

Online Shopping and Web-Accessibility: Strategies to Ensure Equal Access to Blind Users in E-commerce Platforms

By

Nuzhat Jahan Samreen

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Abstract

Online shopping has become vastly popular and is easily accessible to people worldwide. Considering the accessibility criteria, many brands are yet to incorporate it into their online interfaces. Most brands have been following the trend of creating beautiful and appealing web layouts that are usable but not accessible to everyone. Most visually impaired Internet users rely on assistive devices such as screen readers or magnifiers to make websites readable and usable. Despite having accessibility guidelines for over a decade, disabled users still have problems using websites because of how the content is put out (Information Architecture). We as designers have a limited understanding of the challenges that blind users face while accessing the internet. Following my REB (Research Ethics Board) approval, participants were recruited and interviewed to help identify a list of issues they encounter while shopping online, which would then help in developing visual interface design solutions. The WCAG 2.0 (Web Content Accessibility Guidelines) rules would be assessed to address the accessibility issues raised, and new adjustments would be proposed to improve the existing guidelines regarding user experience and interface design.

Acknowledgement

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Introduction

Research Question and Objectives

The overarching goal of the research is to contribute to the field of accessibility by investigating the issues that blind users face when shopping online, providing design solutions for some of the most common problems, and supplementing existing web accessibility guidelines to address those issues. The research intends to solve the following research questions:

- What are the specific problems that blind and partially sighted users have while shopping online?
- What are the possible interface design solutions to the key problems in the blind users' experience?

The objectives are:

- To identify the differences between blind and sighted users while shopping online.
- To elicit and classify the range and diversity of user problems.
- To provide details of what causes the user problems.
- To assess how certain design solutions can solve the issues that blind users have on the internet to increase website accessibility.
- To review the current WCAG (2.0) guidelines and, if necessary, recommend additional changes.

Background

Researchers Peter Lennie and Van Hemel, both members of the Committee on Disability Determination, report that poor acuity (a vision that is not crisp), tunnel vision (seeing just the middle of the visual field), central field loss (seeing only the borders of the visual field), and clouded vision are all examples of low vision (also known as "partially sighted") (Lennie, Hemel, 2002). Some people with impaired eyesight use extra-large monitors and magnify system text and images to access the internet. Others use software or screen magnifiers to improve their viewing experience. Some people with limited vision also use extra-large monitors and enlarged system fonts and graphics to utilise the internet. Others employ screen magnifiers or software to enhance their viewing experience (Lennie, Hemel, 2002). Some people use specific text and background colour combinations, such as a 24-point bright yellow font on a black background, or select legible fonts for their vision needs, as mentioned by UX researcher Jurek Breuninger (2019).

Individuals with impaired vision may face various challenges on the internet, including difficult-to-navigate web pages, poor colour contrast, and the use of the wrong font size that makes it difficult to read. Amongst the essential parts of the internet, accessibility is the organisation of content so that users who use assistive technology can readily understand what is being shown.

There is a need to devise solutions that address the issues faced by blind people and improve their web experience. This might be accomplished by understanding blind users' challenges regarding the information architecture of the shopping websites they visit. Then, design solutions that effectively address these issues and improve the user experience can be presented. However, to recommend design solutions to the most common web challenges faced by blind users, a complete understanding of how specific design solutions can improve blind users' web experience is required. Access by everyone is one of the primary motivations for creating the world wide web (Berners-Lee, 1997). There are many reasons developers and designers should make their websites accessible to people with disabilities. From a business

standpoint, this means that websites can reach a larger audience and, as a result, increase the number of possible new customers. According to a recent survey conducted by CNIB (Canadian National Institute for the Blind), an estimated 1.5 million Canadians are experiencing vision loss, with another 5.59 million having an eye illness that could lead to vision loss (Blinch, 2013). As stated in article 19 of the UDHR (universal declaration of human rights), freedom of information is an inherent aspect of the fundamental right of freedom of speech, which includes the freedom to "search, receive, and impart information and ideas through any means and regardless of frontiers" (united nations, UDHR, article 19). Even though web accessibility has been widely studied for a long time now, there are different definitions of the concept found in the literature. There are various definitions of web accessibility from standards issued by international bodies, such as the web accessibility initiative (WAI, 2005) of the world wide web consortium (W3C) and the international standards organisation (iso 9241-171, 2008).

Definition of web accessibility	International Bodies
Web accessibility means that websites, tools, and technologies are designed and developed so that people with disabilities can use them (WAI).	WAI (Web Accessibility Initiative)
The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect. (Berners-Lee, 1997)	W3C (World Wide Web Consortium)
Guidelines for standards developers to address the needs of older persons and persons with disabilities. (ISO/IEC Guide 71:2014)	ISO (International Standards Organisation)

Table 1: Definition of Web Accessibility by various international bodies

One important consideration should not be overlooked before conducting studies investigating blind users' problems while shopping on online websites and apps. Almost all studies with blind users that look into the issues they encounter while online shopping is conducted with them speaking aloud to the researchers about each problem, they kept meeting. Although this seemed normal, many researchers like Shambhavi Chandrashekar, Tony Stockman, Deborah Fels and Rachel Benedyk have raised their concerns regarding this approach (Chandrashekar, Stockman, Fels, & Benedyk, 2006; Coyne & Nielsen, 2001), as it might not be the most appropriate method for blind users. To define 'thinking aloud,' it is a test where participants are asked to utilise the system while thinking out loud — that is, just verbalising their thoughts as they navigate the user interface (Nielsen, 1993). But there are many downsides to this approach, such as:

- Unusual circumstance. Unless they are a little odd, most individuals do not spend their days talking to themselves. This makes it difficult for test-takers to maintain the required monologue.
- Instead of reflecting on their experience and providing an edited commentary afterwards, users are expected to say things as soon as they come to their minds. However, most individuals want to appear intelligent, so there is a chance they will not talk until they have thoroughly considered the problem (Nielsen, 2012).

Alternative approaches should be considered as they may be better in drawing out problems with blind users on the web. Thus, these two points must first be considered before studies are conducted to investigate this research's main aims.

Relation Between Accessibility and Usability

Some of the standards refer to accessibility with usability properties. However, the relationship between accessibility and usability is still unclear. Different perspectives of this relationship can be found in the literature by researchers Helen Petrie and Omar Kheir (Petrie & Kheir, 2007; Shneiderman, 2002). Author Ben Shneiderman has proposed "Universal Usability," covering usability and accessibility problems. The definition of web accessibility by Thatcher et al. (2002) suggests that accessibility is a subset of usability. Usability problems imply that accessibility problems affect only disabled people without affecting non-disabled users. However, they also have stated that usability problems affect all users equally, regardless of ability or disability.

Petrie and Kheir (2007) have proposed a definition of web accessibility describing it in terms of usability characteristics, such as effectiveness, efficiency, and satisfaction.

They did a study with six visually impaired and sighted users to better understand the relationship between accessibility and usability. They looked at the issues that both user groups had. The study's findings revealed that the problems faced by both user groups could be divided into three categories: problems faced by sight-impaired users only (accessibility issues only), problems faced by sighted users only (usability issues only), and problems faced by both user groups. (Common universal usability problems).

According to the results, each group had discovered different problems, but problems also affected both groups. This result shows that usability problems do not encompass accessibility problems (Shneiderman, 2000, 2002) and that accessibility problems are not a subset of usability problems (Thatcher et al., 2002). As can be seen from the literature, issues in accessibility and usability are related, as there are problems encountered by each user group separately.

Accessibility in Relation to User Experience

The term user experience goes beyond the scope of usability and accessibility. User experience is a concept that starts with users and their relation to the technology and is often described with a variety of meanings ranging from usability to the beauty and emotions of using a system. Researchers, Hassenzahl and Tractinsky (Hassenzahl, Tractinsky 2006) suggest that user experience encompasses pragmatic and hedonic attributes. Pragmatic attributes embody qualities related to usability, such as effectiveness and efficiency. The hedonic attribute includes qualities pertaining to the user's emotional state. Hedonic quality refers to non-instrumental attributes such as aesthetics, innovativeness, and originality that have no evident relationship to the goal the user wishes to complete with the system. Previous research by Andre Pimenta and Christopher Power has focused on the problems and performance of blind users on the web and their navigation techniques and coping strategies, as well as the emotional aspects of users (Disability Rights Commission, 2004; André Pimenta Freire, 2012; Power et al., 2012).

An article by Amaia Aizpurua, Simon Harper, and Michael Vigo (2016) explores the relationship between web accessibility with different emotional user experience attributes. Web accessibility was measured by conformance of the website to the guidelines and the perceived accessibility of the website as rated by 11 blind users. For measuring user experience, the researchers used the AttrakDiff 2 questionnaire that measures the hedonic and pragmatic qualities. The results help to determine how users feel about an interactive product's usability and design. It analyses the participants' emotions using the emotion word prompt list by Helen Petrie (Petrie, 2010), which consists of eleven emotional words that the participants can rate. The study showed that perceived web accessibility is associated with most user experience attributes. A strong correlation was found between perceived accessibility and hedonic qualities, such as the website being professional, classy, inclusive, and presentable. This indicates that participants felt closer to the websites they thought were more accessible.

Regarding the relation between perceived accessibility and emotional words, it was found that there was a positive relationship between words with a positive meaning, such as happy, interested, pleased and a negative relationship to terms with a negative connotation, such as annoyed, bored, confused, disappointed, frustrated (Hassenzahl, 2004). It was found that websites that had conformed to the WCAG guidelines were known to be innovative, exciting, and original. In contrast, websites with lower conformance to the guidelines were typical, conservative, and non-inclusive (Hassenzahl, 2004). Overall, the study results suggest that accessibility, as perceived by the users, can affect a user's experience on the web. Thus, accessibility can be considered a critical quality measure for creating a better user experience on the web for blind people. This result highlights the importance of considering accessibility as a quality of users' experience with the website rather than a checklist property that a website conforms to. Moreover, this result suggests that if we want to create a better accessible user experience for everyone, the field needs to move accessibility from an assessment of technical accessibility standards, which is the most common method, to create great user experiences for everyone. Designers and developers should first understand the audience, which includes people with disabilities as well. Understanding the user's needs helps designers and developers to understand the diversity of accessibility needs. Researchers, Horton and Quesenbery, provided a framework of principles to help designers and developers to create accessible user experiences on the web. The approach is based on not retrofitting accessibility as the last checklist of additions to the website but incorporating accessibility through the design and development process of the website (Horton, Quesenbery, 2014, p. 49). They also mentioned that "accessible user experience brings the benefits of good user experience to people with disabilities" and can increase disabled users' satisfaction and enjoyment of the web (Horton, Quesenbery, 2014, p. 152). It was also pointed out that web accessibility approaches focused on technical compliance to guidelines are insufficient to ensure a quality user experience. To create a quality user experience for disabled people, brands should establish a practice that commits to accessibility adopted by every development team member (Horton, Quesenbery, 2014, p. 219).

Accessibility and online shopping

The rise of the digital world has presented us with a slew of new obstacles in accessing websites. Screen readers were accessible even before the first web browser was released in 1989. (Walden, 2016). One of the breakthroughs in web accessibility during this time was the establishment of the first accessibility rules in 1995, the same year Amazon was founded. In 1998, the World Wide Web Consortium (WCAG) 1.0 standard was released, the same year that Paypal was founded. The US government established regulations governing the accessibility of federal government websites in the year 2000. The province of Ontario enacted legislation on the subject in 2005. The WCAG rules were added in the second version, released in 2008. The Government of Canada's Web Accessibility Standard, which went into effect on August 1, 2011, requires all government websites and web apps to meet the WCAG 2.0 Level AA requirements (Doyle, 2020).

