design

1-Aisle Signage

The design proposes changes to the aisle signage by providing two numbers for each aisle; each number will identify the side of the aisle so it will be more convenient for the shoppers and VI shoppers to orient themselves and to know the products in relation to the aisle number.

Figure 2: Aisle signage

For example, if the VI shopper is passing in aisle 4, the aisle signage to the right side will show the aisle number (which is the number 4), and the types of products will be displayed on the right side of the aisle. The left side the aisle`s signage will show the aisle number (which is also the number 4) but will display the types of products on the left side of the aisle.

In addition, the design proposes changing the location of the signage to be over the end cap and within the eyelevel (180cm (70” inch)-220cm(86”inch). The aisle

numbers will be displayed in white on a green background. The aisle text (types of products contained within each aisle) will be displayed in white on a black background.

Please select what applies to the following themes. Please rank the following from 1-10, 10 is very important 1 is not,

1.1 Locating the aisle signage over the endcaps within the height range of 180cm-220cm will

☐ make the signage usable by VI shoppers as well as the general population
☐ reduce the vision effort needed since it is located within the vision range needed for VI shoppers
☐ be accessible for VI shoppers to read

1.2 Using the color contrast (black & green backgrounds with white text & numbers) will

☐ provide comfort in accessing the information (comfort/appeal)
☐ reduce the vision effort needed to access the information (convenience)
☐ will make the aisle signage usable for VI shoppers
☐ will reduce the time needed to find the needed type of products

1.3 The proposed design will be usable by the following people with different vision impairment, please check the box for all that applies.

☐Cataracts
☐Diabetic Retinopathy
☐Glaucoma
☐Macular Degeneration
☐Retinitis Pigmentosa (RP)

2-Product Signage

The design proposes adding product signage over each section in each aisle and this signage has an angle (30 degree), the signage will be located at the top end of each aisle the text will be in black and the back ground will be in white, Please rank the following from 1-10, 10 is very important 1 is not

Figure 3: Product signage

☐Adding product`s signage over the different sections will help VI shoppers and the general shoppers to find the needed sections with ease and with less time
☐The proposed color contrast will be legible and accessible for VI shoppers
☐The proposed angle will reduce the vision effort needed by the VI shopper to access the product signage information

2.2 The proposed design will be usable by the following people with different vision impairment, please check the box for all that applies.

☐Cataracts
☐Diabetic Retinopathy
☐Glaucoma
☐Macular Degeneration
☐Retinitis Pigmentosa (RP)

3- Metal Transition Stripes

It is very important for visually impaired shoppers to know when the aisle starts and ends. To aid VI shoppers, the design proposes using a metal transition stripes on the floor before entering and exiting from the aisles area, as per the 3D image. The floor's metal transition will

Figure 4: Metal transition stripes

function as a haptic wayfinding cue and a haptic landmark. VI shoppers will feel the floor's metal transition by either stepping on it or moving their carts over it. This will serve as an indicator that they are entering or exiting the aisles section. Please rank the following from 1-10, 10 is very important 1 is not

☐ The proposed element will be a haptic wayfinding cue for VI shoppers, as it will identify the two ends of the center zone
☐ The proposed element is a haptic landmark

3.2 The proposed design will be usable by the following people with different vision impairment, please check the box for all that applies

☐Cataracts
☐Diabetic Retinopathy
☐Glaucoma
☐Macular Degeneration
☐Retinitis Pigmentosa (RP)

4-Light-projected Floor Numbers

Using ceiling light to project aisle numbers on the floor is a digital element in the grocery store building environment. When a grocery store identifies a visually impaired shopper is in the store, a light from the ceiling will project numbers on the floor for each aisle, so the shopper will get to know which aisle they are in, and by the time they will get to know what products are available in each aisle. Please rank the following from 1-10, 10 is very important 1 is not,