Understanding Assistive Technology

Blind and visually impaired individuals can and do use computers, phones, and other electronic devices the same way that sighted people do. Blind people use alternate methods to use these technologies. To connect with high-tech products, blind individuals need assistive technology such as screen readers, refreshable braille displays, and digital screen magnification. Any hardware or software used by persons with disabilities to use computers, phones, tablets, and printed documents is referred to as assistive technology. Screen readers are used on desktop and laptop computers. Users who are blind or visually impaired can navigate the computer and access most of its features using software such as JAWS® (Job Access with Speech) for Windows and NVDA (Non-Visual Desktop Access). Instead of using a mouse to travel around the screen, blind people utilise a key command system to reach the elements on the screen. Some screen readers can also send content to a Braille display that can be refreshed. The navigation of the web page is done with keystrokes. The tab key can

browse from link to link if the user does not want the screen reader to read the complete contents.

JAWS is a popular screen reader for the Windows operating system created by Freedom Scientific. All Microsoft and IBM Lotus Symphony applications are compatible with JAWS (Freedom Scientific, n.d).

Adobe Acrobat Reader, Firefox, Internet Explorer, and various other software systems are all compatible with JAWS. Text can be sent to an electronic Braille device using JAWS (Common Sense Media, n.d). JAWS use many hotkeys and key shortcuts. This helps a significant amount of learning to become familiar with the software. JAWS can handle dynamic content such as flash media and provides an overview of the table by reading aloud the number of rows and columns in the table when reading tabular text. The current version of JAWS can read out the number of regions, headings, and links on a page to provide a page summary to some extent but it is comparatively an expensive software. A single license costs 1200 CAD currently. As a result, not everyone can afford JAWS without government or insurance assistance.

Other main screen readers include Window-Eyes, VoiceOver, Speakup, and Thunder. The University of Washington created WebAnywhere, a web-based screen reader (King, n.d). This online screen reader can help visually impaired people who cannot afford a full-screen reader. Screen readers would not be installed on most public computers because they are expensive. Because of this, users who are blind can use WebAnywhere to browse the internet via any device through this link <http://webanywhere.cs.washington.edu/wa.php>.

Audio feedback can be provided through screen readers, and they can also be connected to refreshable braille displays. Refreshable braille is a type of braille that may be read using an electronic device. Pins on a device show up and can be read like print braille with a finger. The pins drop after the reader finishes reading a line and pop up again when the following line in the text is read. People who are deaf or blind and cannot use text-to-speech output benefit from refreshable braille displays (Wonderopolis, 2020). Blind users use screen readers on touch screen phones and tablets. All the content on the screen, including navigation buttons, is read aloud by this type of software. Talkback is an app for Android devices. VoiceOver is a built-in feature

on Apple iOS devices that converts text to speech. Text-to-speech is a synthesised voice that reads aloud what is on the screen. On a phone or tablet, there are a variety of hand movements called "gestures" used to do various functions. For example, tapping three times on the screen with VoiceOver provides you with an auditory indicator of where you are on a page. The link or object indicated by the cursor is selected by tapping twice anywhere on the screen.

These are just a few examples of how blind or visually impaired people utilise computers, phones, tablets, and other forms of technology. Assistive technology advancements have made it more possible for blind and visually impaired persons to learn, compete, and communicate equally with their sighted peers. Many blind users are more hooked to their electronic gadgets than sighted people due to the rising ease of getting information and interacting.

Methodology

The primary purpose of this study is to compile a list of issues that blind online buyers face, as well as the types and frequency of such issues. The four processes used to accomplish the results are research, preparation, organisation, analysis, and design. My target users ranged in age from 16 to 55, and they were all from Ontario, making it easier for me to contact them in the future if necessary.

Solutions that correctly address their challenges were designed to provide a better web experience for blind users. This was done by recognising the challenges that blind users encountered regarding the information architecture of the E-Commerce websites they frequented. Then, to address these concerns and improve the user experience, appropriate design solutions are offered in the Initial Exploration section. Research methodologies included conducting online interviews, surveys, and virtual participant observation. Virtual meetings are now being used to conduct user research that formerly required researchers to sit face to face with their participants and interview them. This gives a solution and saves a lot of time and money when preparing a project budget.

After receiving approval from the REB (#2022-05), a list of questions was selected for the interview (Refer to the questionnaire in Appendix: A). Testing this set of individuals is, for the most part, the same as testing any other. While conducting these interviews with participants who were blind and had poor vision these were a few factors that I kept in mind (Stewart, 2021) to make things easy for everyone involved.

- I ensured the testing materials met the accessibility criteria by using a more prominent font size colour contrast and ensured that every bit of the content was easy to navigate through a keyboard.
- Allowed participants to use their assistive technology by guiding them through the testing materials beforehand.

I provided the same set of websites for testing, which allowed for comparisons between the characteristics of problems they encounter, the frequency of those problems, and their perceived severity by them.

The primary target audience of the study were users who were fully blind and users who were partially sighted or had low vision. They have diverse ways of interacting with websites, which results in them encountering several types of problems. Qualitative approaches and Inductive Analysis were used to find out the behaviour of people with vision impairment when exploring various online shopping websites. I chose to use qualitative methods for a variety of reasons. Without preset material from the literature, the qualitative technique was used to explore and comprehend the complicated demands and behaviours of the users in this study. This method also helped me capture the perspective of the visually impaired users directly in a way where I could develop unique explanations that were specific to them instead of trying to fit their behaviour into already existing frameworks and theories. Inductive analysis was used to determine the browsing behaviours drawn directly from the participants (Thomas, 2003). I attempted to reveal and provide more insights regarding their issues, perceptions, and ease of use while shopping online.

These two goals were kept in mind while carrying out those methods: (a) to explore and identify the different browsing patterns of blind and partially blind users using various online shopping websites; (b) to develop a theoretical design guideline specifically for brands that would make the online shopping experience much easier for everyone. The participants were asked which websites were the most and least accessible to navigate, and their feedback served as a base for producing guidelines and a prototype.

Participants

Participants of this study were recruited to determine the list of problems that they face while shopping for products online. This helped me to gain a better understanding of what the solution to the issues can be.

For the study, I decided to limit to an age group between 16 to 60 years old who live in Toronto and who have a previous online shopping experience. To recruit the study participants, I began contacting administrators of active virtual blind communities in Toronto to obtain their permission to publish or distribute the recruitment posters. These communities included websites of self-advocacy groups, forum-based communities, and Facebook groups. Six people reached out for more information after seeing the recruitment post. Out of these six, three completed and returned their consent forms, agreeing to proceed with the interviews.

The study enlisted three adults—Wendy, Mohammad, and Hersha—who are members of The CCB Toronto Visionaries, a local chapter of the Canadian Council of the Blind (CCB). From the beginning of the study, all three gave their consent to be identified with their names. All three co-creators identified themselves as partially blind or with low vision. Wendy is currently the social media coordinator at CCB Toronto Visionaries; Mohammad is a recent master's graduate from Centennial College, and Hersha works at Apple retail and has a blog where she writes about how committed she is to instruct people who are blind or have visual impairments to become more self-sufficient and adapt to their circumstances. All three participate in other online communities focused on their interests, such as cooking, electronics, and music.

Upon completing the interviews conducted online, participants were thanked for their time and contribution with an electronic gift card (value of 30 Canadian dollars) for the store of their choice for their time and assistance.

Data Collection

Because of the pandemic's remote nature, all interviews were conducted online via Zoom, often regarded as the most accessible collaboration platform. Each participant met with me for an hour and a half to go through the interviews and then completed a brief survey that I had sent them following their appointment, which they could meet at their leisure. All talks were recorded for the data collection and analysis methods mentioned in the following sections. Our discussions revolved around how effective today's E-commerce platforms are and what problems they encounter when using them.

Data Analysis

All three of the participants were asked the same set of questions during their interviews online (Refer to Appendix), and each of their interviews was later transcribed and coded to find similar themes between them. The coding followed the following list of themes:

- Reliant on technology.
- Use of Screen Reader.
- Screen reader accessible.
- Online shopping.
- Inaccurate image descriptions.
- Utilise alt-text for images.
- No detailed description of the product.
- Walmart is the most inaccessible app.
- Drop-Down menu.
- Bigger Buttons.
- Search button in the middle.
- Minimalist layout.
- Ability to use image descriptions one-handed as it can be a bit awkward to use the three fingers single tap motion.
- Grocery apps do not show an expiration date.
- Incorrect app layout.

- The illogical sequence of forms.
- Feedback forms should be included in the customer support section.
- Small spaces for interaction.
- Time limits at checkout.
- Poor on-site search engine.
- Persuasive copy.
- Search auto-complete is not forgiving of typing errors.
- Complex check out and return process.
- Bigger font size.
- Scanning QR Codes on products.

A brief survey was sent to them before the interview, the results of which are highlighted in Figure 1.

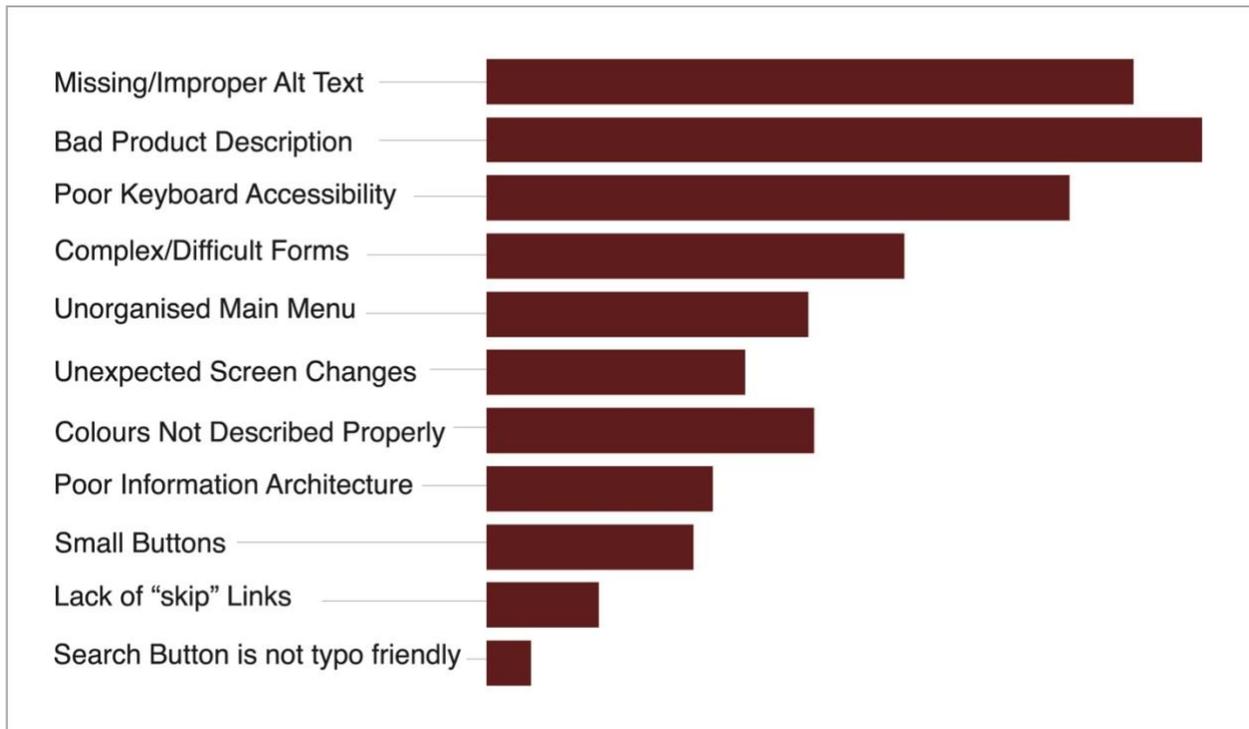


Figure 1: Survey results regarding elements of websites that cause problems in their online shopping journey

Summary: After analysing the problems mentioned above, for a blind user navigating through web content is difficult. Navigation structures like menus appeal to sighted users while creating much trouble for the vision impaired. Most navigation menus nowadays use JavaScript and CSS (Centre for Sensory Studies) for their pleasant look. Menus that expand on mouse hover use JavaScript. In the case of such menus, the submenu is inaccessible for a screen reader user. The navigation menus are read just as hyperlinks, so for a blind person, it is difficult to recognise the hyperlinks constituting the navigation menu (Refer to Part 1: Understanding Assistive Technology). When a screen reader is used, many websites, read lots of hyperlinks before reading the hyperlinks in the main navigation menu. The main navigation menu and submenu about the selected menu item are read as two separate lists by the screen reader on some websites. The blind user cannot identify the relation between the main menu and submenu. Menus with many items are also a problem for blind users since they will not be able to memorise the whole thing to perform effective navigation. Navigating through tables is extremely hard for a blind user. They will not be able to distinguish between a layout table and a data table if the data table does not have a proper title. Tables containing HTML elements like hyperlinks offer an additional challenge in navigating between web pages. In such cases, frame navigation by them will not be helpful since buttons and hyperlinks can be reached using other shortcuts.