Figure 5: Light-projected Floor Numbers

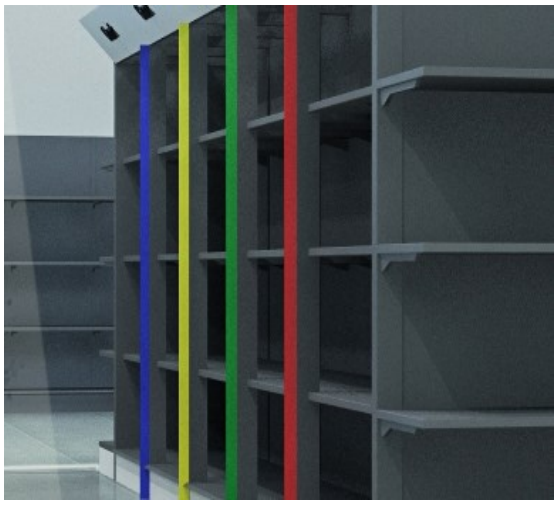
☐The light-projected floor numbers will help VI shoppers identify which aisle they are in

☐The light projected floor number will make the shopping journey convenient since it will make the shopper navigation more accurate, if VI shoppers were not able to access the information on the aisle signage the floor numbers will be more convenient and accessible since the number will be in large size

4.2 The proposed design will be usable by the following people with different vision impairment, please check the box for all that applies

☐Cataracts
☐Diabetic Retinopathy
☐Glaucoma
☐Macular Degeneration
☐Retinitis Pigmentosa (RP)

5-Using Flags to Color Code Sections and Products



The design proposes using flags to color code the aisles and some sections. These flags will be on the vertical dividers of the shelving system and 2" wide. Their purpose is to color code the products and aisles. For instance, baby blue flags is used in some sections to mark baby

Figure 6: Colored flags

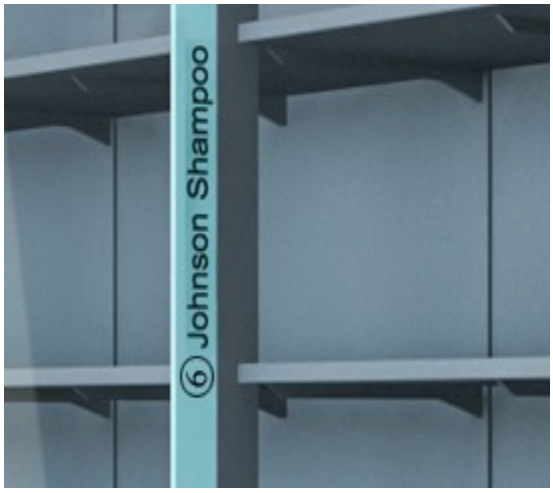
products in aisle number 6, the international food will have different colors in the same aisle so when the shopper pass by different colors in the same section will get to know that the aisle present the international food. Please rank the following from 1-10, 10 is very important 1 is not

☐The colored flags will code the products and will help VI shoppers to identify the different sections and the products easily
☐The colored flags will work as a wayfinding cue for VI shoppers

5.2 The proposed design will be usable by the following people with different vision impairment, please check the box for all that applies

☐Cataracts
☐Diabetic Retinopathy
☐Glaucoma
☐Macular Degeneration
☐Retinitis Pigmentosa (RP)

6-Raised Text and Numbers



6.1 The design suggested adding the product's name and aisle number on the colored flags beside each shelf; the print will also be raised to be convenient and legible for VI shoppers and will be depicted in the 3D model. Also, it will work as a haptic wayfinding technique. Please

Figure 7: Raised Text and Numbers

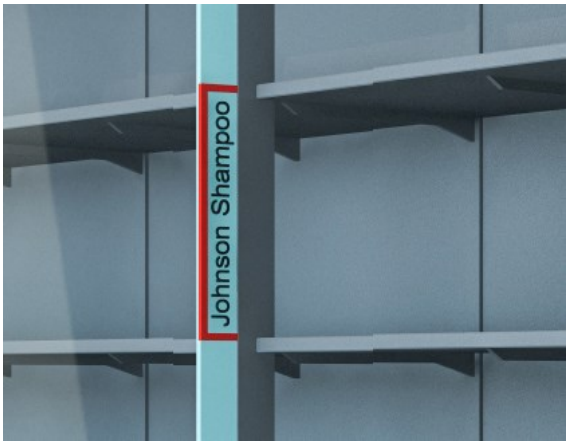
rank the following from 1-10, 10 is very important 1 is not,

☐Printing the product`s name beside each shelf on the colored flags will help VI shoppers identify the different types of products on each shelf.
☐Using raised text will make the information more accessible for VI shoppers
☐VI shoppers will use the proposed haptic wayfinding cue

6.2 The proposed design will be usable by the following people with different vision impairment, please check the box for all that applies

☐Cataracts
☐Diabetic Retinopathy
☐Glaucoma
☐Macular Degeneration
☐Retinitis Pigmentosa (RP)

7-Coding products on sale



Visually impaired shoppers are not able to find the products on sale easily; the design model suggests designing a red clip to be clipped on the colored flag beside the shelf that has products on sale. The 3D image will present the idea, Please rank the following from 1-10, 10 is very important 1 is not,

Figure 8: Coding products on sale

☐The red clip will be a wayfinding cue for VI shoppers to find products on sale in the different shelves

☐The red clip will enhance the shopping experience and purchase decision-making

☐The red clip will increase the unplanned purchase and the impulsive purchase for VI shoppers

7.2 The proposed design will be usable by the following people with different vision impairment, please check the box for all that applies

☐Cataracts

☐Diabetic Retinopathy

☐Glaucoma

☐Macular Degeneration

☐Retinitis Pigmentosa (RP)

8 Removing the free standing displays

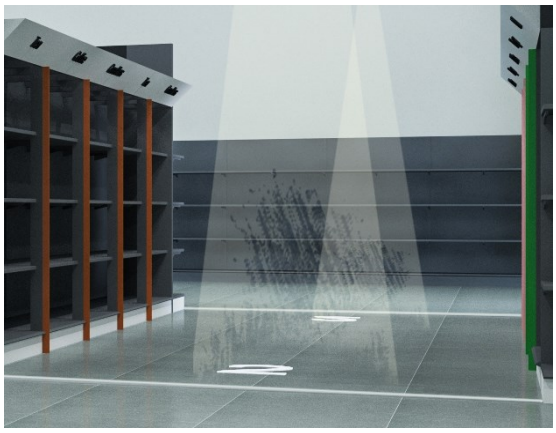


Figure 9: Clear Pathways

Safety is one of the main factors that should be considered while designing the building environment. Most grocery stores use freestanding displays in the pathways between different aisles, as per a previous ethnography to a visually impaired shopper do the grocery shopping, the shopper bumped the cart many times on free-standing displays and that made him feels unsafe in his shopping journey. Providing clear pathways with no free-standing displays or columns in the shopper's pathway in the aisles is very important. Please rank the following from 1-10, 10 is very important 1 is not,

☐Removing the freestanding display will increase the safety factor for VI shoppers

8.2 The proposed design will be usable by the following people with different vision impairment, please check the box for all that applies.

☐Cataracts
☐Diabetic Retinopathy
☐Glaucoma
☐Macular Degeneration
☐Retinitis Pigmentosa (RP)

Closing Questions

1. The design proposed 8 elements of design to create an independent shopping journey for VI shoppers. Please check the box for the elements that are the most important to create an independent shopping experience for visually impaired shoppers in grocery stores.