Accessibility Problems in E-Commerce Websites

As previously stated, E-commerce websites, particularly online shopping websites, are significantly less accessible than other websites. According to the findings of the WebAIM survey, many blind users avoid online shopping websites because they are too complicated for them (WebAIM, 2021). It is worth noting that only one online shopping website was determined to be universally accessible in Researcher T. Sullivan and R. Matson's analysis of 50 major websites (Sullivan, Matson, 2000) which was Amazon's website (www.amazon.com). Even for a sighted person, online shopping websites can be complicated, so picture the difficulties a blind person will have while engaging with them.

Mohammad Waliul Islam, a visually challenged person, and a skilled computer user told me in one of the interviews that he once spent three hours searching for a portable hard disc on an online page and was unsatisfied with the web experience. The accessibility issues addressed in the preceding sections also apply to online purchasing websites. However, these websites have certain unique issues that make them more difficult to use than others.

After the interview with all three of the participants, of the two websites Walmart was chosen unanimously as the least accessible website of all. I asked all of them to go through the website while being on the call so I could identify their behaviour and patterns. I also asked them to go through the Williams Sonoma website, which is a retail website for kitchen supplies and home furnishings, something which all three of the participants confirmed that they buy online.

Website Navigation

Specific issues that complicate online purchasing websites are mentioned in this section. Only a few issues that I believe are extremely important are mentioned. The navigation menu is overly complex on most websites. The main menu itself will contain numerous items, and each item in the main menu will have numerous items in its submenu again. Most websites have an extremely complicated navigation menu. The main menu will contain many items, and each item in the main menu will have a submenu with even more items. The navigation menu from the Walmart Canada website is used to explain this issue. Below is a screenshot of the submenu items that correlate to the main menu item, 'Clothing.' A sighted user can simply navigate the primary menu items on the left panel of the web page. They can select a department from the main menu, and when they hover their mouse over that item, a submenu appears. The submenu, as shown in Figure 2, is extensive, occupying the entire page. The elements in the submenu are divided into categories once more. A sighted person will have little trouble navigating the main menu and its submenus to locate the department and sub-department that corresponds to the product of their choice. The navigation menu in this example is inaccessible to screen readers. The items in the main menu are not available when using the shortcut key to go through hyperlinks. When the screen reader is reading line by line, the items on the main menu are only read out. Instead of listing the items in its submenu, pressing the enter key after picking an item from the main menu opens the web page for that department. The main menu only displays submenu items when the mouse has hovered over them, something a blind user cannot do.

The elements in the submenu are divided into categories once more. A sighted person will have little trouble navigating the main menu and its submenus to locate the department and sub-department that corresponds to the product of their choice. The navigation menu in this example is inaccessible to screen readers.

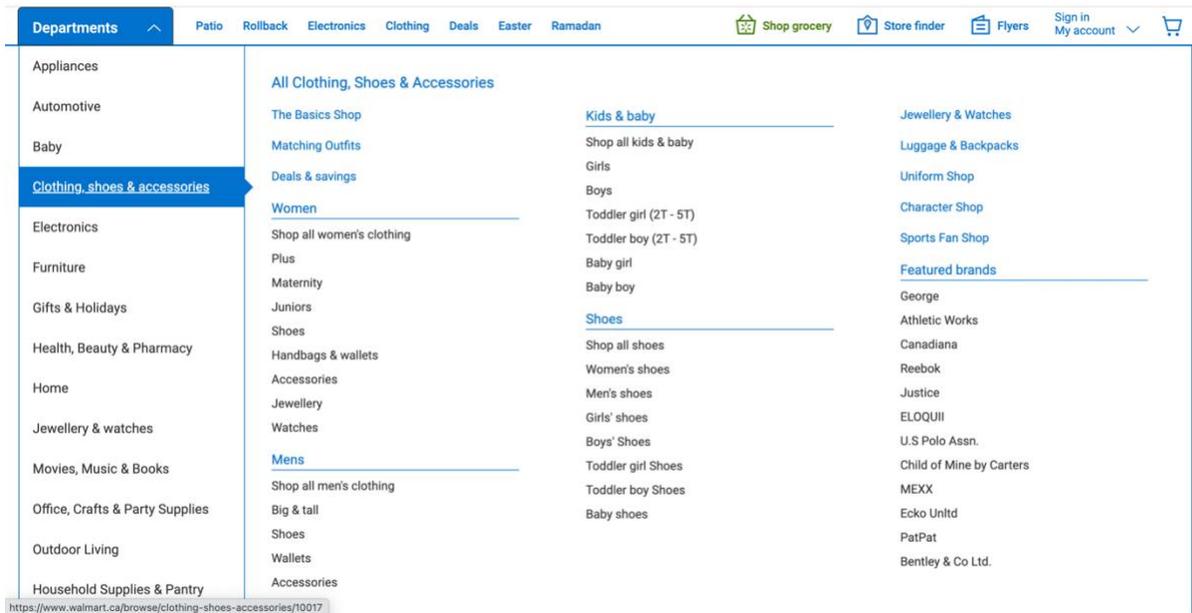


Figure 2: Screenshot showing navigation menu from Walmart, Canada website.

The items in the main menu are not available when using the shortcut key to go through hyperlinks. When the screen reader is reading line by line, only the items in the main menu are read out. Instead of listing the items in its submenu, pressing the enter key after picking an item from the main menu opens the web page for that department. The main menu only displays submenu items when the mouse has hovered over them, something a blind user cannot do.

Because there are so many items in the main menu and submenus, website navigation menus are extremely complicated. As a result, going through the navigation menu to identify the product of interest is a time-consuming operation. Unless someone is familiar with the website, they may have to navigate through the major menus and submenus several times to discover the product of interest. Furthermore, most of the navigation menu is unreachable using the keyboard, adding to the difficulty level.

Information Search Difficulties

It is frequently difficult to locate needed information on online buying platforms. If a blind user wants to buy something or search for something, it is much easier to use the search tool rather than travelling through numerous departments. If the user knows the product name and brand name, the search result will be more refined, and the number of things presented will be reduced. When a user searches for more broad terms, such as 'cutlery set,' the resulting set may contain several hundred items. It will be quite difficult to select the necessary item from the list, as it may necessitate navigating through multiple pages. All three participants were asked to go through the Williams Sonoma website and search for a 'cutlery set' to illustrate the difficulty to search for products using a screen reader. A sighted user can simply navigate through the search results, which cover several pages. Some information, such as price, product name, and ratings, can be gathered by glancing through the search results. Images of the product also provide a wealth of information about it. A sighted user will have no trouble navigating between pages to check the complete set of results. They can easily return to the search result page after selecting things in the result set to review the information.

Participant's point of view: While performing line by line reading, before reading the contents in the search result, the complete hyperlinks displayed in the top section and the contents in the left pane are read out. When the items from the search result are read out, alternate text for images, hyperlink text and other information displayed are conveyed to the user. Going through the entire result set line by line will take a long time. Moreover, the blind person needs to select a particular item and access a new page to get the details. Traversing between pages is a challenging task for a screen reader user. So going through the entire search result is extremely tedious. If the user navigates through hyperlinks, only the product description available as a text for the hyperlink link will be read out. So, the tactics of traversing through hyperlinks will not be useful.

Exploring the items in the search result is a tedious task for screen reader users. Most of the information displayed will be read out only when one performs line by line reading.

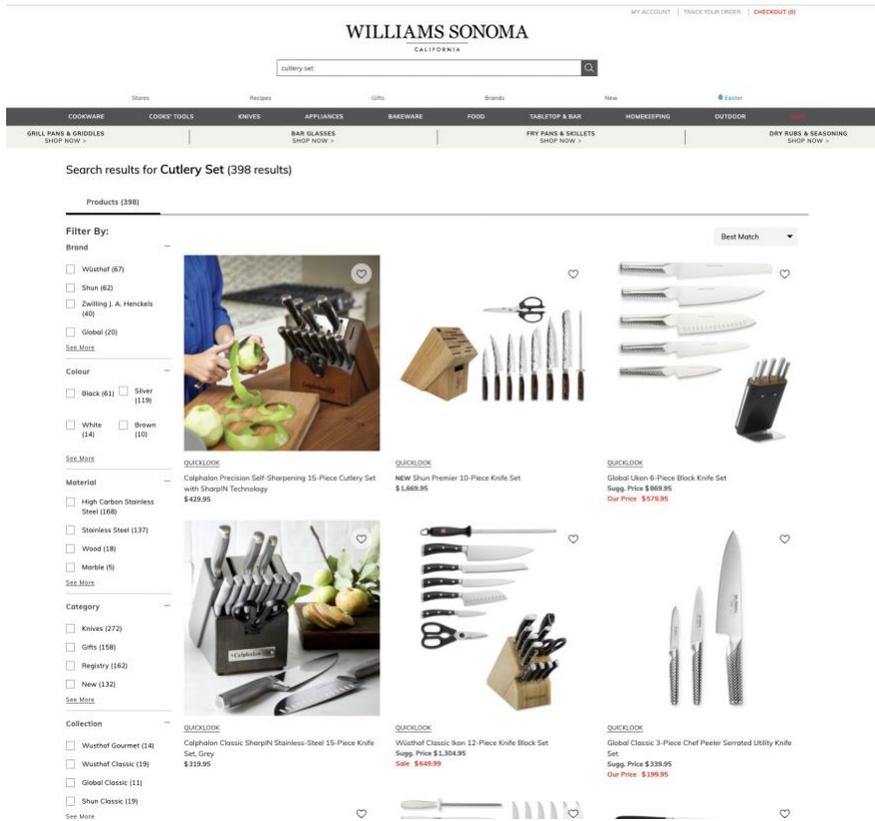


Figure 3: Screenshot showing search result for cutlery set from the Williams-Sonoma website

Presence of more Images and Graphics

Images and graphics are used to display vital information on online buying websites. Many online shopping websites contain picture slide shows that condense crucial information such as exclusive discounts and new product arrivals. These visuals and graphics are appealing and simple to utilise for a sighted user. However, most graphics, photos, and slide displays are less accessible to screen reader users if they do not adhere to web standards. One main problem identified with images on online shopping websites is that most of the text which is printed in the image is not conveyed in the alternate text.