   ☐Aisle Signage
   ☐Product signage
   ☐Metal transition stripes
   ☐Light projected floor numbers
   ☐Colored flags
   ☐Raised text and number
   ☐Red clip for sale products
   ☐Removing the free standing displays

2. Please add anything else as a recommendation

Closing

Thank you for all of your valuable information, if you have questions or concerns about the Survey or the evaluation please do not hesitate to contact me or my supervisor

Appendix C: Preliminary Results
Survey 1

Guttman scaling (y)							
Ranking Scale 1-10 Questions							
Dichotomous Questions&filter questions: Yes/No (0,10) some has a rank							
Likert response scale (0,2.5,5,7.5,10)							
The senses as a wayfinding technique							
Sense of smell	***PL1***	***PL2***	***PL3***	***PL4***	***Av.***		
Sense of smell: Ambient scent is the scent that is in the environment but not emanating from a particular object. In grocery stores, is the pleasant scent that relates to each zone crucial in making shoppers spend more time in grocery stores and enjoy the shopping experience?	***LV1***	***LV2***	***LV3***	***LV4***	***LV5***	***LV6***	***Av.***
Yes, if yes what zones	10	10	10	10	10		
No							
Is the pleasant scent that relates to each zone will help people with vision loss to find the zone they are looking for more easily?							
Yes	10	2	10	4	10	10	7.7
No							
Is it going to affect positively their orientation and wayfinding technique especially if they have low vision?							
Yes	10	10	10	10	10	10	10
No							
Which sense do visually impaired people rely on the most to do their daily tasks?							
Hearing							
Touching							
Smell	5	5	7	5	7	8	6.2

Sense of Touch	PL1	PL2	PL3	PL4	Av.		
Is the touch sense (not related to products) helps visually impaired shoppers to recall some information about the space, orient, and wayfind the different sections in the zone easily?	LV1	LV2	LV3	LV4	LV5	LV6	Av.
Strongly agree							6.7
Agree	7.5	7.5	7.5		7.5	7.5	
Neutral							
Strongly disagree							
Disagree				2.5			
Do visually impaired shoppers are likely to shop their grocery where they can`t touch such as online shopping? If no, what are the challenges?							
Yes	10	10	10				5
No				0	0	0	
Which sense do visually impaired people rely on the most to do their daily tasks?							
Hearing							
Touching	5	7	9	8	8	9	7.7
Smell							
Haptic wayfinding: Haptic perception is the connection between dynamic movement and the sense of touch. It is a way in which shoppers are connected physically with the building's environment where they can modify or manipulate the world around them. Is it possible for the retailors to provide a multi-sensory environment within the grocery store to enhance the shopping experience for all shoppers?							
Yes, how?	10	10	10	10	10		
No							

Hearing sense	***PL1***	***PL2***	***PL3***	***PL4***	***Av.***		
Which sense do visually impaired people rely on the most to do their daily tasks?	***LV1***	***LV2***	***LV3***	***LV4***	***LV5***	***LV6***	***Av.***
Hearing	5	5	10	10	10	10	8.3
Touching							
Smell							
Is the different type of music in each zone is considered to be a cue for low vision shoppers to find the different zones easily?							
Strongly agree					10		5.5
Agree	7.5			7.5		7.5	
Neutral							
Strongly disagree							
Disagree		2.5	2.5				
Is the intense of music in the different zones will help visually impaired shoppers to recall some information about the space, orient, and wayfind the different sections in the zone?							
Strongly agree					10		5
Agree	7.5					7.5	
Neutral							
Strongly disagree				0			
Disagree		2.5	2.5				
Sense of hearing: The music in grocery stores has a positive effect on the store atmosphere and increases the shoppers' intention to purchase in grocery stores.							
Strongly agree							
Agree		10	10				
Neutral	7.5			7.5			
Strongly disagree							
Disagree							

Music positively affects the time perception for grocery store shoppers.							
Strongly agree	10		10				
Agree		7.5		7.5			
Neutral							
Strongly disagree							
Disagree							
We can have each zone of the grocery store use a different type of music in a way that all the music will not be blended together.							
Strongly agree			10		3.75		
Agree							
Neutral				5			
Strongly disagree	0	0					
Disagree							
For shoppers who have a disability or are from the aging population, the music in the different zones will help them orient themselves, recall some information about the space, and find the different sections in the zones.							
Strongly agree	10	10			8.75		
Agree			7.5	7.5			
Neutral							
Strongly disagree							
Disagree							

Enviromental Wayfinding Cues	*LV1*	*LV2*	*LV3*	*LV4*	*LV5*	*LV6*		*Av.*
	PL1	*PL2*	*PL3*	*PL4*				Av.
Light								
Use light as a wayfinding technique	10	2	1	9	7	9		**6.3**
	8	2	10	1				5.3
What is the most effective technique for visually impaired shoppers to use while they do their grocery shopping independently?	*LV1*	*LV2*	*LV3*	*LV4*	*LV5*	*LV6*		*Av.*
1.Getting Closer								
2.Eccentric viewing								
3.Use of strong Light	5	5	2	7	7	8		**5.7**
4.Use of colored Light	5	5	2	2	0	4		**3**
5.Contrast enhancement								
6.Wayfinding cues to be within the eye level								
Color								
If the grocery stores pathways have different colours and different materials for the different zones, will that improve the wayfinding for the low vision shoppers and the aging population?								
Yes	10	9	10	7	10	5		**8.5**
	9	0	10	10				**7.3**
Use different flooring colors for the different aisles one color for each Aisle	10	5	5	7	10	5		**7**
	8	8	1	10				**6.8**
Use different colors in the same aisle to identify the different sections	10	5	5	7	10	5		**7**
	6	1	10	1				**4.5**
Use different colors for the shelving system and use one light color for the floor	10	6	4	6	9	5		**6.7**
	9	1	5	5				**5**

The best wayfinding is to be based on, Please rank them according to their importance from 1 to 10 (1 = not important, 10 = very important).								
Signage Visual display syst em Texture& materi als Colour Map	8	8	7	6	8	10		**7.8**
	10	8	5	7				**7.5**
Signage								
Wayfinding cues to be within the eye level	10	9	8	7	9	10		**8.8**
Use information signage and to be at the eye level	10	9	7	8	10	10		**9**
	7	1	1	3	3			
The best wayfinding technique is to be based on, Please rank the followings according to their importance from 1 to 10 (1 = not important, 10 = very important). Environmental cues								
Signage	10	8	8	7	10	9		**8.6**
	9	8	10	10				**9.3**

Layout								
Remove all the free standing displays in the pathway between thedifferent aisles	10	3	7	6	10	9		**7.5**
	8	8	1	10				**6.8**
Increase the width of the aisles	5	3	2	5	**5**	10		**5**
	8	8	5	8				**7.3**
The circulation system in any building is a key element that organizes and connects the different spaces. People use this system to develop a mental map of the interior space of the building. In each box below, please assign a number from 1 to 10 that ranks the importance for shoppers regarding layout design and how shoppers can easily find their way through a grocery store (1= not important, 10 = very important). If a shopper has low vision, what is the best layout to help in his or her wayfinding?	***PL1***	***PL2***	***PL3***	***PL4***				
Grid	10	8	10	10				**9.5**
Texture and Material								
If the grocery stores pathways have different colours and different materials for the different zones, will that improve the wayfinding for the low vision shoppers and the aging population?								
Yes	10	9	10	7	10	5		**8.5**
	9	0	10	10				**9.5**
The best wayfinding technique is to be based on, Please rank the followings according to their importance from 1 to 10 (1 = not important, 10 = very important). Environmental cues								
Texture& materials	8	8	9	4	9	5		**7.1**
	7	6	5	5				**5.8**