The main problem with image and graphics content is that alternate text is rarely available. Some of the graphic links are also inaccessible when hitting the enter key. The slide shows are also difficult to navigate, and the buttons or links placed on the photos in the slideshows are not accessible by keyboard. The alternative text for these buttons is frequently uninformative. Another issue is that the alternate text does not convey the content printed in the image.

Initial Exploration

After analysing the data gathered from the semi-structured interview, the website analysis, and the survey, an affinity map diagram was created to highlight the major themes found after data analysis.

Affinity Mapping

Affinity Mapping helped me to organise all the information into three separate groups. The first group is categorised as all the major User Interface elements that were deemed problematic to the participants—the second category is about how to improve the user experience journey for them. And the third is categorising all the significant problems that were identified by them.

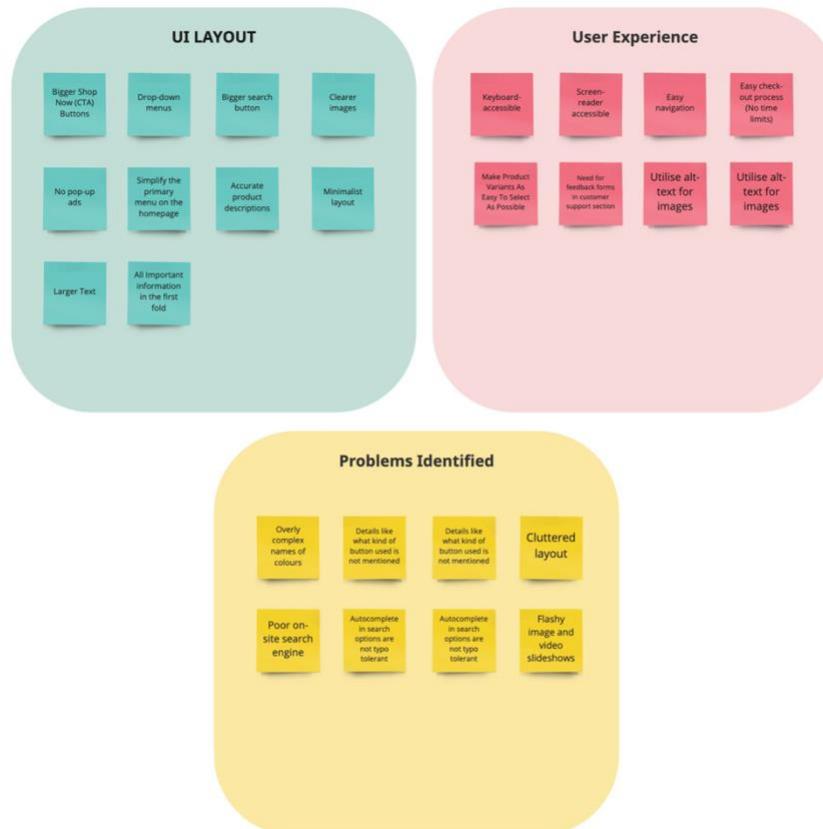


Figure 4: Affinity Mapping

User Personas

To further help me develop solutions for making E-commerce accessible to blind users, I created three user personas of the participants I interviewed.

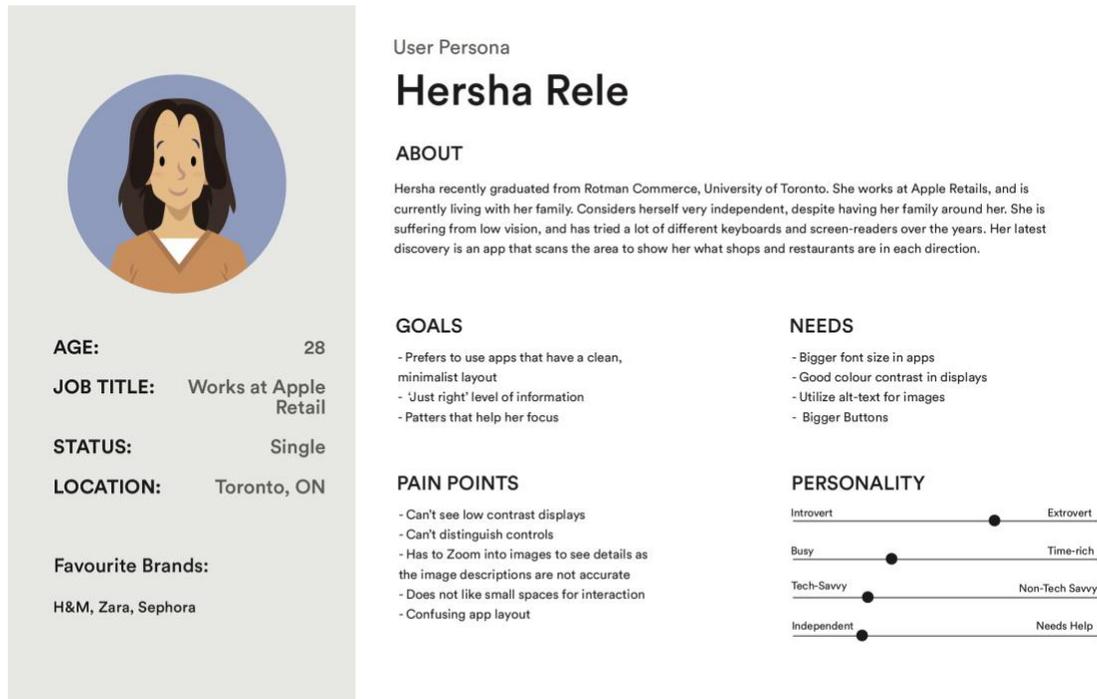


Figure 5: User Persona for Hersha



AGE: 36

JOB TITLE: Social Media Coordinator

STATUS: Married

LOCATION: Toronto, ON

Favourite Brands:
H&M, Amazon, President's Choice App

User Persona

Wendy Hoang

ABOUT

Wendy is a social media coordinator at CCB Toronto Visionaries. She is married and lives with her daughter and husband in Toronto. Her family helps her in dropping in groceries and other supplies for her, and has never gone shopping in-person by herself. Considers herself to be a very tactile person. Has Degenerate Myopia and extreme near sightedness since she was 4. Wears thick glasses but does not require cane. Her vision has gradually worsened, and she is completely blind on her right eye. Loves shopping online, and requires assistance by her daughter a lot of times because she is more tech savvy.

GOALS

- To be able to shop online in websites where the product descriptions are accurate.
- Be able to use applications on her own without any assistance.

PAIN POINTS

- Difficult to find the shape and details of outfits she wants to buy.
- Items not matching the description when she orders them online.

NEEDS

- Looking to shop from brands where the customer journey experience from adding to cart to check-out is easy.
- Simple and effective controls
- Bigger Buttons on apps

PERSONALITY



Figure 6: User Persona for Wendy



AGE: 48

JOB TITLE: In-between part-time jobs

STATUS: Married

LOCATION: Toronto, ON

Favourite Brands:
Amazon, Winners, Best Buy

User Persona

Mohammad Waliul Islam

ABOUT

Mohammad is a recent Master's Graduate from Centennial College, and is working as an advocate for the blind for TD. Has Retinitis pigmentosa. He is married with two kids, all of them stay in Bangladesh. He's a bit of a gadget geek, always trying out new tools, looking for a little edge and something new. The last few years have been a lot of fun with all the new apps, and VoiceOver on his Mac and phone lets him use most of them pretty well. He likes the challenge of learning new tools.

GOALS

- Relies on sites and apps that are built well
- Ability to use image descriptions one handed as it can be a bit awkward to use the 3 finger single tap motion.

PAIN POINTS

"When a website is not accessible, or I run into broken links or forms, it's really frustrating. Sometimes I miss important information because it's hidden from my screen reader. Or I have to spend a lot of time figuring out what's going on. I just want to be able to do things for myself, and when sites are broken, I can't."

NEEDS

- Feedback forms to be included in customer support section
- Search autocompletes at websites to be typo tolerant.
- Persuasive copy for products

PERSONALITY



Figure 7: User Persona for Mohammad

Wireframes

Below are the different wireframes that I created to iterate the next steps of developing the visual aspects of the guideline.