Contrast								
What is the most effective technique for visually impaired shoppers to use while they do their grocery shopping independently?								
Contrast enhancement	10	9	9	8	8	10		**9**
Use large floor numbers and high contrast colors	10	8	9	5	10	5		**7.8**
	7	1	10	8				**6.5**
Furniture Design								
The centre zone is being one of the most difficult areas to wayfind for the aging population and visually impaired shoppers (since they have problems finding the needed zone and section because of their limited ability in building a mental map of the space and their low vision) to find the needed aisle, the section within theaisle, the shelf, and the right product								
Redesign the shelf talkers which contains the product price and brand	10	9	6	5	8	8		**7.7**
	4	10	7.5	5				**6.6**
Redesign the shelving system by adding dividers between the different sections	8	9	4	3	10	9		**7.2**
	8	6	6	2				**5.5**
Use markers to determine that the aisle begins and ends	10	7	3	4	5	5		**5.7**
	4	5	10	5				**6**
Use a tactile marker in the different sections in the shelves within the aisle zone	5	8	5	4	0	8		**5**
	9	8	7.5	8				**8.1**

Appendix D: Experts Bio

Grocery store Experts

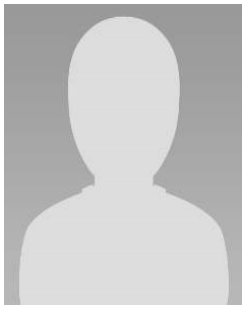
David Yehuda : DY Design is a retail design firm specializing in the food service industry. We have been committed to providing clients with top quality store design & decor for over 25 years. Our company takes pride in its ability to come up with unique design concepts, as well as increase profitabilty for our clients. We offer design packages including: layout, design & decor.

David Yehuda received his Bachelor of Architecture Degree in 1983. He has over 26 years' experience in developing concepts that combine space design & traffic flow within commercial environments. Within supermarket development, he believes the main goal has always been "customer convenience & joy", as well as increasing store profitability. David believes that the store owner is a significant part of the design team, because the store layout & design is a reflection of the store owner & it's environment.

Dan Phillips : Dan Phillips, Managing Partner at Phillips Enterprises, Inc., grew up in the retail/food service design industry. His father, Tom Phillips, has been producing grocery fixture layouts since 1970. After graduating from Johnson & Wales University in 2003 with a B.A. in Business Management, Dan and his father started Phillips Enterprises, Inc. as a consulting firm for independent grocers. Our company has experience in a vast array of concepts and sizes from small convenient-type stores, to medium-sized gourmet/high-end models, and even 100,000 SQFT big

box concepts. For contact information, demonstrated results, and additional assistance on our services we provide, please visit our website at www.foodmarketdesigns.com.

Lawrence Polyner : With almost 20 years of experience in Store Planning and Design, Larry has had the opportunity to work with many industry leaders to help build their business model and direct them towards future growth. It is Larry's innovative insight and ability to comprehend sequence and protocol that allows him to develop an adaptive and unique solution to each client's challenge.



Michael Farquhar (LCL)

Low vision Experts

Gordon Legge: Gordon Legge is Distinguished McKnight University Professor of Psychology and Neuroscience at the University of Minnesota, and director of the Minnesota laboratory for Low-Vision Research. Legge's research concerns visual perception with primary emphasis on low vision. Ongoing projects in his lab focus on the roles of vision in reading and mobility, development of adaptive technology for wayfinding by visually impaired people, and the impact of impaired vision on plasticity of the visual brain. He addresses these issues with psychophysical, computational and brain-imaging (fMRI) methods.

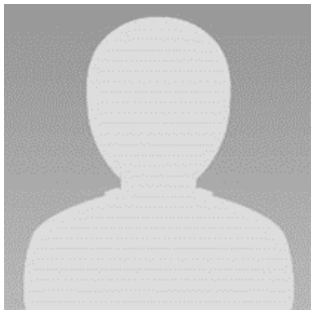
Melanie Taddeo: Melanie Taddeo is a certified special education teacher with 10 years' experience in program development, fundraising, community outreach, volunteer management, and public speaking. Melanie founded Connect 4 Life/Voices 4 Ability based on her personal experience of the lack of programs for people with disabilities that promote independence, and has made it her goal to help empower others.