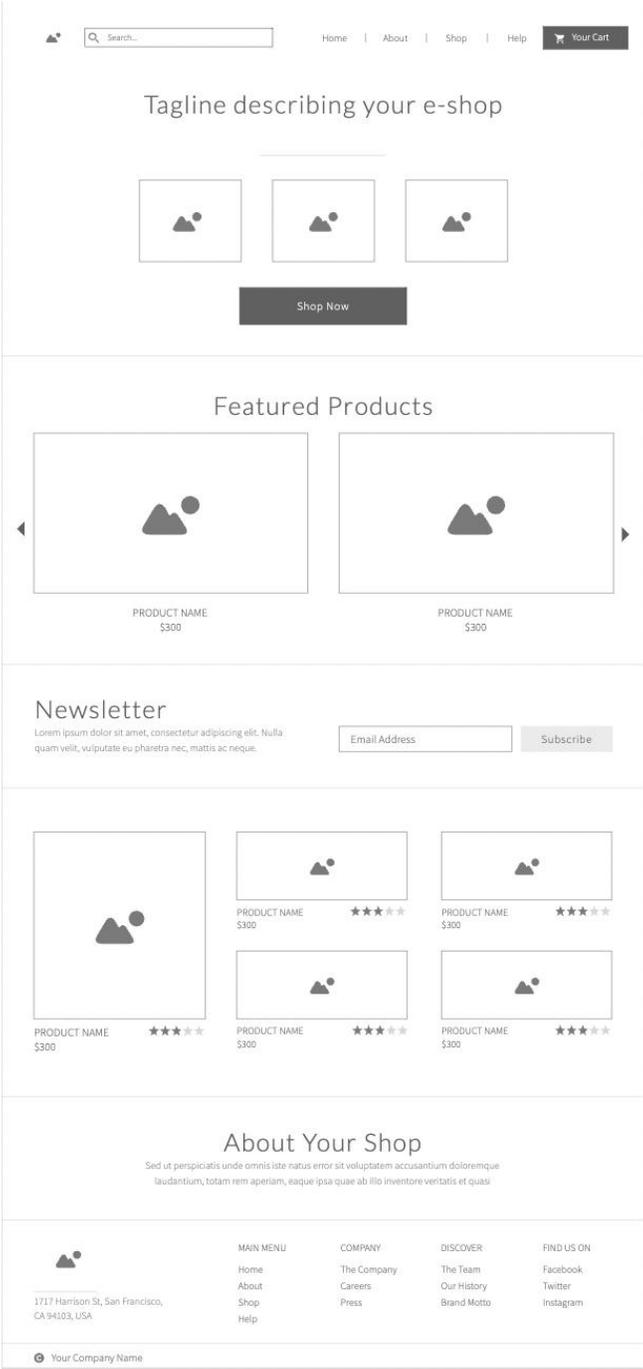


Figure 8: Wireframe of the Landing Page

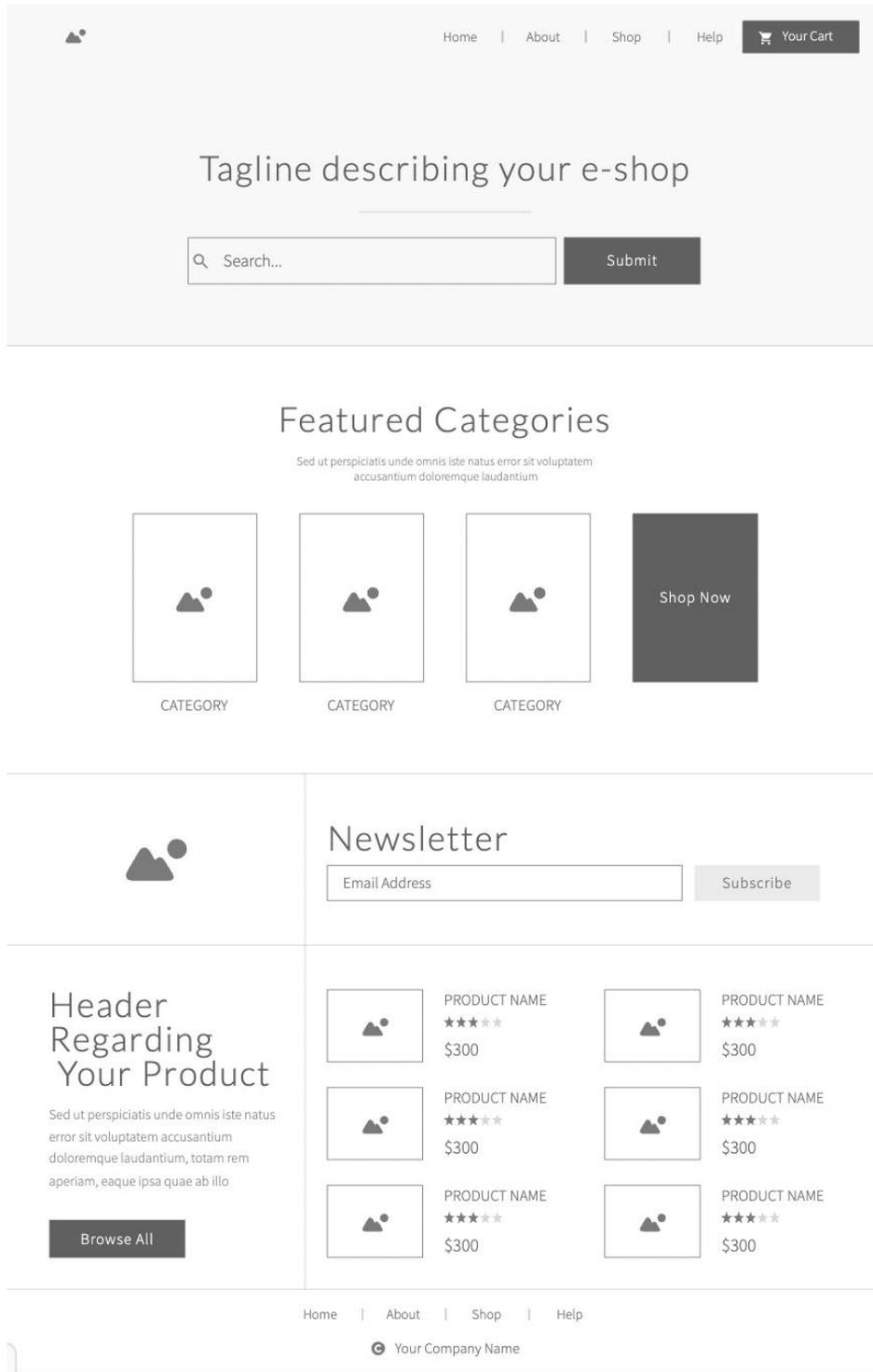


Figure 9: Wireframe of the Home Page

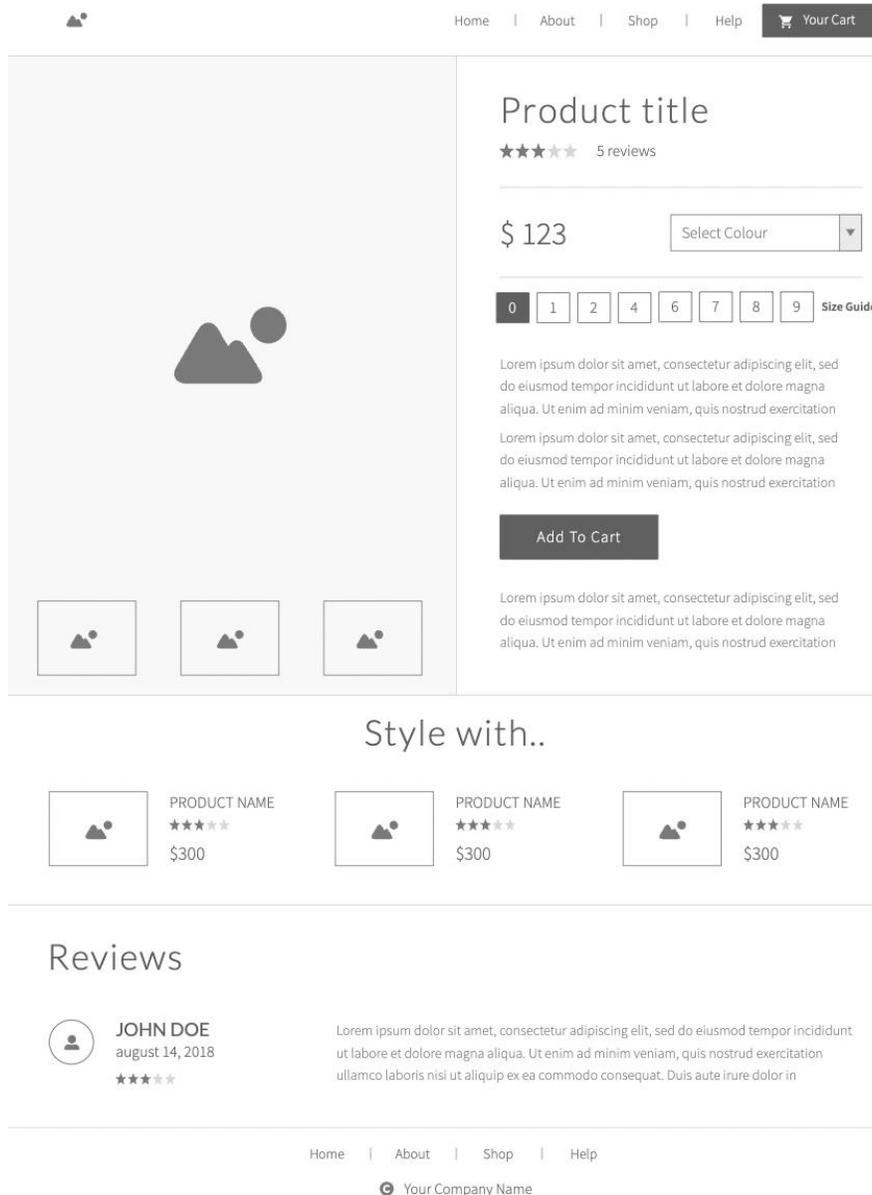


Figure 10: Wireframe of the Product Page

The wireframe in Figure 10 highlights the product page of the website, with an accurate image description and the most pertinent details all at once on one page itself. The more time visitors spend looking for critical information about a product, the more likely they will abandon their search and go to another retailer.

Shipping charges and delays put many buyers off, and sadly, too many e-commerce companies wait until checkout to inform them of these prices and delays. As a result, 63

per cent of online shoppers abandon their shopping carts due to shipping prices, while 36 per cent do so due to the time it takes to get their products (Statista, 2021)

These are not the only details that online customers want to be aware of before purchasing. They are also curious about:

1. The policy on returns and refunds
2. The terms and conditions of use and the privacy policy
3. The available payment options
4. Online and offline purchase-and-pickup options are available

These options are designed on the product page in the interface solutions proposed from page 40 onwards.

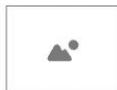


1. Shopping Cart

2. Shipping Details

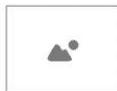
3. Payment Options

Shopping Cart



PRODUCT NAME
Lorem ipsum dolor sit amet, consectetur
\$300

1 pcs



PRODUCT NAME
Sed do eiusmod tempor incididunt ut labore et
\$300

1 pcs

Next

Cancel

Summary

ENTER COUPON CODE

SUBTOTAL	\$600
SHIPPING	FREE
TAXES	\$13
TOTAL	\$613

Figure 11: Wireframe of the Product Shopping Cart

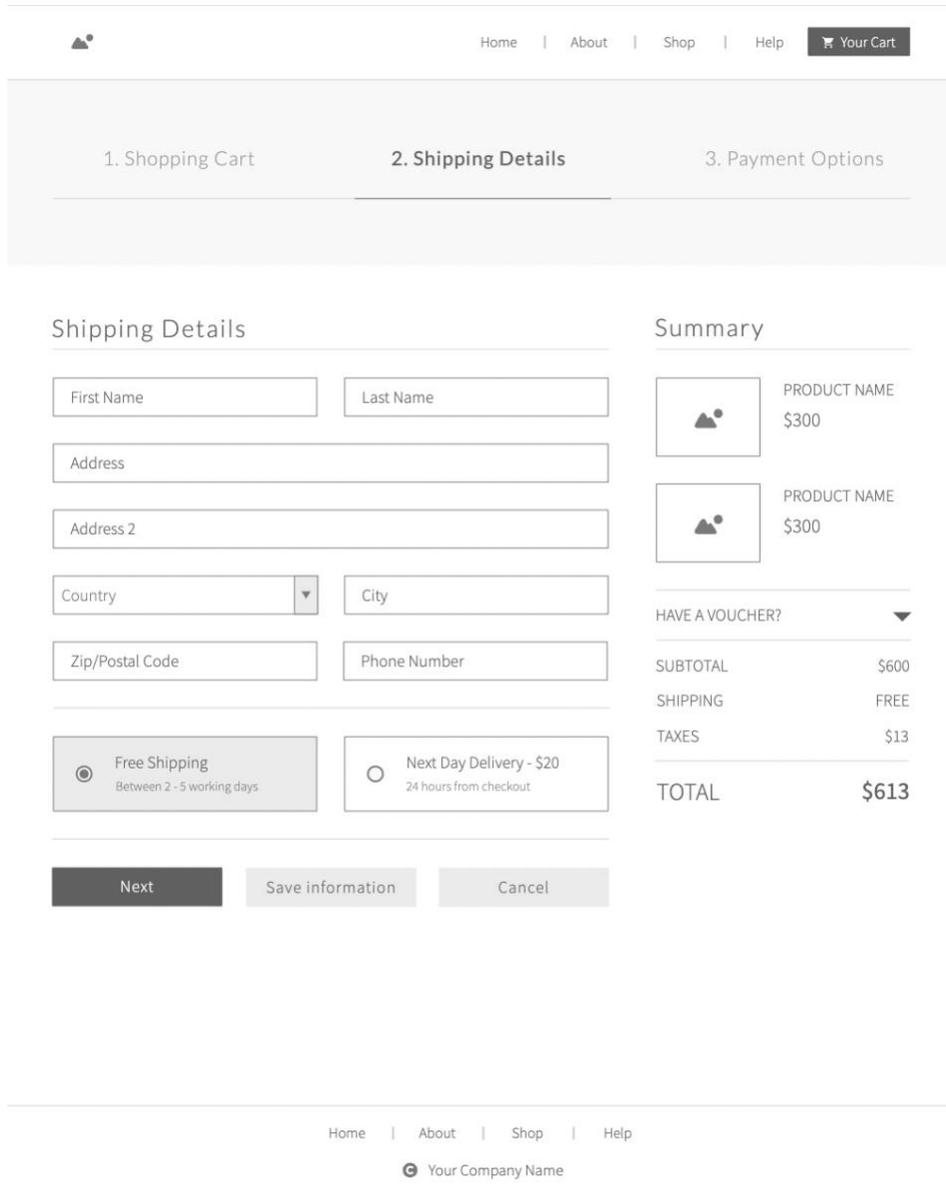


Figure 12: Wireframe of the shipping details page

The wireframe in Figure 12 highlights the shipping details page of the website. Here users will be able to type out their shipping details and other information and have the option of saving the data in case they want to check out later. This would allow them to save time typing out the information again and facilitate an easy check-out process.

User Interface Solutions

After sketching the initial wireframes for the interface solutions, I designed six different parts of the interfaces by re-designing Zara's E-commerce website.

1. Homepage
2. Product listing
3. Product
4. Shopping Cart
5. Shipping Details
6. Payment Information

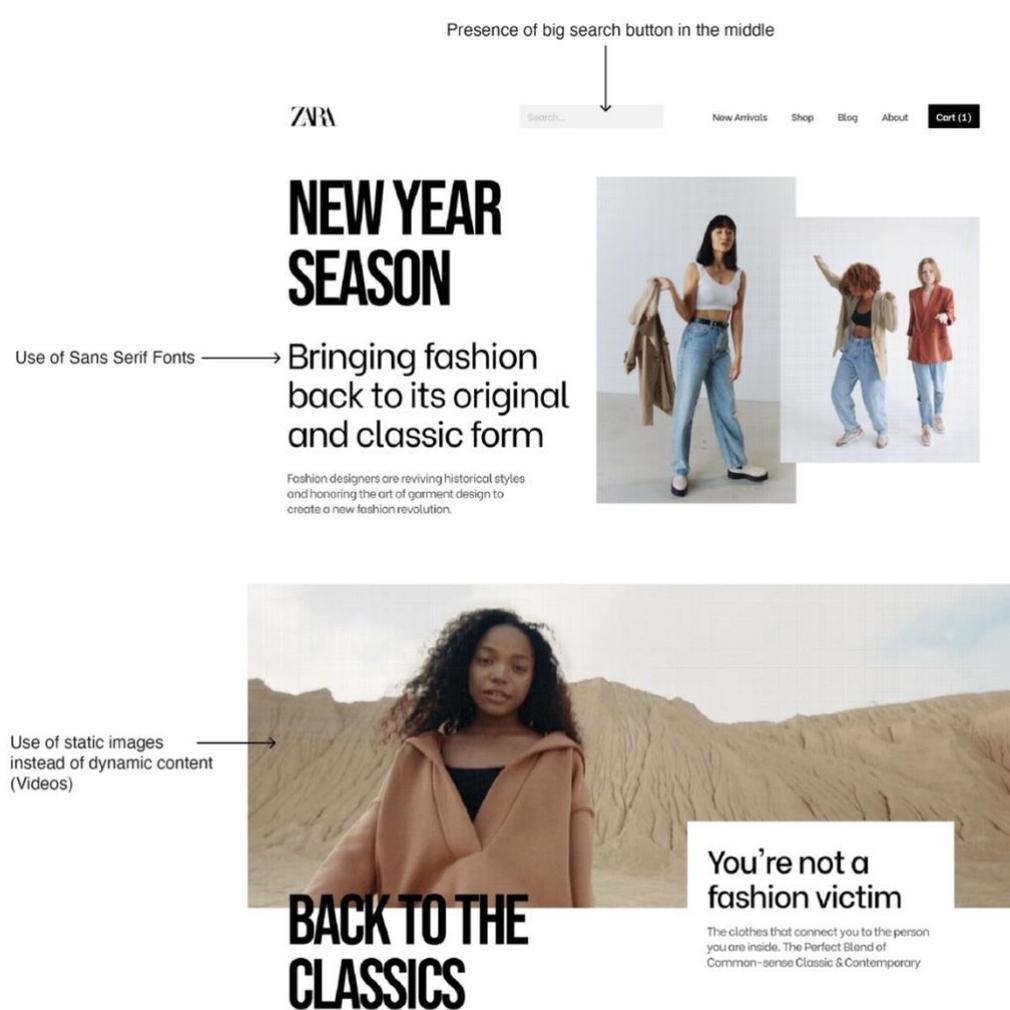


Figure 13: Part 1 of the Homepage Interface

Minimalist Layout

Limited edition wool blend cape
[Shop the Collection](#)

Reversible also Printed Kimono
[Shop the Collection](#)

Long trench wool coat with hood
[Shop the Collection](#)

Use of descriptive sentences to describe collections

BACK TO THE CLASSICS

The clothes that connect you to the person you are inside. The Perfect Blend of Common-sense Classic & Contemporary

ZARA

About Us
Our Story
Memory
Terms & Privacy

Customer Care
FAQ
Contact
Shipping

Follow Us
Instagram
Twitter
LinkedIn

Stay for future updates from ZARA

Accessibility option available on every page

Figure 14: Part 2 of the Homepage Interface

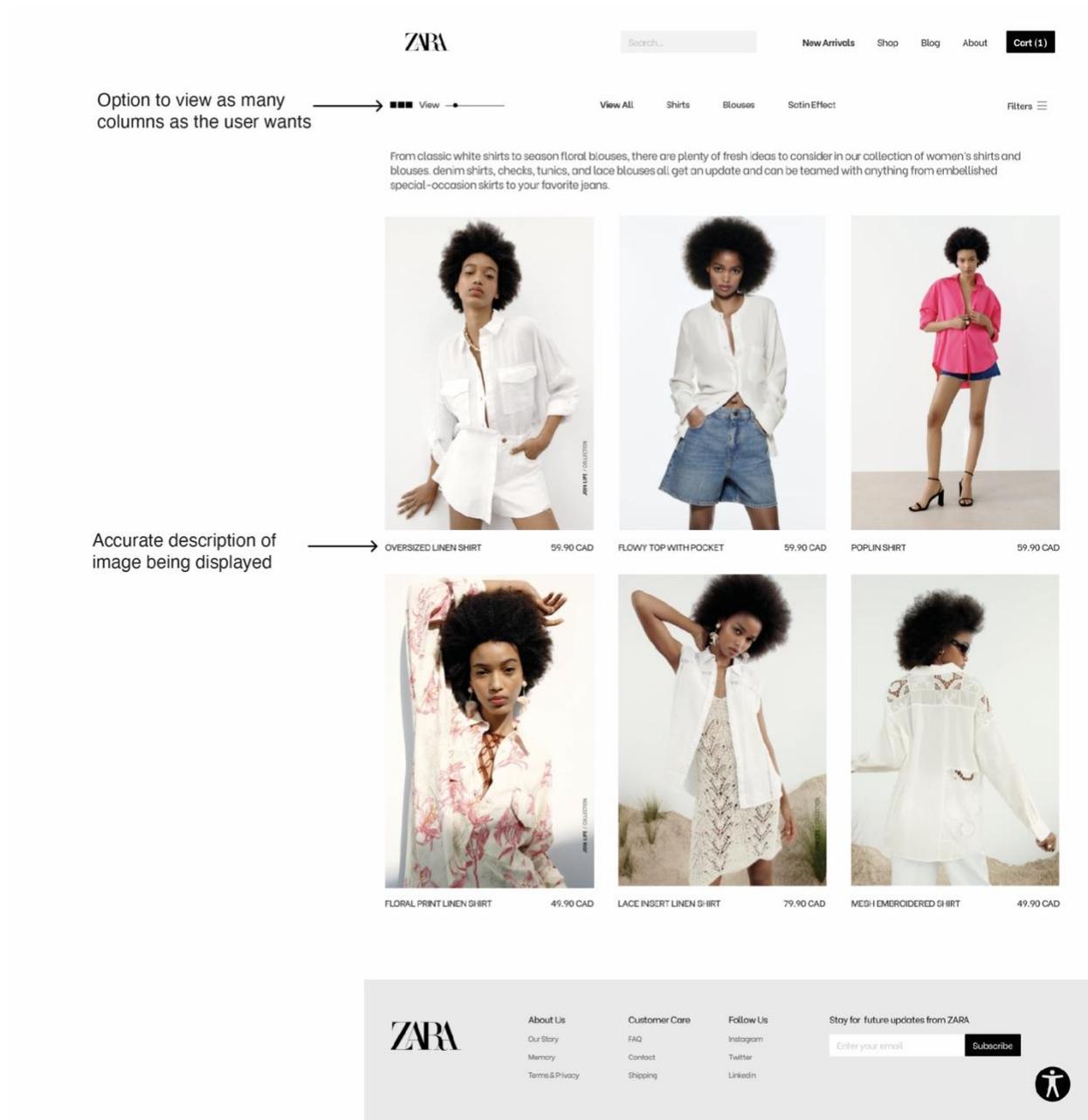


Figure 15: Interface Design for the Product Listing Page

Figures 13 and 14 demonstrate the homepage's interface design, including a large search button at the top. During all the user interviews I conducted, this was one of the most common requests. The user can choose to minimise or maximise the product listing in Figure 15, which is the product listing page, to make it easier to navigate

through. I have also ensured that no dynamic material (video) is used anywhere on the website because it interferes with screen reader users' navigation.

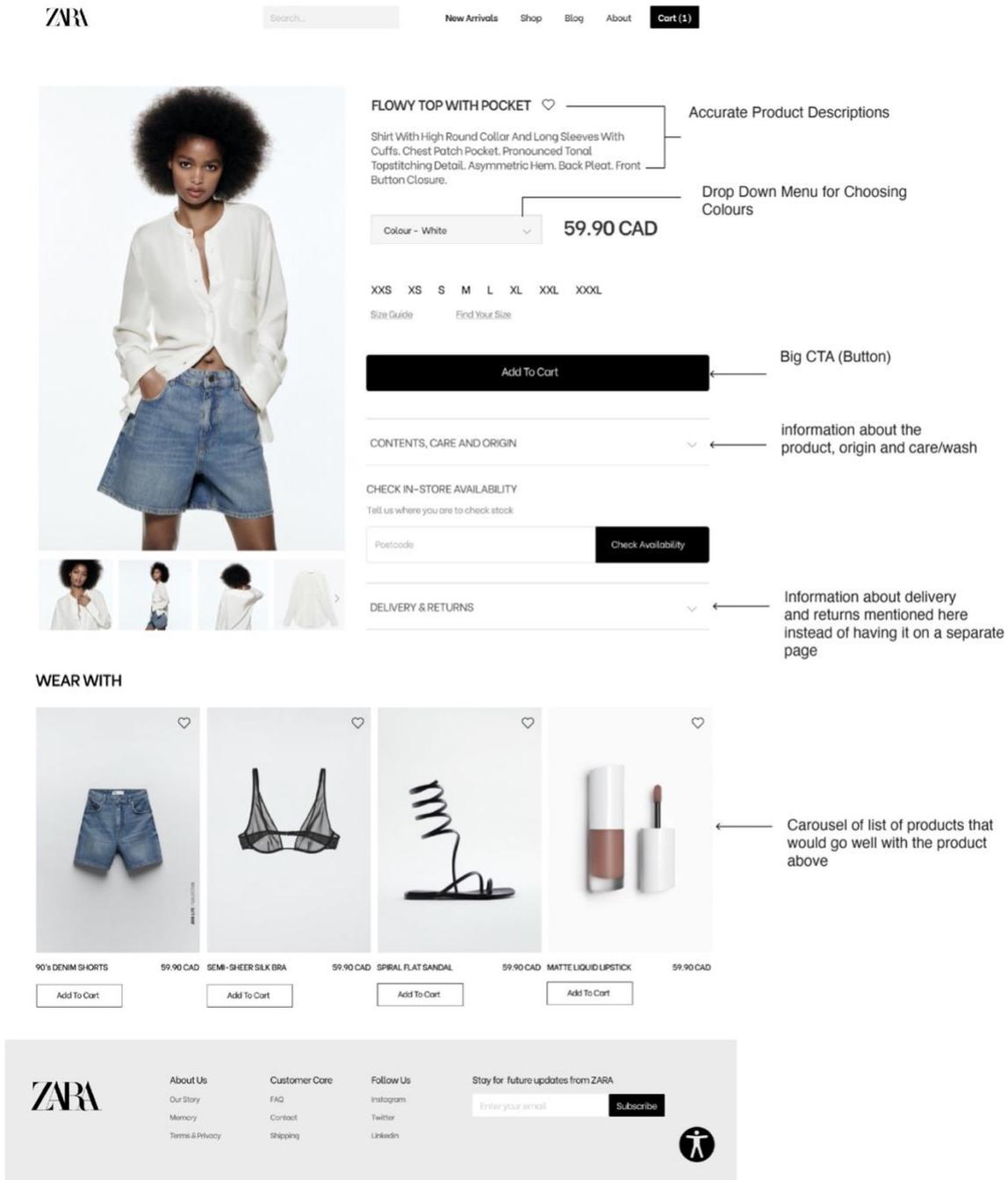


Figure 16: Interface Design for the Product Page

Figure 16. shows the interface design that follows a particular information architecture— followed by adding a drop-down menu for choosing the colour of the product. The name of the colours should be generic so that the user can identify them instead of using complicated words.

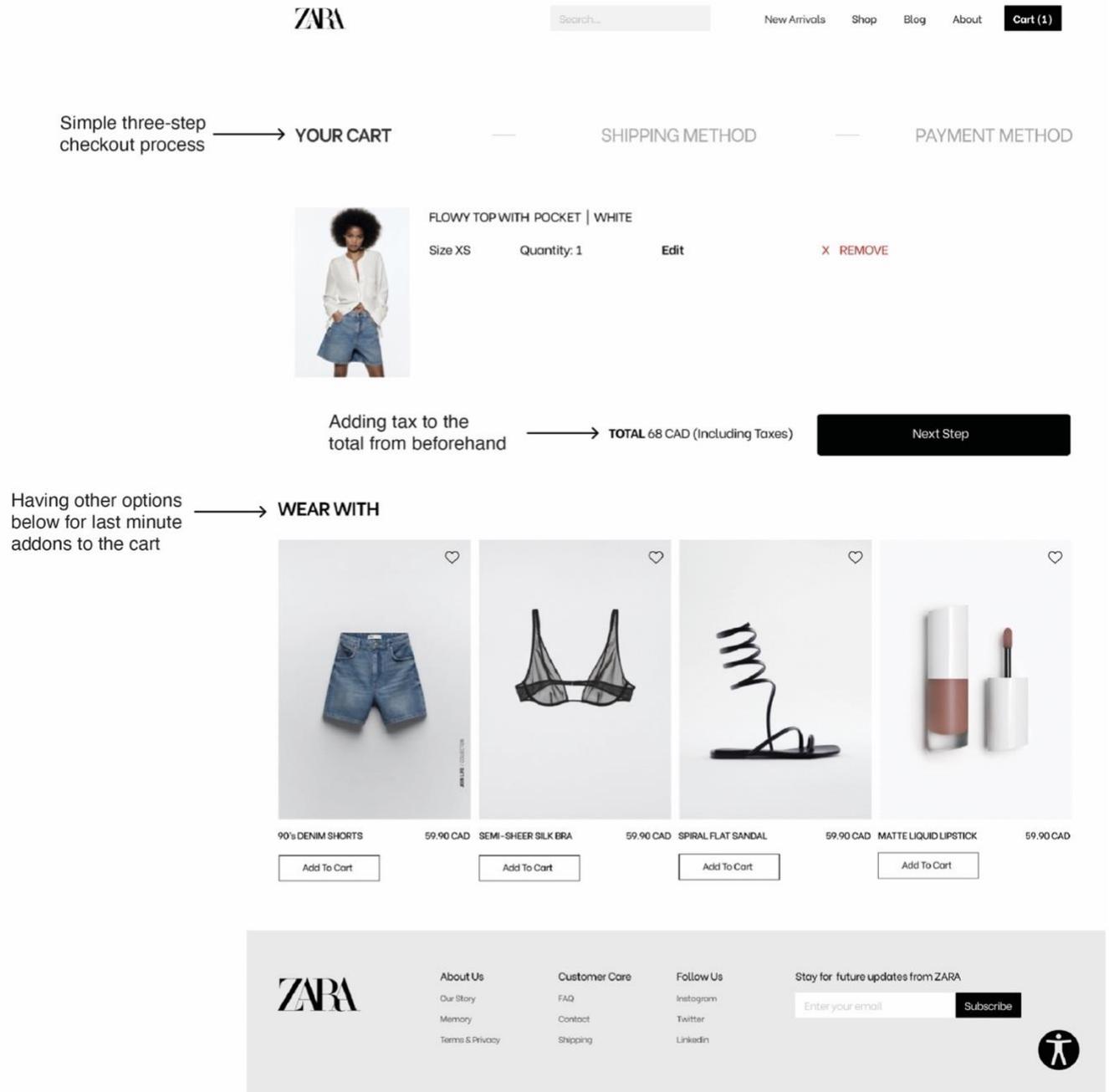


Figure 17: Interface Design for Shopping Cart Page

Having a three-step checkout process is an easier option for the checkout process instead of the page reloading every time for the next step. This lets the user also go back and make changes if needed.

The image shows a screenshot of the Zara website's shipping method page. At the top, there is a navigation bar with the Zara logo, a search bar, and links for 'New Arrivals', 'Shop', 'Blog', 'About', and 'Cart (1)'. Below this, the page is divided into three steps: 'YOUR CART', 'SHIPPING METHOD', and 'PAYMENT OPTIONS'. The 'SHIPPING METHOD' step is currently active and contains the following form sections:

- PERSONAL INFORMATION**: Two input fields for 'First Name' and 'Last Name'.
- CONTACT INFORMATION**: An 'Email' input field, a checkbox for 'I wish to receive emails from Zara', and a 'Telephone' input field with an 'Ext.' sub-field.
- Address**: A large 'Address' input field, and three smaller input fields for 'Zip/Postcode', 'City', and 'State' (with a dropdown arrow).
- Shipping Options**: Two radio button options: 'Free Shipping 5-7 Business Days' (selected) and 'Express Shipping- 15 CAD 1-3 Business Days'.

At the bottom of the form, there are three buttons: 'Next Step' (black), 'Save Information' (grey), and 'Cancel' (grey). An annotation points to the 'Save Information' button with the text: 'Option to save information for checking out later if required'. Another annotation points to the 'PERSONAL INFORMATION' heading with the text: 'Clean layout for forms, with heading written on top instead of inside the form.' The footer of the page includes the Zara logo, links for 'About Us', 'Customer Care', and 'Follow Us', and a 'Stay for future updates from ZARA' section with an email input field and a 'Subscribe' button.

Figure 18: Interface Design Shipping method page

Users should have an option to save their shipping information for later if they change their minds and want to carry on the process later. Many websites do not let users keep their information, which results in them having to type out the information all over again, making the entire process cumbersome.

The screenshot displays the ZARA checkout interface. At the top, the ZARA logo is on the left, a search bar in the center, and navigation links for 'New Arrivals', 'Shop', 'Blog', 'About', and 'Cart (1)' on the right. Below this, the checkout process is divided into three sections: 'YOUR CART', 'SHIPPING METHOD', and 'PAYMENT OPTIONS'. Under 'PAYMENT OPTIONS', there is a link to '+ Add Gift Card', radio buttons for 'PayPal' and 'Credit/Debit Card' (the latter is selected), and input fields for 'Card Number', 'Expiry', 'CVV/CVC', and 'Name As Written On Your Card'. A checkbox for 'Remember this card' is present. Below the payment section is a 'Discount Code' field with an 'Apply' button. The 'ORDER SUMMARY' section features a product image of a 'FLOWY TOP WITH POCKET | WHITE' in size XS, with a quantity of 1. A price breakdown table shows a subtotal of 59.90 CAD, tax of 8.1 CAD, and a free shipping fee, resulting in a total of 68 CAD. A 'Confirm Order And Checkout' button is located below the summary. The footer contains the ZARA logo, a grid of links for 'About Us', 'Customer Care', and 'Follow Us', a newsletter sign-up field with a 'Subscribe' button, and a user icon.

ZARA

Search...

New Arrivals Shop Blog About **Cart (1)**

YOUR CART — SHIPPING METHOD — PAYMENT OPTIONS

+ Add Gift Card

PayPal

Credit/Debit Card

Card Number Expiry

CVV/CVC Name As Written On Your Card

Remember this card

Discount Code **Apply**

ORDER SUMMARY

 FLOWY TOP WITH POCKET | WHITE
Size XS Quantity: 1

Subtotal	59.90 CAD
Tax	8.1 CAD
Shipping Fee	FREE
TOTAL	68 CAD

Confirm Order And Checkout

ZARA

About Us Our Story Memory Terms & Privacy

Customer Care FAQ Contact Shipping

Follow Us Instagram Twitter LinkedIn

Stay for future updates from ZARA

Enter your email **Subscribe**



Figure 19: Interface Design for the last checkout page

Accessibility Improvement Solutions

In this part, I researched whether the WCAG rules are adequate for ensuring content accessibility on E-commerce websites concerning the feedback received from the interviews conducted previously. New suggestions are offered in circumstances where the WCAG guideline is found to be insufficient.

Website Navigation

1. Navigation menu inaccessible with keyboard
2. Complex navigation menu with multiple items in the main menu and submenu

The key recommendations are to stick to guideline 2.4.1 and introduce a new one requiring the usage of HTML list elements to generate the main menu and submenus. A suggestion is also made to add a new part to the WCAG 2.0 rules for navigation structures, which would include guidelines specific to navigation structures.

WCAG 2.0 Guideline	Explanation
2.4.1	The goal of this Success Criterion is to give individuals who explore through material in a sequential manner easier access to the page's main content.

Table 2: WCAG Guideline explanation(!)

I propose adding textual or audio descriptions to the main menu items to minimise the complication of having many things in the main menu and a submenu. Each main menu item's description should include a list of items in its submenu as well as any other vital information that will provide insight into the products categorised under each submenu item.

The difficulty of navigating through different submenus will be much reduced because of this. If the main menu items are described, the screen reader user will be able to understand the contents of the submenu while navigating through the main menu items. As a result, they can choose the appropriate main menu and submenu items without having to go through the complete menu structure. This will result in reducing the amount of time spent navigating through the menu.

The suggestion that descriptions for primary menu items be presented under a separate section dedicated only to navigation structures should be added. It is also an innovative idea to include shortcuts in web pages that are not given by screen readers to help in navigation. When such shortcuts are available, a list of the shortcuts and their functions should be preserved in an easily accessible location.

Summary: The new section primarily for navigation structures should contain a recommendation to give textual or audio descriptions for primary menu items.

Information Search Difficulties

Problems identified:

- Line by line reading should be done to acquire more information about the product
- The search result set is huge

Before reading out the search result, several hyperlinks and contents are read out to the user. To make it easier to find the information needed, searches should be simplified and the number of things in the search result should be reduced. In addition, if further product information can be accessed by clicking on hyperlinks, the screen reader user does not need to read each and everything line by line. In WCAG 2.0, there are no clear standards that would provide an efficient solution for search complexity. To deal with search complications, I considered adding a new part to the WCAG 2.0 rules.

To make a search mechanism as simple as possible, I propose placing the search option after the page title. So, a screen reader user does not have to click through a lot

of links and headings to get to the search option, by following 2.4.1, which mentions skipping blocks and enforcing the 'skip to main content' feature. This will allow the screen reader user to obtain the search result without waiting until the entire navigation menu and other items have been read, which occurs before the search result in the HTML markup of the web page.

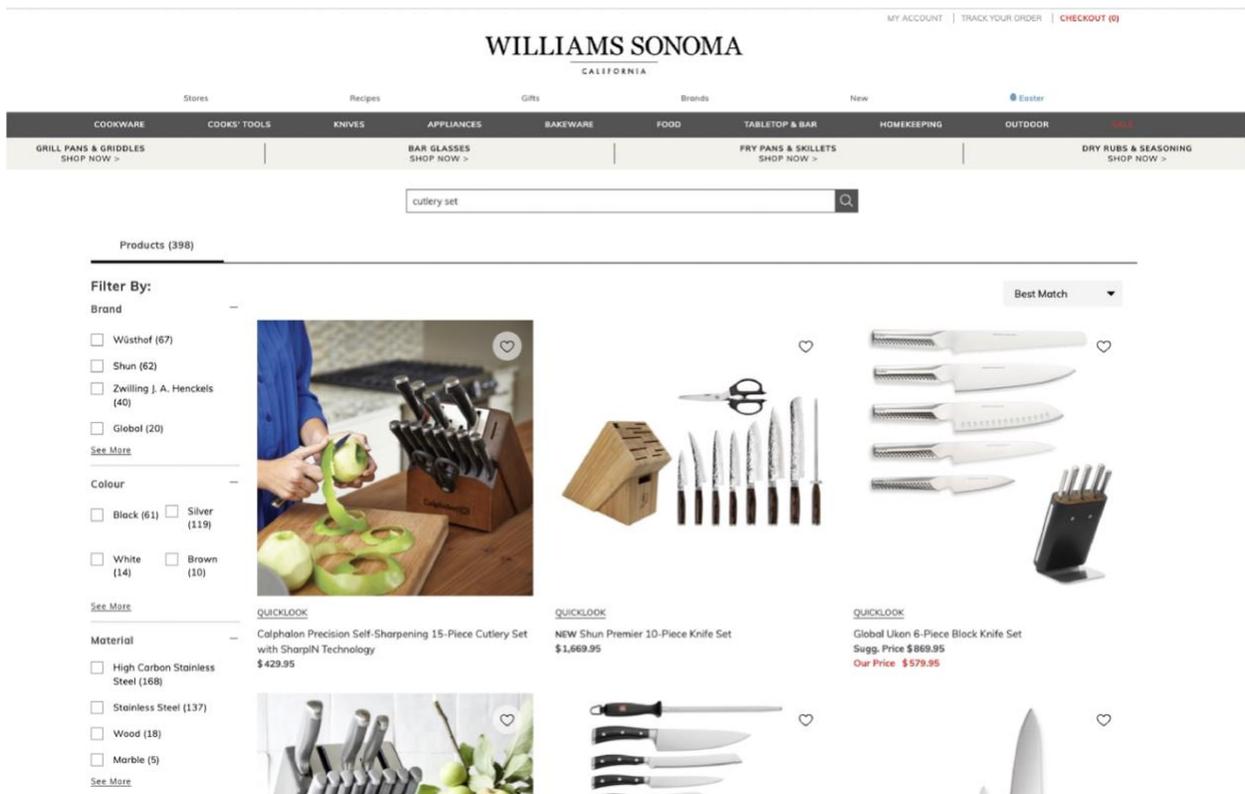


Figure 20: Example of how the interface would look if the search button were after the page header

When the 'Skip to main content' option is used, it should be done in such a way that the screen reader can access the search results.

A few suggestions are proposed for reducing the number of things in the search result set.

One is to add other sorting options to the mix, such as sorting by brand or manufacturer, availability, and so on, in addition to the standard ones. Another suggestion is to include an advanced search option that accepts the brand name, price range, features, and product name.

The other suggestion is to alleviate the problem of navigating via different websites to explore the complete search result. When assistive technology is discovered, it is recommended that all items in the search result be displayed on a single page. Product photos can be eliminated if the entire result is too large to fit on a single page.

To obtain all the information provided on the web page connected to the product, one must read it line by line. To avoid the difficulty indicated above, a recommendation to offer a textual description that includes product name, brand name, price, rating, and availability should be provided. This description should be read out when assistive technology is detected when focusing on the hyperlink. After following this advice, the screen reader user can learn more about the product by simply clicking on the links.

Summary: It is suggested that WCAG 2.0 include a new area dealing with search difficulties. Guideline 2.4.1's 'Skip to main content functionality' should be implemented. The new area for search complexity should include a recommendation to add advanced search choices and more sort by options. A suggestion should be added to keep the search option immediately after the page title. Other tips include displaying all search results on a single page and providing textual descriptions that reveal product specifics by focusing on the hyperlink about a specific product.

Presence of More Image and Graphics

Problems Identified:

1. Images and graphics with no image description
2. Graphics/images not accessible through a keyboard
3. It is tough to navigate slide shows
4. In slide shows, there is no alternate text for the buttons/links
5. The alternate text does not convey the entire text presented in the image.

Providing alternate text for images is suggested in guideline 1.1.1, which deals with handling non-text information. Images will become more accessible if one follows this rule. The difficulty accessing visual links with the keyboard can be overcome by following guideline 2.1.1, which stipulates that all functionalities should be available via the keyboard.

WCAG 2.0 Guideline	Explanation
1.1.1	Non-text Content: All non-text content that is presented to the user has a text alternative that serves the equivalent purpose
2.1.1	Except where the underlying function requires input that depends on the direction of the user's movement rather than merely the endpoints, every functionality of the content is operable through a keyboard interface without requiring exact timings for individual keystrokes.

Table 3: WCAG Guideline explanation (II)

Summary: The problem of alternate text not being available for images and graphics can be addressed by following guideline 1.1.1. Following guideline 2.1.1 will also fix the accessibility problem with visual links while using the keyboard. To efficiently manage slide shows, a recommendation should be included in guideline 1.1.1. All non-text material, including flash objects, should include alternate text, according to Guideline 1.1.1. According to my research, giving flash objects alternate text will not help with accessibility. Instead, the page description should include an overview of the page and animation, which is simpler for the web page developer. After the page title, the page description should be read to better understand the page and animation. In addition, rule 1.1.1 should consist of a suggestion that the image's textual information must also be present in the alternate text.

Other Solutions

Designing websites according to the WCAG 2.0 principles will assure accessibility. However, adherence to accessibility guidelines does not guarantee usefulness. The link between the concepts of accessibility and usability is investigated by Researchers Barbara and Fabio (Leporini & Patern, F, 2004). According to the research, even if a website perfectly meets accessibility guidelines, it can be challenging to use for blind users. This remark genuinely forces one to evaluate the issue of usability that must be considered while developing new accessibility guidelines.

Educate People About Accessibility

Because accessibility guidelines are not followed during page design, many websites are inaccessible to blind people. Because they are unaware of the accessibility issues and requirements, web developers and designers may not follow them. Another problem could be that they believe accessible design is challenging to adopt. To avoid the first issue, I recommend that web design classes include the concept of accessibility and accessibility rules. The latter case can be addressed by having accessible web design tutorials and sample code in textbooks and online learning materials.

Outcomes and Recommendations

Based on accessibility concerns, blind users find it difficult to use computers and the internet. Websites that use modern technologies such as Flash animation, JavaScript, HTML 5, and others have major accessibility issues when utilising assistive technology. The three areas of classifying web accessibility issues are Website Navigation, Information Search Difficulties, and the Presence of more Images and Graphics. Accessibility issues are examined through the eyes of a screen reader user. Users were asked to navigate several websites through their screen readers to find the numerous web accessibility concerns within each category, obtained through participant observation. The study also considers accessibility issues unique to e-commerce platforms. Below is a list of recommendations that I feel would make an E-commerce platform interface accessible to blind users.

Recommendation	Explanation
Big search button	Having a big search button in the middle makes it easier for users to look for items while shopping online
Use of San Serif Fonts	Times New Roman, Verdana, Arial, Tahoma, Helvetica, and Calibri are unofficially recommended by the US Department of Health and Human Services as the most accessible typefaces for screen reader users.
Accessibility Widget	E-commerce brands can incorporate many accessibility widgets available online, that would let users edit the layout of the websites according to their comfort level.

Descriptive product name	Instead of using fancy titles that make little sense when read out loud by a screen reader, having a descriptive product name makes it easier to hover over to the product.
Drop-down menu	The most preferred choice among the participants interviewed was to have a drop-down menu that displayed the available colour options.
Accurate product description	Product descriptions, like product names, should be set out accurately so that the user understands exactly what is being sold.
Information about the material, care, delivery and returns	Having this information all on the same page saves a lot of time for users to go back and forth on the website.
Clean forms	Exclude any words, images, fields, or characters that are not strictly necessary to keep the form as simple and easy to read as possible.
Enable autofill and autocorrect	Autofill and autocorrect are two features that improve the user experience by making the process of filling out forms easier.
Save Information	Option to save the user's details so that they can check out later if necessary.
Addition to WCAG Guideline 2.4.1	Addition to adding a section for navigation structures where textual or audio descriptions are provided for menu and submenu items in a website.

Addition to WCAG Guideline 2.4.1	'Skip to main content functionality' should be added to this guideline.
Addition to WCAG Guideline 1.1.1	The page description of a website should include an overview of the page and video content/animation.
Addition to WCAG Guideline 1.1.1	If an image is used on the website, its textual description should also be included.

Table 4: Recommendations for improving accessibility in E-commerce websites

Websites that comply with accessibility guidelines can benefit a vast community of visually impaired people who use screen readers. I compared all the accessibility issues found in the study to the WCAG 2.0 rules and offered adjustments to improve the existing WCAG 2.0 guidelines. Suppose the website does not follow accessibility requirements. It will be an excellent way to educate people on online accessibility to include the notion of accessibility in web design classes and to provide lessons on accessible web design to online technology websites. Blind users will not have a rich user experience if just accessibility guidelines are followed.

Conclusion

This research study helped me analyse participant behaviour and user journeys, allowing me to develop a set of recommendations (see Table 4).

The proposed recommendations are my contribution to accessibility design in the field of E-commerce. Implementing these recommendations would help us get a step closer to overcoming the difficulties that blind users face when accessing E-commerce platforms. Many of these are straightforward and affordable to implement for web designers and developers. Putting forth the effort to consider how to make a website accessible always results in positive feedback and increased website traffic, which is a solution where everyone benefits for both the brand and the users.

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Appendix A: Semi-structured Interview Guide

Ice Breaker Questions:

1. How do you feel about the year 2022 so far?
2. What positive impact do you think the pandemic can have on the world?
3. Describe your most challenging moment during the pandemic/quarantine

Open General Questions:

1. Describe your daily routine
2. How did the lockdown measures affect daily routine?
3. Within the context of the pandemic and lockdown measures, what aspects do you wish you had more control over, or what would you change to make yourself feel more comfortable?
4. What is your living situation like?
5. Could you please share (your perspective on) how COVID-19 has impacted your community?
6. Would you mind sharing a bit of background about your vision impairment?
7. Do you prefer going to shopping malls or online shopping?
8. What do you do when you attend an event that requires specific attire?
9. How do you follow fashion trends in this online era?
10. Is there anything else you would like to share that might assist our research that we have not asked about yet?

Deep Questions:

1. What type of products do you buy online?
2. Do you use screen reader technology? If so, what kind?
3. Have you experienced any barriers to accessing the websites?
4. Do you have any concerns about buying products online?
5. How comfortable are you in buying products online from a brand whose website is inaccessible?
6. What elements make a website easier for you to navigate?
7. Do you find it easy to get the accurate product description of an item you are trying to purchase?
8. Do brands also make the content accessible enough to buy two pieces of an outfit that go well together?
9. What elements would make a website your ideal shopping destination?