Sambhavi Chandrashekar : Sambhavi Chandrashekar is an Adjunct Professor in Research and Graduate Studies with the OCAD University and a Sessional Instructor / Research Supervisor in their Master of Design program in Inclusive Design. She holds a Ph.D. in Information Studies from the iSchool, University of Toronto, complemented by two-years of postdoctoral research with the University of Toronto funded by a MITACS Elevate Industrial Postdoctoral Fellowship. She holds two Masters degrees–M.Sc. in Human-Computer Interaction with Ergonomics from University College London (UK) and M.Sc. in Chemistry from Indian Institute of Technology (IIT) in India.

Sambhavi's expertise lies in the area of designing information, communication and mobility systems accessible to persons who are blind or vision impaired. She has been working with the Adaptive Technology Resource Centre / Inclusive Design Research Centre since 2005, both directly and indirectly, on several research projects involving people with disabilities. She supervises a variety of student projects in the Master of Design program in Inclusive Design. She also works towards promoting the use of tablet devices as assistive technologies for people with cognitive and speech-language impairments through the design and development of appropriate software. Sambhavi was one of the expert evaluators of candidate implementations of the W3C's Web Content Accessibility Guidelines 2.0 prior to their publication in December 2008.

Leanne Cornell

Sumreen Siddiqui



Jenn Shull

Appendix E: Invitation / Consent Form

Invitation/Consent form

Invitation / Consent Form Template

Date: September 12, 2014
Project Title: Wayfinding system for visually impaired shoppers in grocery store

Principal Investigator:

Doaa Khattab, Student
OCAD University
905-334-4780/ dk13jf@student.ocadu.ca

Faculty Supervisor (if applicable):

Nicoll Gayle, Dean of The Faculty of Design
OCAD University
(416) 977-6000 Ext. 2922
gnicoll@ocadu.ca

INVITATION

You are invited to participate in a study that involves research. The purpose of this study is to design a model (wayfinding system) for visually impaired shoppers in grocery stores to help them find the center zone, orient between the different aisles, decide where to go, move easily between the different sections, and select products from the shelf with ease.

Many visually impaired people face considerable barriers while shopping in grocery stores. One such barrier is that they cannot find their way around easily; especially when they visit the grocery store for the first time and have not yet built a cognitive map in their memory. They may also experience delays in finding the right product or waiting for assistance from store employees, thus leading them to rely on family, friends, relatives, or volunteers to help them with their shopping. The problems start when these people are not available, in which case the individual is forced to cancel their visit to the grocery store and reschedule the trip.

Grocery stores include many different zones and services, the aisles area being one of the main barriers to access for people with impaired vision. This area features many different sections such as canned goods, dry packaged goods, spices, drinks and snacks, baking supplies, baby items, cereals, cleaning products, pet supplies, and health and beauty items. For visually impaired individuals, however, it can be hard to reach these various sections and to find the relevant products.
The purpose of this paper is to reduce the anger and frustration that people with vision impairment experience while shopping in the center zone (aisles area), by creating an innovative and accessible model for the aisles zone. This design proposes various adjustments to the current shelving system, as well as the flooring design, lighting, and signage. It therefore puts forward a model whereby visually impaired individuals can navigate the zone independently, find the section that they are looking for, the needed shelf and select products with ease.

Invitation/Consent form

WHAT'S INVOLVED

As a participant, you will be asked to participate in a Delphi study, the aim behind this study is to collect reliable information and to enhance effective decisions by store planners and accessibility experts for the proposed design, since there are no guidelines or accessibility building codes for people with vision impairment, Delphi study will be a great method to gather the experts` opinions for the design process.

Delphi study can be continuously iterated until achieving the needed result. For the research, two iterations will be used as follow:

1-Round one: the first round will be processed by structured questionnaire that asks a very structured questions about accessibility& Store planning requirements within the aisles area for the visually impaired users, and how can designers develop a design to fit the needs of the users and to be applicable in grocery stores. . After receiving the responses the model will be designed to meet the experts` direction.

2-Round two: each participant will receive the design model for their comments and feedback, a second questioner will be attached to the design to help in developing the model by getting more detailed information. In this round, experts will make further clarifications, adjustments, and be more detailed in their comments to develop the final model

The expected time for the first round is 30 min. The second round is 20 min.

POTENTIAL BENEFITS AND RISKS

Maybe there is no personal benefit in participating in this research, but the participants` contribution is important since it will assist in reducing the pain that people with vision impairment feel while they do their grocery shopping. Designing an innovative and inclusive wayfinding system is the objective of the study, people with vision impairment will benefit from the design as well as the grocery stores` owners.
One of the major objectives of grocery stores` owners is to increase the selling products by staying costumer focused. Accessibility& wayfinding in grocery stores will not only benefit people with vision impairment to shop independently and find the product with ease, but it will also benefit stores` owners by increase the number of shoppers as well as the number of selling products, in which it will draw more profit.

In the study, time and risk involvement is low to human subjects, no compensation will be provided, but the participants` contribution is really important to help in creating an inclusive community& barrier free shopping environment.

Invitation/Consent form

CONFIDENTIALITY

The information you provide will be kept confidential, i.e. your name will not appear in any thesis or report resulting from this study. However, with your permission attributed quotations may be used.

Attributing quotes

In the case that you would like to attribute statements/quotations, consider placing a check box for participants so that they can indicate agreement. Be sure to discuss with them what it involves in terms of potential risk and benefit.

☐ Yes, I wish to be attributed for my contribution to this research study. You may use my name alongside statements and/or quotations that you have collected from me.

Recording

☐ Yes, audio recording maybe used to ensure the quality of research and analysis stages

Data collected during this study will be stored in a hard desk. Data will be kept until the last week of (July, 2015) after July 2015 all data will be disposed Access to this data will be restricted to Principle investigator (Doaa) and the advisor of the research (Gayle Nicoll)

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study. Further, you may decide to withdraw from this study at any time, or to request withdrawal of your data (prior to data analysis), and you may do so without any penalty or loss of benefits to which you are entitled.

PUBLICATION OF RESULTS

Results of this study may be published in [select from among: reports, professional and scholarly journals, students theses, and/or presentations to conferences and colloquia]. In any publication, data will be presented in aggregate forms. Quotations from interviews or surveys will not be attributed to you without your permission.

Feedback about this study will be available by contacting:

-Doaa Khattab
Intern Architect-OAA
Masters in Inclusive Design (Candidate)
Email: dk13jf@student.ocadu.ca
905-334-4780

Invitation/Consent form

-Nicoll Gayle, Dean of The Faculty of Design
OCAD University
(416) 977-6000 Ext. 2922
Email: gnicoll@ocadu.ca

CONTACT INFORMATION AND ETHICS CLEARANCE

If you have any questions about this study or require further information, please contact the Principal Investigator **Doaa Khattab** or the Faculty Supervisor **Nicoll Gayle** using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at OCAD University. If you have any comments or concerns, please contact the Research Ethics Office through jburns@ocadu.ca.

CONSENT FORM

I agree to participate in this study described above. I have made this decision based on the information I have read in the Information-Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

Name: _____

Signature: _____ Date: _____

Thank you for your assistance in this project. Please keep a copy of this form for your records.

If you like to hear more about the study please check the box below,

☐ Yes, I would like to hear more about the study. You may reach me by (provide contact information):

Email:
Post:
Phone: