

Does the lack of Accessibility design in web development impact businesses negatively?

Declaration

I hereby declare that this is my own work and does not use any materials other than the cited sources and tools. All explanations that I copied directly or in essence are marked as such. This work has not been previously submitted.

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Abstract

The present study analyses the financial impact that the lack of accessibility has on E-commerce websites, measured by the development challenges and the cost of accessibility audits after production, also touching on the legal consequences inaccessible websites generate for businesses.

Alongside the research paper, the submitted product aims to model an E-commerce website built with inclusivity as an intention, particularly with regard to people with disabilities. The product is an example of what an accessible E-commerce website can be like as it uses a similar layout to most profitable websites detailed further in this paper. Moreover, the focus of the product will be to showcase and discuss new features built for accessibility based on the research.

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Introduction

Accessibility is a core principle in the creation of the web, developed initially as a means to share information without barriers. “*The power of the Web is in its universality.*” - Sir Tim Berners-Lee, inventor of the World Wide Web (W3C, 2014) and as the web extends borders, many countries have acted to protect their disabled communities from discrimination through the creation of accessibility standards and laws. For example, America’s ADA (American with Disabilities Act, 1990) and the UK’s EQA (Equality Act, 2010) legislation that includes the web. It is due to this that the inaccessibility of websites have the potential to negatively impact businesses financially.

It is often forgotten that there is a strong link between innovation and accessibility. Most features that have been developed to tackle problems that stem from accessibility issues now benefit the wider society. Examples include dark mode (most commonly used on browsers) and close captioning on videos (Bureau of internet accessibility, 2021). The topic of this project has been influenced by the recent update on Elon Musk's Neuralink. The hardware produced by Musk's company showcases the innovation and huge leaps that can be made when technology tackles a problem the disabled community face. The potential for this new technological advancement will not only aid the paraplegic in connecting online, but also has profound implications for the rest of society, such as: being able to download memories. It is through this new development that accessibility on the web was introduced as a topic of interest. Having “*inclusive design spurs creativity and innovation and benefits everyone.*” - (Yeliz Yesilada and Harper, 2019, p.137). This notion was explored in the development of the practical component.

Aims

This project aims to highlight the importance of compliance with accessibility guidelines for businesses operating via E-commerce platforms. The trajectory of this project has been strongly influenced by the difficulty found in identifying examples of AAA-rated (the highest accessibility rating awarded to websites) E-commerce sites. The disappointing void in the enquiry led to the creation of a practical component that will be presented alongside this research and will demonstrate the assertion that businesses need to build accessibility into their E-commerce websites. It is clear that the implementation of accessible websites is integral to people with disabilities in a society that has increasingly turned to web platforms in the aftermath of the Covid-19 pandemic.

Objectives

In order to accomplish the aims, the project will be divided into a research component (investigating inaccessible E-commerce sites and the impact inaccessibility has on businesses

and users) and a practical component. The research will explore building accessible businesses, the legal repercussions and accessibility development.

Building accessible businesses

It is asserted in this paper that accessibility should be the foundation on which businesses build their platforms. By aiming to reach even a minimum level of accessibility, businesses are availing themselves to the 20% of the population who identify as being disabled. The reasons this ambition is sometimes disregarded will be discussed further, alongside the financial implications of not strategising to achieve this goal.

The legal repercussions

This surveys the legal actions that have been taken against websites and the risks online retailers face by not meeting accessibility rules in their territories. Additionally, the cost of legal fees and how this impacts customer retention within the disabled community.

Accessibility development

This is explored through the lens of a developer and the changes that can be made within the code that will allow more websites to gain the minimum level of accessibility. It also looks at the difficult matrix of decisions developers have to make when faced with certain features that are not accessible but are necessary for the site.

The development of the practical component will further evidence the case for B2C (Business-to-consumer) businesses to build accessible websites. It will demonstrate that this type of web development does not diminish a business's brand - in fact, it enhances it. The end product will be a website that will pass Priority 1 and 2, striving to pass Priority 3 (of WCAG standards) (W3C), inspired by established B2C websites, thus proving that E-commerce can be accessible.

Literature review

The need for accessibility is a topic discussed not only in the world of web development but also in User experience (UX) / User interface (UI), product design and software engineering. It is because these are the places where new products originate and therefore are the source of the problem. As it stands, accessibility is an option that most do not follow, and this is why there have been many discussions on the topic and its implementation by several designers and developers. There are bodies of work that refer to the accessibility of technology, but as they do not relate to the code or the impact it has on businesses, these were not referred to in this research. This section will look at the primary sources used throughout this paper and evaluate their relevance and content.

W3C, 2014

The W3C regulates web standards and is also part of the regulating body that constructs the WCAG guidelines. The research based on the W3C allows for an in-depth understanding of the guidelines and the disabilities that are likely to be impacted by features on the web. The WCAG guidelines themselves are laid out in a clear manner, even detailing common accessibility violations and methods to resolve them. However, the information spans across many pages and can be hard to follow in places, and does not touch on the legal aspects of the accessibility regulations, which would complement the information the W3C provides.

Regardless of this, the W3C is a reliable source from which to base this project's research on as it is the source all developers and accessibility consultants go for guidance. It informs not only the practical component but also allows the right to state whether websites are accessible or not.

Usable Net, 2022

This organisation is a network of researchers formed explicitly to monitor accessibility lawsuits. Their work allows for the analysis of the legal action taken against businesses and the financial toll wreaked as a result. The researchers converted their data into graphs and pie charts, presenting it in a more readable format. Usable Net's monitoring of lawsuits throughout each year and representation of the data in an annual report provided this paper with relevant statistics that verify the claims made in the 1.2. Legal repercussion section.

Brandl and Wibowo, 2021

This online resource provided the information needed to undertake an analysis of Amazon, Asos and Shein. The resource highlights parts of the websites that are inaccessible and who is impacted as a result. The majority of the research on inaccessibility in E-commerce did not often have detailed examples of where certain websites fell short. The advantage of using a source

such as this, it lays out a brief guide to accessibility online and the websites that do and do not comply, therefore, allowing an analysis of how E-commerce sites differ from other industries.

Bélanger and Rayner, 2015

The study conducted was in reference to ‘what eye movements reveal about deaf readers,’ hoping to better inform ‘reading education’ for the deaf community. Despite being a topic that does not directly correlate with this project’s research topic, it does provide insight into the struggles the deaf and hard of hearing community face, not only in tech but also in education. This insight proves useful for gaining a wider understanding of the community and, further applies the newfound knowledge to the practical component.

Methodology

This paper will look into the impact inaccessibility has on businesses. In order to analyse this, a process of qualitative research was undertaken as a means of providing insight into this discourse. This project utilises secondary research from a combination of studies, mainly from American and British sources; this is the primary method used to acquire information. The data needed to progress the research would have been time-consuming and thereby limiting the broader information needed to be collected if primary research were to be conducted. The sources used are a range of books, online articles and reports that cover the impact inaccessibility has on businesses, the financial impact of it, the legal aspects and development costs. The inclusion of qualitative research is useful in the development of this project; it provides the viewpoint of the community this paper is focused on. Statistics used are based on surveys conducted by organisations, using a large demographic in order to service the data, for instance, the referenced ‘Click-Away Pound’, a survey which explores the E-commerce experience of disabled users.

WCAG Standards

The WCAG (Web Content Accessibility Guidelines) was formed by W3C; this “global organisation was founded in 1994” (10to8, 2021). These guidelines were created so that “people living with disabilities can more comfortably use and enjoy the web” (Out-Law Guide, 2011). There has been a new perspective on the importance of accessibility in society, which is attributed to laws, such as the Equality Act (EQA, 2010 in the UK) (Cabinet Office, Government Digital Service and The Rt Hon Simon Hart MP, 2019). In 2011, the EQA was amended to clearly state that “Websites provide access to services and goods, and may in themselves constitute a service, for example, where they are delivering information or entertainment to the public.” This meant that websites were clearly under the EQA and must abide by the anti-discrimination law. With the implementation of these laws comes more rights for those with any level of disabilities, protecting them from discrimination and exclusion. There is evidence of this in other industries as well, such as the architecture and construction sector, pushing for all buildings to become accessible (Access to and use of buildings, 2016). Furthermore, this has been expanded to the web, and the upcoming WCAG 3.0 update will include all software and hardware produced by companies. This aims to bring to light the importance of accessible development across all platforms, thus creating an environment where developers can start to think of accessibility as an opportunity for innovation. The W3C is working towards the regulation of our technologies so it is accessible to those that use it.

The way WCAG Standards grade websites is based on a three-tier system that classifies them as accessible. The tier system is ranked based on how many of the guidelines are met per page; when the results are compounded, we are presented the level the site is at, this is often presented in the form of percentages. The higher the Tier, the more complex the guidelines are, and each priority level provides a solution for certain disabilities, such as visual, cognitive, physical and more.

- Priority 1, Level A - covers user experience, content structure/ readability and navigation. It does not tend to affect the UI of the site.
- Priority 2, Level AA - this covers solutions for people with visual or hearing impairments, developing with screen reading in mind, text resizing, contrast ratio of background to text and overall structure/ navigation consistency throughout.
- Priority 3, Level AAA - this covers the user's ability to modify the website as needed, from colour ratio to stopping animations, the content reading level and even “providing sign language translations for pre-recorded videos.”(Mcgrath, 2013).

The UK government (and all public sector websites) is required to meet the Priority 2 (Level AA) rating as a minimum (as of 2019 accessibility regulations). As it stands, only public sector websites must make the “reasonable adjustments” (Government Digital Service, 2018) to be at the minimum Priority 2 for governments and councils to avoid being sued. However, for most

private sector sites, this does not apply; for example, online retailers are not legally obligated to reach the Priority 2 guidelines but are recommended to meet Priority 1 in most countries. If the WCAG did not put in place the guidelines, then there would be a large portion of the population that could not be autonomous online.

1.1 Building Accessible Businesses

It should not be assumed that the lack of accessibility on the web is due to developers or business owners being negligent. Despite the lack of accessibility on the web, it does not mean that developers or business owners are purposely avoiding doing so. Accessible design can be expensive; the price for which “may range between \$2,500 and \$2.5 million” (User, 2017). Multiple factors contribute to the total cost of accessible design, and this includes the number of pages and functions the site contains, such as: add-to cart, favourites, login and filtering options, as well as the level of accessibility the site already has, if at all. Big companies like Amazon, whose websites continue to scale upwards, might find the prices as a deterrent and, therefore, would aim no further than Priority 1. To add to this, the Priority levels increase in difficulty to complete, therefore raising the cost in tandem with the “level of the web accessibility” (User, 2017).

Type of website	Features	Designer cost
Basic	<ul style="list-style-type: none">• 1-5 mobile responsive pages• Contact page• Landing page	£200–£500
Small business	<ul style="list-style-type: none">• Several pages• Social media integration• ‘Google my Business’ page• Google Analytics and Maps	£500–£1,000
Ecommerce	<ul style="list-style-type: none">• Ecommerce tools• Order management system• Delivery tracking functionality• Live chat	£1,000–£2,500
Database-driven (banking, architecture sites etc)	<ul style="list-style-type: none">• Advanced functionality• Unlimited sub pages• Bespoke design• Database population	£2,500–£10,000

Figure 1.1 - Table of different types of websites development cost (Barraclough, 2019).

Cost of an ecommerce website	
Upfront costs	
Design	£1,000 to £2,500
Domain	£2.99 to £100 / year
SSL certificate	£15 to £250 / year
Total Upfront Cost	£1,017.99 to £2,850
Ongoing costs	
Hosting	£10 to £350 / month
Content Updates	£0 to £60 / month
Total Ongoing Costs	£10 to £410 / month

Figure 1.2 - (Barraclough, 2019).

Additionally, we have to consider the cost of the initial development and maintenance of the website (Figures 1.1 and 1.2). These combined fees can be easily covered by most big E-commerce websites such as Amazon and eBay, and yet, big companies do not often comply with the guidelines. Therefore, it is unfair to expect it from steadily scaling companies, such as Chella and Cait+Co. Given the expected costs of a website, many smaller companies would not be able to cover the fees incurred from the development, as well as the price of accessible design. Most B2C websites are complex and often have several functions as mentioned earlier. All of these would have to be audited, and if not accessible, re-design and development would have to occur.

The financial impact is not the only hurdle when it comes to accessibility, as of 2022, the WCAG has 78 success criteria in total that impact the development and structure of a website. Within business, trends tend to be adopted as a means to entice consumers. The web design is heavily influenced by companies following what consumers respond positively to. This usually leads to complex layouts, the increased use of images, videos, time-sensitive pop-ups (e.g. discount offer pop-ups), and animations to entice their target demographic. Unfortunately, these features often do not comply with the guidelines based on the nature of their development, but companies choose to go for what is '*flashy*' and most likely to grab the attention of their primary demographic thus, disregarding accessibility. An example of this can be seen in companies like Asos, Shein, and again, Amazon. According to (Brandl and Wibowo, 2021), Amazon does not comply with some WCAG standards; people who have tunnel vision would struggle to use this site, as it "would make a huge amount of products completely invisible". Similarly, Shein's

filtering system uses colour to “convey meaning” (Brandl and Wibowo, 2021), using colour to distinguish and categorise products which is redundant for some colour-blind users (Figure 2).

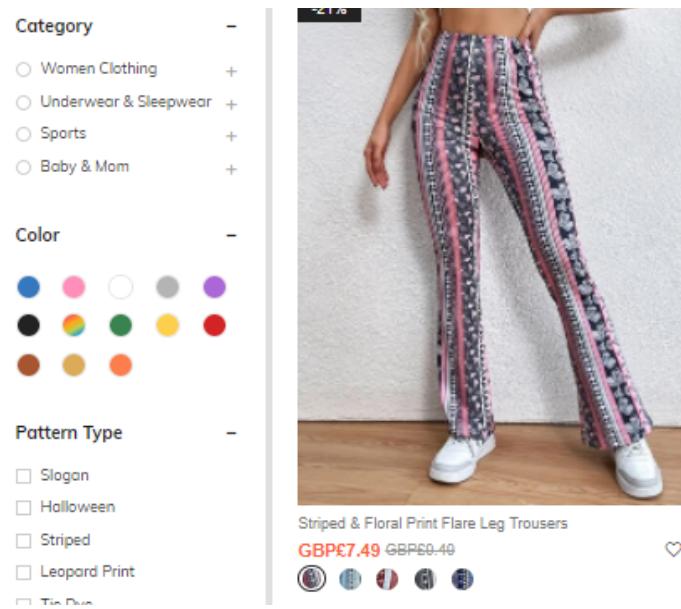


Figure 2 - A section of the website showcasing the filter function (Shein, 2022).

Furthermore, the Asos website is measured as inaccessible at a “staggering 21.38%” (Brandl and Wibowo, 2021) in accordance with WCAG standards. The majority of their errors come up as “missing labels”, “poor colour contrast”, and “missing ARIA (Accessible Rich Internet Applications) labels” (Brandl and Wibowo, 2021). This makes it difficult for people that use software such as screen-readers since they will struggle to follow the content with everything that’s missing. The results below are an average estimate of each website’s accessibility (Figure 3.1, 3.2, 3.3).

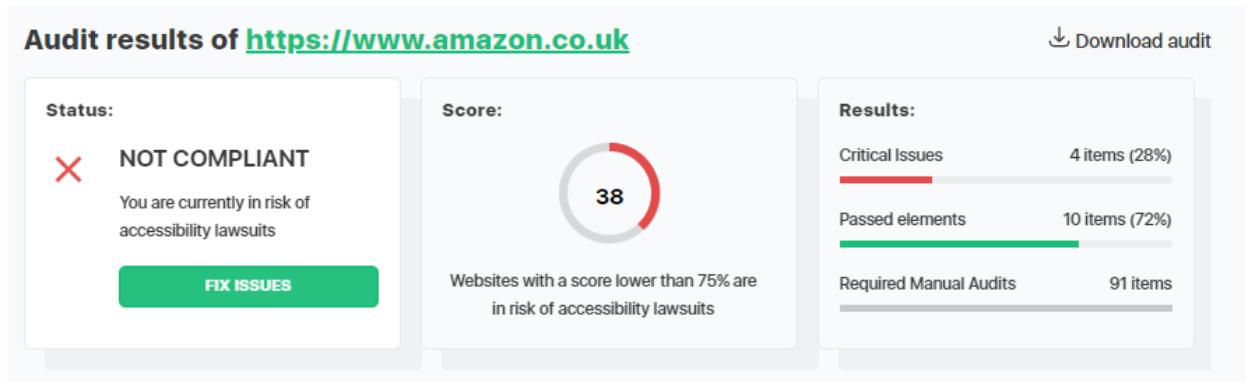


Figure 3.1 - Image of accessibility score for Amazon (Accessibility Checker, 2022).

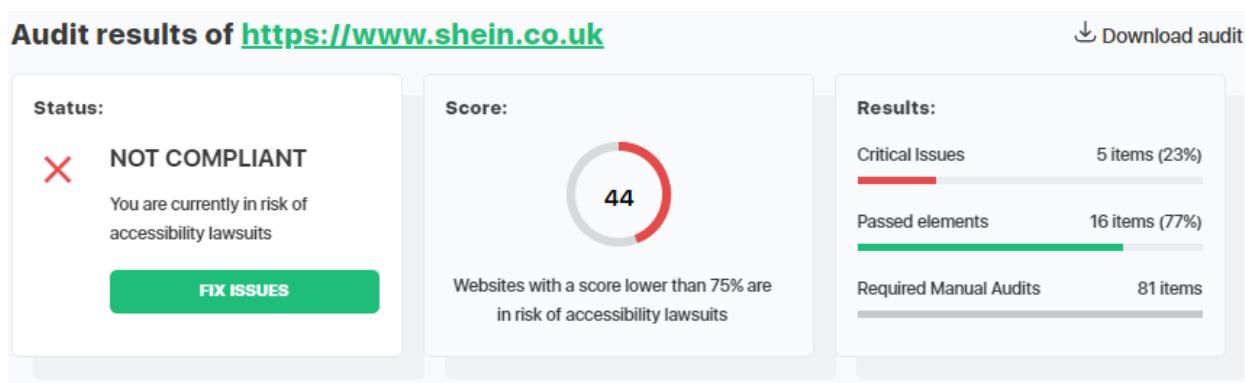


Figure 3.2 - Image of accessibility score for Shein (Accessibility Checker, 2022).

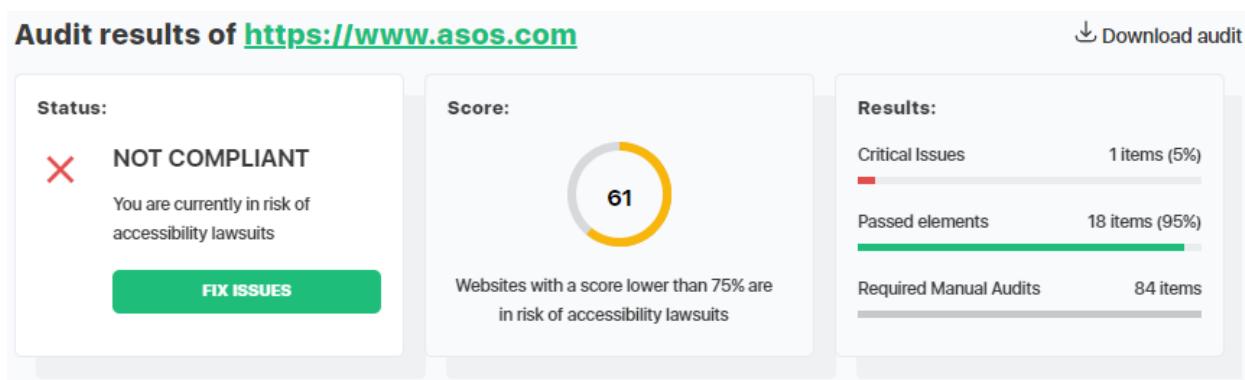


Figure 3.3 - Image of accessibility score for Asos (Accessibility Checker, 2022).

How is it possible for big companies to fail an accessibility check? The reason can be attributed to the overall aesthetic and lack of demand for accessibility within the retail sector. Business owners believe that the disabled make up a “small minority” (User1st, 2016) of their demographic when that is simply not the case. In the UK alone, there are 14.6 million people that live with a disability, which is 22% of the overall population. The “small minority” that businesses ignore has an estimated spending power of “£249 billion a year” (Wright, 2019).

“Purple’s research also suggested that disabled young people between the ages of 16-24 fared the worst, with more than three-quarters saying they found it difficult to shop online” (Wright, 2019). Moreover, Wright states that 75% of disabled people have abandoned carts due to being “unable to finish a purchase because of their disability...on multiple occasions” (Wright, 2019). As the current generation of young people (known as Generation-Z) become the dominant market for most E-commerce websites, those that ignore the disabled community creates a considerable disadvantage for themselves. The Click-away Pound Survey was formed to “explore the online shopping experience of people with disabilities and examine the cost to business of [sic] ignoring disabled shoppers” (Williams and Brownlow, 2020). The increase of the “Click-Away Pound” from “£11.75 billion” in 2016 to “£17.11 billion” in 2019 (Click-Away Pound, Williams and Brownlow, 2020) indicates that inaccessible design is costly. It is reasonable to conclude that the businesses that ignore the needs of the disabled community will, in the long run, miss out on the billions of pounds the community has to spend. Businesses that lack an understanding of accessibility’s importance will unintentionally drive forward those businesses that promote inclusive practices, limiting the market available to them and benefitting their competitors. Fortunately, for those companies with accessible design, their website becomes a priceless asset as they cultivate a loyal customer base that keeps returning to them.

“If I find a site I can use then I use it as much as possible; often even if I know I might be able to get things cheaper elsewhere. For example, I find it easier to have my supermarket shopping delivered and the best site I found to use is Ocado, so I use it. I know some things would be cheaper elsewhere but, well, the accessibility of the site and the app make it so easy why would I bother to look elsewhere when my experience tells me I’m likely to find problems.” (brightdesign, 2016).

This can be seen in a study where “83% of participants with access needs limit their shopping to sites that they know are accessible” (Ward and The Big Hack, 2021). In the wider scope of costs, accessible design not only gives the disabled community an opportunity to participate online but also provides a better experience for those without disabilities (W3C, 2016). “Well-designed websites are more usable for everyone and are cheaper to run and maintain” (La Rocca, 2016), which decreases the overall cost of the site in the long run, while also aiding businesses with customer retention.

Christopher Danielson, a representative of the National Federation of the Blind, said the following: “Rather than refusing to take the money of those of us with disabilities, why not innovate and take our money?” (Firth, 2019, pp.135–136). It is clear that the disabled community want to be consumers and be active online, especially as technology begins to automate and take over important functions of daily lives, access to it is a need. As a result of inaccessibility, businesses are taking away the autonomy of people, thus hindering the businesses reputation and losing a slice of the spending power the disabled community have to contribute.

1.2 Legal Repercussions

Inaccessible websites are exposed to a higher risk of legal action. The consequences of fixing a faulty product instead of correctly building it with accessibility from the start can result in devastating repercussions, especially for smaller businesses. In America, receiving an ADA lawsuit could result in a civil penalty ranging from “\$55,000 to \$75,000” (ADA, n.d.) as a first-time violation, which paired with the legal cost could be “upwards of \$1,000/hour” (Schulz, 2022). In most cases, the lawsuits are resolved with hefty settlements.

THE COVID-19 EFFECT

Cases rose 50% after slowing during the initial COVID-19 lockdowns.

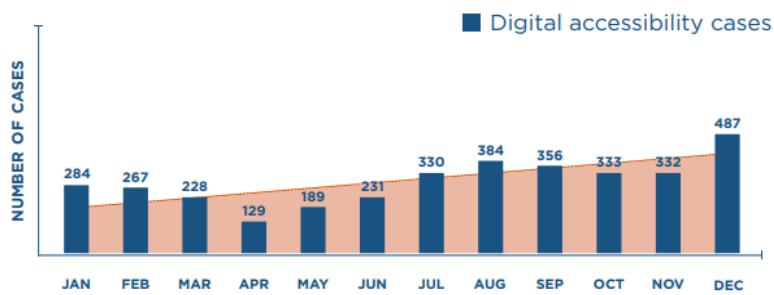


Figure 4.1 - (UsableNet, 2020).

Unsurprisingly, during the COVID-19 lockdown, there was an increase in ADA violation lawsuits by more than 50% (Figure 4.1). This is, of course, due to the majority of the general population being forced to live their lives online, and as such, the inaccessibility of many websites became glaringly apparent. It even obstructed many disabled people from carrying out tasks online, for instance, filling out forms, reading the page content (through screen-readers) and navigation (Deque Systems, 2022). One aspect of the web that was hugely affected by the pandemic was online shopping, which became immensely profitable throughout and after the pandemic; according to UN trade and development experts, there was a “dramatic” increase in E-commerce sales, “from 16 per cent to 19 per cent”, generating “\$2.9 trillion in 2020” globally (UN News, 2021). Needless to say, with the pandemic came the era of E-commerce, and as of 2022, it totals “38%” of total retail sales (Statista and Coppola, 2021). Many companies during this period raced to digitise their shop or service in order to profit from the worldwide standstill and also continue to bring in revenue. Due to this, many did not consider most of the WCAG standards. As seen in (Figure 4.3), the consequence of this is that there was a dramatic increase in cases filed against E-commerce businesses.

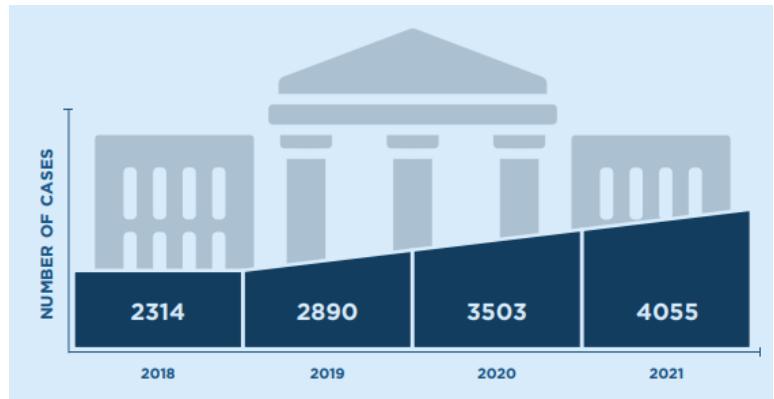
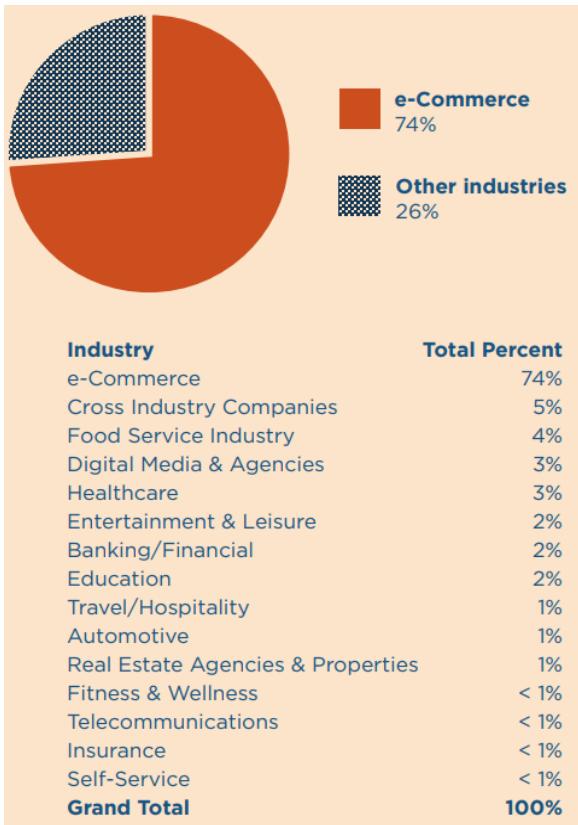


Figure 4.2 (left) - Pie chart showing the distribution of sectors in accessibility lawsuits and the percentage attributed to each (UsableNet, 2020).

Figure 4.3 (right)- Graph depicting the number of cases per year (UsableNet, 2020).

As of 2021, the retail sector is one of the least accessible online spaces evident, as this sector leads with the most lawsuits (Figure 4.2). The economic impact of these cases for companies can be significant, especially as a website can receive “multiple ADA lawsuits, regardless of how a settlement has been reached”. In 2021, 15% of companies that had been sued, had a case filed against them prior to the new case, which means “businesses are not implementing the necessary changes to avoid future litigation” (Tkatchuk, 2020). It seems there is resistance when it comes to accessible implementation in the E-commerce space, as the threat of a lawsuit and the following “\$150,000” (ADA, n.d.) subsequent violation penalty has not motivated business owners to make the necessary changes. This could be because this sector is relatively new and, therefore, is yet to go through the intensive policies and regulations for accessibility that most sectors have gone through. It can also be said that most business owners do not understand the complexity of accessible implementation into a website; therefore, developers are often not funded to make these changes. However, this ignorance is expensive as accessibility-related lawsuits have “drained businesses of more than \$90,000 in some cases and upwards of \$1 million in others.” (Tkatchuk, 2020).

1.3 Accessibility Development

The responsibility for the website being accessible falls entirely onto the business that commissions the website. Accessibility needs to be a feature as fundamental as having a footer or header on the site and should be recommended by all developers to their clients. The WCAG has four main principles from which its guidelines are categorised by (Figure 5).

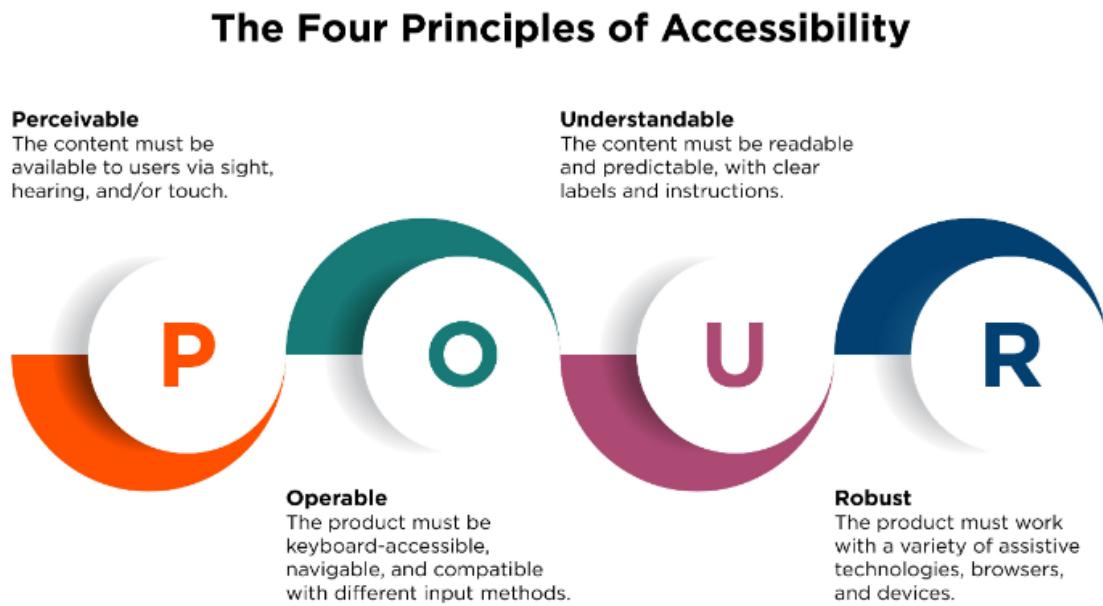


Figure 5 - (Straive, n.d.).

The guidelines can reach a “staggering 80+ page count” (Accessibility Checker and Trichter, 2022), which details instructions on how to make the site accessible while also giving examples and potential ways to debug (defined as correcting errors flagged in the code). The benefit of the WCAG is that it is detailed and direct; the drawback is that it is time-consuming for the developer to study and implement.

The developer is under no obligation to make the website accessible without the correct compensation. Despite this, there are parts of development that can be defined as both accessibility and as *writing clean code*. As a developer, having readable code is important, and semantic tags such as the header, nav, footer, and main help make the code easier to follow and understand for other developers. This implementation is an industry standard and is often required when coding; opportunely, it also doubles as meeting some of the WCAG guidelines: 1.3.1 Information and relationships and 1.3.2 Meaningful Sequence (Mcgrath, 2013). This is an example of what well-structured code can do as a by-product, it aids those who require assistive technology such as screen readers, while also being Semantic HTML. The guidelines are not a checklist that has to be completed in their entirety for every website. A few guidelines are either

irrelevant to the website given its content and structure or may have automatically fulfilled them within the code. Regardless, some guidelines are far more strenuous to complete and require more attention than others. However, based on the research done on the guidelines, there is a baseline of accessibility that developers could and should achieve as part of their design and development, and that is Priority 1, Level A. The most common WCAG failures are not complex at all, these mainly fall under the category Priority 1 (Figure 6.1).

WCAG Failure Type	% of home pages in 2022	% of home pages in 2021	% of home pages in 2020	% of home pages in 2019
Low contrast text	83.9%	86.4%	86.3%	85.3%
Missing alternative text for images	55.4%	60.6%	66.0%	68.0%
Empty links	50.1%	51.3%	59.9%	58.1%
Missing form input labels	46.1%	54.4%	53.8%	52.8%
Empty buttons	27.2%	26.9%	28.7%	25.0%
Missing document language	22.3%	28.9%	28.0%	33.1%

Figure 6.1 - Home pages with most common WCAG 2 failures (WebAIM, 2022).

“While our 2022 analysis saw small decreases in the number of detected accessibility errors and WCAG conformance failures, significant work remains to be done to make the web accessible to everyone.” Amending these minute errors can bring forth a new standard whereby all websites meet the Priority 1 category by simply writing clean code with tags that are meaningful.

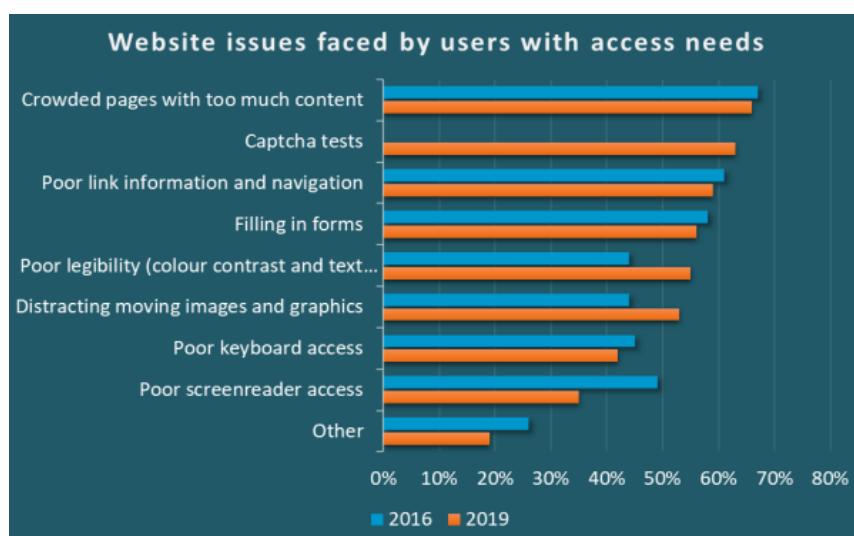


Figure 6.2 - (WebAIM, 2022).

On the other hand, the development of tests to identify if a “user is really human and not a bot” (Cloud Flare, n.d.) has brought about a new wave of accessibility issues. The Captcha (Completely Automated Public Turing Test) is implemented almost by default on many websites, including the tech giant Google, and its main purpose is to add a layer of security for businesses by protecting access, blocking spam, and stopping bots. It can be found on E-commerce websites as it is recommended to use for logins and sign-ups. The issue with this is that it creates a dilemma for developers. Do developers add an extra layer of security to their websites or do they make the website accessible? (Messina, 2021) refer to (Figure 6.2). This is of particular concern for developers that work with databases and sensitive information as they need to ensure the safety of their site, especially with the increase in hacking (Visualmodo, 2019). This is an example of when software is developed without thinking of accessible solutions and is not something that can be resolved by web developers. In this scenario, the WCAG 3.0 guidelines that will be used to regulate software being developed for the web, will initiate the conversation for accessible Captcha-esque implementation.

Development of Website

The objective of the practical component is to prove that E-commerce can be accessible, inclusive and innovative. “There is a ton of space for innovation in this area”, stated C. Danielson (Firth, 2019, pp.135–136), supporting the proposition that accessibility is not a stale topic but one that has the potential to expand and produce further innovation. The progress that W3C has made in making the web more accessible has been based on research, and now there are many communities online where developers, UX/UI designers, and advocates come together to discuss, educate and produce new ideas for continued progress in this area.

The practical component is called ‘Nirvana Cosmetics’, and it sells a range of products. The reason this sector was chosen is due to the cosmetics “market size...valued at USD 254.08 billion in 2021” (Grand View Research, 2019), which is expected to increase dramatically by 2028. Consequently, a bigger online presence will ensue.

2.1 WCAG Guideline Analysis

The WCAG guidelines at first glance, are daunting, the long list of *to-dos* are hard to follow. However, the WHUCAG community of accessibility-certified developers compressed the guidelines and made a checklist that compiled the “staggering 80+ page count” (Accessibility Checker and Trichter, 2022) into a condensed, manageable eight-page document. The underlying message to developers is to give the user, where possible, as much control over the features –an interesting idea and one that encourages developers to become more conscious of small things that certain websites and applications automatically implement that are frustrating, for example, Netflix’s autoplay feature. After assessing and getting inspiration from existing companies, as will be further discussed in 2.3. Design section, a draft of the practical components layout was made as a way to avoid making the same accessible mistakes as other companies. From reading the guidelines for Priority 1 through to 3, the main points that were focused on are:

Priority 1 - 1.3.1 Information and Relationships

- Develop a clear semantic structure.

Priority 1 - 1.3.2 Meaningful Sequence

- Present content in a meaningful order.

Priority 2 - 2.4.5 Multiple Ways

- Provide many forms of navigation (in the header and footer).

Priority 2 - 1.3.4 Orientation

- Responsiveness without losing meaning or function.

Priority 2 - 1.4.4 resize Text

Priority 3- 1.4.6 Contrast

- The contrast ratio between text and background is at least 7:1 (black and white).

Priority 3 - 1.2.6 Sign Language

- Provide sign language translations for pre-recorded videos

Priority 3 - 3.1.5: Reading Level

- Readability/ Understanding Content.
- Users with nine years of school can read your content.

Figure 7 - Wuhcag checklist (Mcgrath, 2013).

The majority of the guidelines would be fulfilled through development. However, for this project, the importance of constant accessibility development and innovation needed to be emphasised. Each of the stated guidelines (Figure 7) were further investigated in order to analyse how other websites across a diverse range of industries had implemented these guidelines.

2.1.2 Sign Language

Sign Language was a topic that was intriguing the more it was researched. An article written by Nathalie N. Belanger and Keith Rayner states, “Levels of illiteracy in deaf populations around the world have been extremely high for decades” (Bélanger and Rayner, 2015). Further research into this research was needed, as it was clear that this was an issue among the deaf community that was not being addressed. This is evident after considering the research found, the earliest of which was from 2017. A study conducted with deaf children found that “82% of signing children” were “reading below their age level”. The study concluded the deaf children overall performed “below average” (Bélanger and Rayner, 2015). It is important to note that sign language and written English are different, it is equivalent to having to learn a new language to understand it. Sign language depends on body language, gestures and facial expressions to convey information (Calvert Trust, 2020). Whereas verbal and written communication does not rely on external gestures or context to understand the words being said or read, making it simpler than the more nuanced demands of sign language.

“It can be pretty challenging for someone with severe hearing loss to be able to learn how to read, which is why there are often high levels of illiteracy found amongst the deaf population” (Garcia, 2021). As a result, it is essential that changes are introduced to make it easier for the deaf community to participate in commerce by providing an alternative method to read the content. To further emphasise this point, “of the 11 million people in Britain who are deaf, over 150,000 use British Sign Language (BSL) as their preferred language, not English” (Firth, 2019, pp.135–136). This is similar to the struggles of many bilingual people, who often, if given a chance, will pick their native language to read in rather than their second language. “What makes a foreign language so difficult is the effort we have to make to transfer between linguistically complex structures. It is also challenging to learn how to think in another language. Above all, it takes time, hard work, and dedication.” (Justlearn, 2020).

The difference between Sign language and English is complex, which is what makes it difficult to pick up reading easily, this results in the significant illiteracy rates in the community. In a study by Sedey (1995), he “found that deaf adolescents' ability to learn new fingerspelled words quickly (i.e., fast mapping) was highly correlated with their reading vocabulary, meaning that the better a student's receptive fingerspelling skills, the larger their knowledge of English words.” (Haptonstall-Nykaza and Schnick, 2007). This shows it would be beneficial if the option to have Fingerspell as an English substitute would prove valuable and could double as an additional accessibility feature. Fingerspell is used in education as a bridge between sign language and

spoken language (Worldwide, n.d.), this attests to the importance of having Fingerspell widely available on the web as an aid for the deaf community as this would make it easier for deaf people to comprehend content.

2.2 Accessibility Feature

As previously stated, accessibility can be the driving force for innovation and in this project, the fingerspell feature can be a worthy addition to the existing accessibility standards. Fingerspell will be an option alongside the colour ratio and font size as part of an *accessibility menu*, which can be used to make adjustments to the website. The fingerspell function will convert all text into fingerspell that is generated from an already existing font. This will occur with the click of the button. This will be able to be scaled up or down in size using the font-size feature; however, this will not be implemented to the mobile view as, in the debugging stage, the font would not correctly scale to the viewport and therefore would distort the pages layout. If it would have stayed as it was, it would have violated one of the WCAG guidelines, where the overall layout is inconvenient to the user due to the scaling of the text (Mcgrath, 2013).

Alongside this, the WCAG guidelines have been followed throughout the code, without bypassing the statistically minute features.

In the interest of demonstrating the accessibility of the practical component, the following websites will be used to assess the different guidelines that have been successfully met.

The selected accessibility checkers are Accessibility Checker and Site Improve.

An additional website will be used to help with the site's development process, as it scans the site and shows accessibility errors. It will be one tool used to ensure the aim is accomplished. The toolkit used belongs to Accessible Web. The reason there is a range of accessibility checkers is to add credibility to the score (see section 2.5 Results).

2.2.1 Accessibility Menu Layout

The website that inspired the design for the accessibility menu comes from an ‘accessibility’ agency, which audits and consults with developers on how to reach the different Priority levels of the WCAG. The layout itself is based on the typical horizontal navigation menu layout.

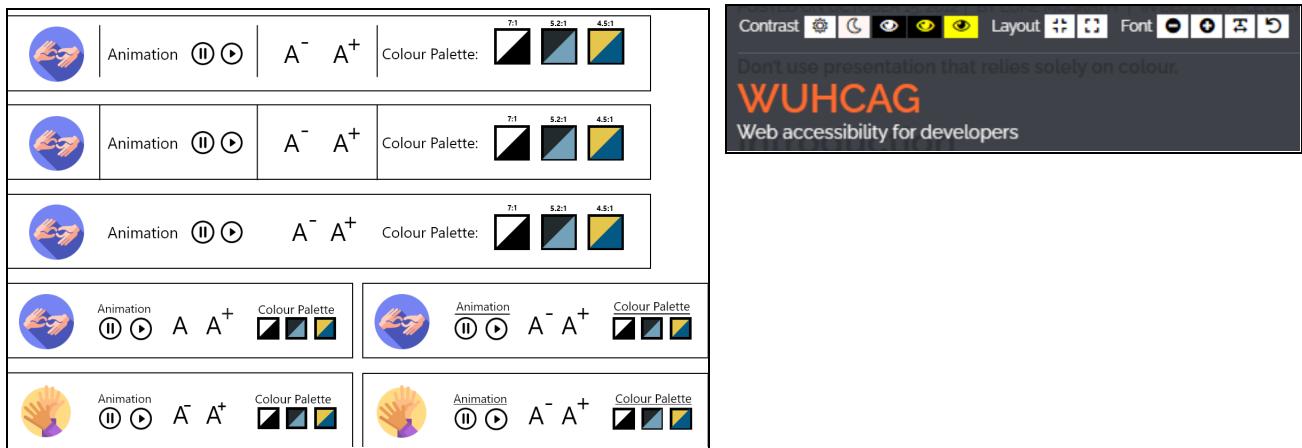


Figure 8.1 (left) - list of draft designs for the accessibility menu (WUHCAG, 2022).

Figure 8.2 (right) - accessibility menu on the WUHCAG website (WUHCAG, 2022).

As seen in (Figure 8.2), the menu follows a horizontal layout incorporating the ‘*position: sticky*’, which allows the menu to stay on the page as you scroll down. The reason for this is to show that the accessibility menu should be by default on the main page for users to see, rather than hidden within an icon that then expands to reveal it. (Figure 8.1) is a collection of designs that were created in order to examine which would be user-friendly, best designed and also easy to understand.

2.2.2 User Testing

The intent was to develop a prototype of the website with an accessibility menu, which would undergo user testing of the target demographic and test overall usability, focusing more on the fingerspell feature. The target demographic is specific to people within the deaf community whose first language is Sign language. However, the lack of funding which would have been required to facilitate meeting with the target demographic and having an interpreter presented a barrier. Additionally, the people that were contacted and were interested did not want their personal information to be used for this research. This, therefore, meant an evaluation from the selected Amazon, Shien, Chella and Cait+Co websites against the practical component was impossible. Despite this, the secondary data, accessibility checkers and the use of examples provided enough data for the final layout to be selected. The time allotted to user-testing was redistributed to make the backend of the website and further research the secondary data.

2.3 Design

To develop a design that reflected the current trends in E-commerce: Amazon and Shein were reviewed, as they are bigger E-commerce sites and tend to be up-to-date with most media trends. Also, since the site being developed is for cosmetics, Chella and Cait+Co were selected due to being smaller online businesses and relevant to cosmetics. These examples give a general feel for what businesses are trying to present to their consumers. The inspiration taken from these can be clearly seen in the practical component, where the method in which the products are laid out is in a grid format, the cart is simple showcasing the products selected, and the checkout method (Figures 10.1 and 10.2).

2.3.1 Moodboard

These websites have been selected as they are popular while also representing an aesthetic that aligns with modern E-commerce trends. Additionally, these layouts can be said to be successful mainly due to the images used that represent the business's tone. The structure of most of these sites is a simple grid layout with pictures that tend to take up a large portion of the screen which give the users a sense of the business's identity. The key to achieving a similar feel is to follow its simplicity (Figures 9.1 and 9.2).

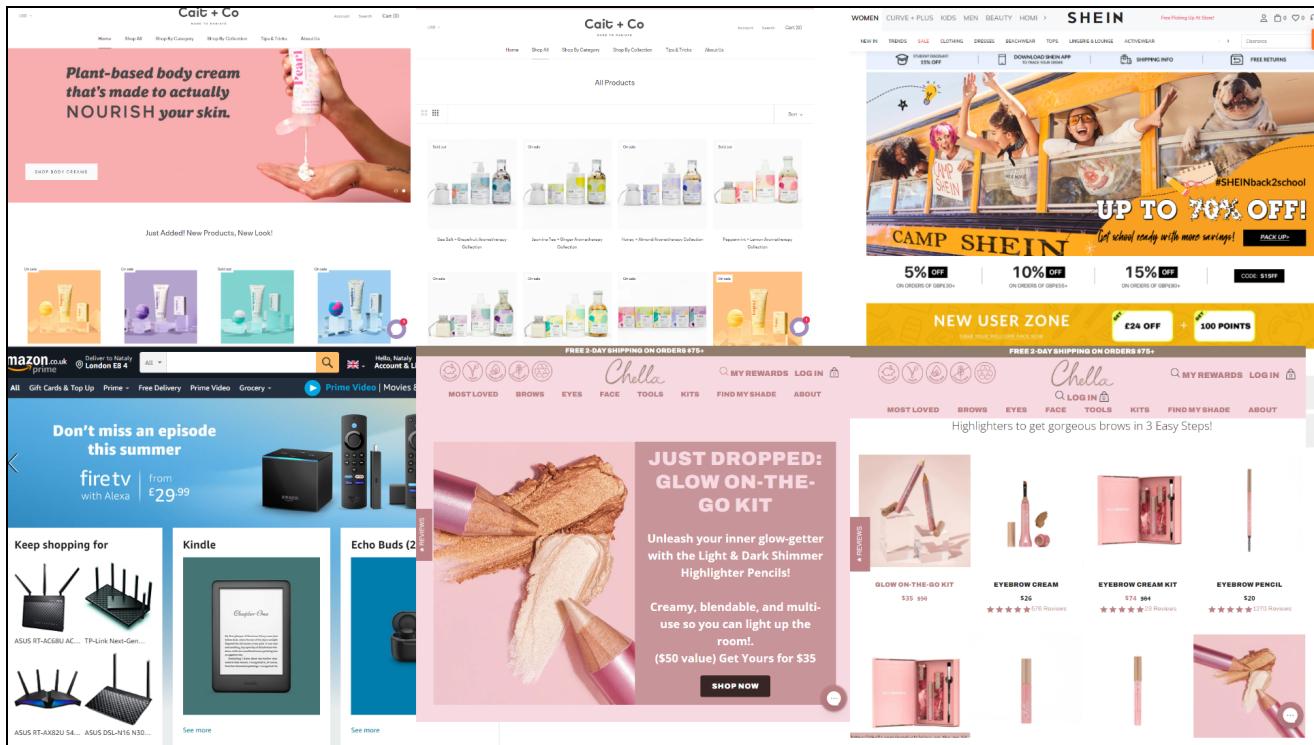


Figure 9.1 - A collection of screenshots from the selected websites, including the homepage and product page.

The image shows the Chella website's cart and checkout process:

- Cart Page**: Shows a single item: "Jasmine Tea + Ginger Aromatherapy Collection" (\$45.99). It includes a note about free shipping and a section for adding an order note.
- Checkout Page**: Shows payment options (shopPay, Amazon Pay, PayPal, Google Pay) and contact information fields. It also displays a promotional banner for the "GLOW ON-THE-GO KIT".
- Shopping Basket**: Shows a list of items including "Mai Chella + VelaBeauty Blushing Rose Eyeshadow Palette" and "Hydrating Cleanser Lush Balm". It includes a "prime" badge, a "Best Seller" badge, and a "Maybelline Eyeliner Hyper Precise Liquid Eyeliner Black" item.
- Order Summary**: Shows the subtotal of £4.99, shipping fee, and a total of GBP£10.99. It also includes a "checkout securely now" button and payment method icons (Visa, Mastercard, American Express, etc.).

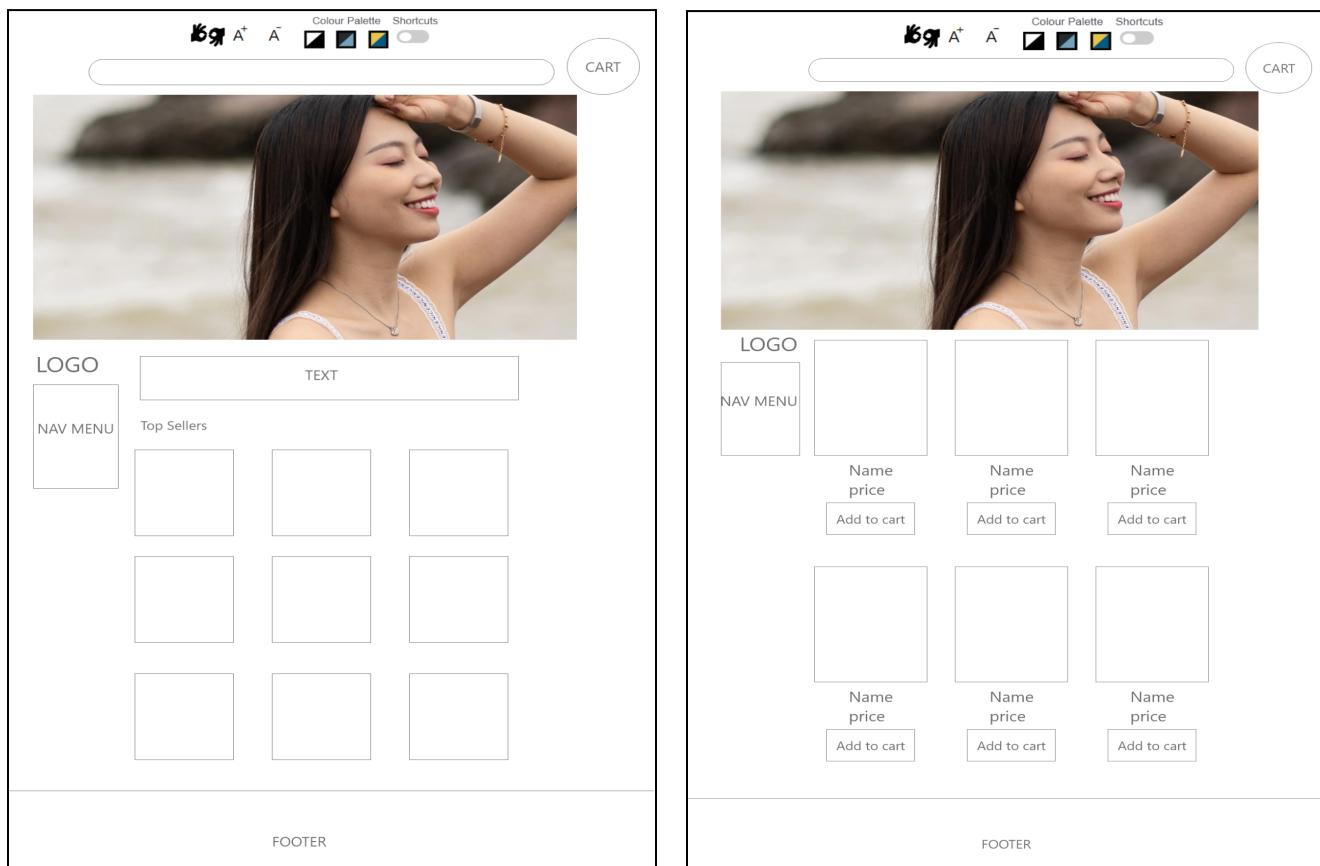
Figure 9.2 - A collection of screenshots of the selected website's cart and checkout layout and methods.

2.3.2 Wireframes

Wireframes are commonly used in web design and are essentially visual drafts of the structure the website is likely to take. The process for developing the wireframes for Nirvana Cosmetics was straightforward, given the fact that the layout was already decided based on the examined websites (Figures 10.1 and 10.2). Even so, it is best practice to create wireframes as a base to start from, this, of course, changes and adapts throughout the development of the website. In the website, there are a few features that differ from the original wireframes, however it does not stray too far from it. The reason for the changes from the wireframes was due solely to aesthetic reasons, the end layout is what was thought to be the better design at the time.

Figure 10.1 (left) - Image of homepage wireframe.

Figure 10.2 (right) - Image of product page wireframe.



2.4 Development

After reading through the WUHCAG's checklist and making further notes on the guidelines, searching for AAA-rated (Priority 3) websites was the next step. It was difficult to find a specific website that surpassed Priority 2, illustrating that most websites are, by default, excluding users. The development of this project uses industry-standard technologies. The reason for this is that as the industry evolves alongside its programming languages, developers have to evolve too. Therefore, it is the logical step to develop this project using the following:

Frontend

- HTML
- CSS/SASS
- JQUERY

Backend

- MongoDB
- NODE.JS
- HEROKU

The practical component was not originally intended to be Fullstack (including frontend and backend development), yet, as the project developed, it evolved into it. The reason being that without the backend implementation, the amount of data being held on a JSON file would only slow the website down. For the front-end, jQuery was used as it is a popular JavaScript library and is used on many websites, more notably: Zoom, Spotify and Opera browser. jQuery simplifies event handling, Ajax configuration and even animations. jQuery makes code lightweight, thereby increasing the speed of the site. This allows for readable code and smoother client-side event handling. Additionally, it was used as an opportunity to learn new industry technologies and expand the stacks available to the developer. Having experience with different libraries and programming languages is beneficial as they require different mindsets when approaching problems, thereby improving critical thinking and providing value to future projects.

Furthermore, the use of MongoDB was due to prior knowledge of databases and understanding of which works well. Naturally, the most common backend languages were reviewed. Node.JS is said to be reliable and similar to JavaScript, which helps when it comes to debugging. Lastly, Heroku was paired with MongoDB in order to host the server, if not, the website would not have been able to go live. The drawback of not having a dedicated server set up and relying on a free service is the cost of run-time for the website, thus causing a delay when loading certain features. Despite this, it was still the best option as the website's primary focus is the front end.

2.4.1 Functions

The following section will be a detailed breakdown of the main functions of the website, it is essential to know why these functions were implemented to follow industry standards and trends.

2.4.1 (a) Accessibility Menu

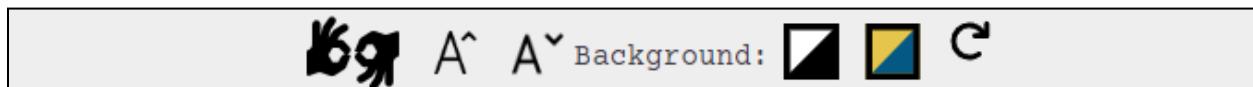


Figure 11 - An image of the final design of the 'accessibility menu'.

The reason the Accessibility Menu was implemented as a function was the result of the research conducted on accessibility. The functions available on this menu are as follows: Fingerspell conversion, font-size increase and decrease, changing the colour ratio from coloured to monochrome and the refresh feature (Figure 11). These functions were added using a combination of jQuery and CSS/SASS to impact the website's styling while also capping the font size to about 40 pixels at its maximum and 16 pixels at its minimum. Originally, the background ratio would have had three options but they were later deemed unnecessary as the website's colour palette would be pre-defined by the business, and the adjustments made should be to achieve the 7:1 ratio (the highest contrast between background and text), thereby achieving the Priority 3 guideline as per 1.4.6 Contrast (Enhanced) (Figure 7) . The reset feature takes the site back to its original state. The Fingerspell feature was adapted as a result of the research on the deaf community's illiteracy rates, providing an alternative option for reading content. The development of this feature allows the user to convert all the content on the site into fingerspell icons, which can be made smaller and larger with the font-size feature. The Fingerspell function was developed here as an innovation to develop more accessibility functions; therefore, it does not check off any of the guidelines as it stands. The intention of this is to contribute to accessible development and explore new ways to be inclusive.

2.4.1 (b) Navigation Bar

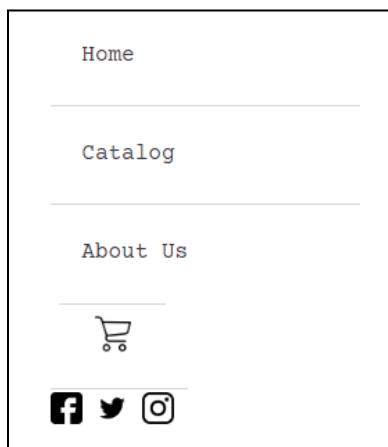


Figure 12- An image of the navigation menu layout.

The navigation menu here (Figure 12) differs from most in its use of a vertical layout instead of a horizontal one. This was accomplished through CSS/SASS.

The decision to have the social media links with the navigation menu was a user-experience choice. Typically, these links are kept in the footer but this design choice allows them to be easily found.

2.4.1 (c) Search bar and Cart

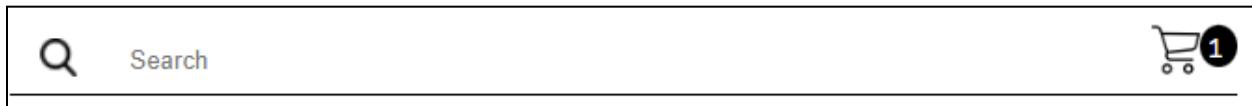


Figure 13- An image of the search bar layout.

The search bar layout can be seen in the mood board, a frequently used design and feature for most E-commerce websites (Figures 9.2 and 13). To achieve the search function on the website jQuery and Node.JS were used for the connection to the database. Additionally, the cart takes the values from the Add to Cart buttons and stores them in the Local Storage, where it is then presented on the cart pop-up. When developing the cart, there was a bug that would not allow the item to be deleted from the cart, this meant that once an item is added, it will stay there. After debugging, this issue stemmed from the Local Storage not having a function to delete individual items it has stored, only being able to remove the whole array of items. Due to this, the delete function is not operational. The method to correct it would involve restructuring the carts implementation that would require the use of an API (Application program interface). An API often means the code is not open source and if there were any core accessible issue in its foundation, there would be no way to correct it.

2.4.1 (d) Payment gateway

The cart pop-up guides the customer to the payment gateway, Paypal (Figure 14). The use of the PayPal API is frequently seen on many E-commerce websites. It provides the necessary data security customers expect when they input their sensitive and personal information while also saving the need to implement more tables on the database, and providing secure transactions. The layout is common and inspired by other websites (Figure 9.2).

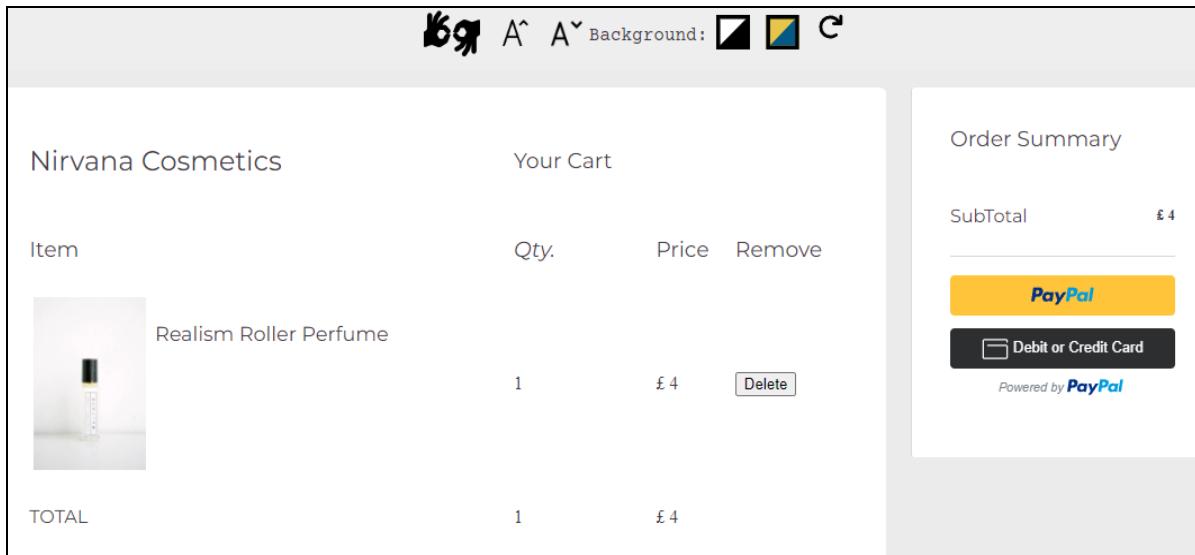


Figure 14- An image of the cart and payment method.

2.4.1(e) Accessibility Policy

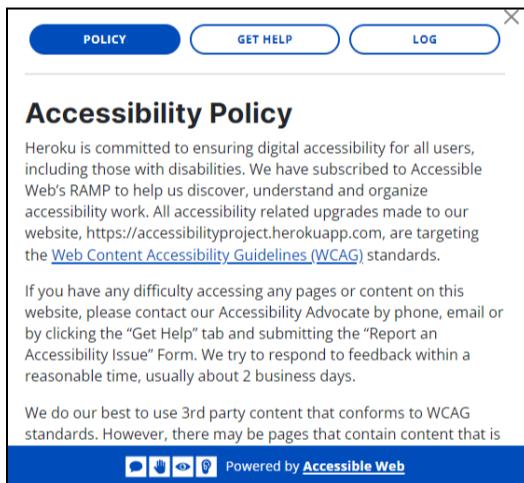


Figure 15 - Accessibility Policy API Accessiblity Web, 2022).

Through the use of Accessibility Web's toolkit to monitor Nirvana Cosmetic's website level of compliance, their API was the one selected to implement. This feature is recommended as a form to declare that the site is accessible but also a means in which to give feedback or flag any problems by the user through their 'get help' tab (Figure 15). This feature is placed in the footer as it is information that is not directly related to the page's content.

2.5 Results

With the completion of the practical component, the final task left is an audit utilising the two websites mentioned in the 2.2 Accessibility feature; Accessibility Checker and Site Improve. As demonstrated previously in (Figures 3.1, 3.2 and 3.3), the audit determines the level of accessibility the website contains and outputs a percentage. The overall purpose of the practical component was to pass Priority 1, 2 and meet the majority of Priority 3 guidelines—the results will show the development of this website has been successful in generating an example of accessible E-commerce.

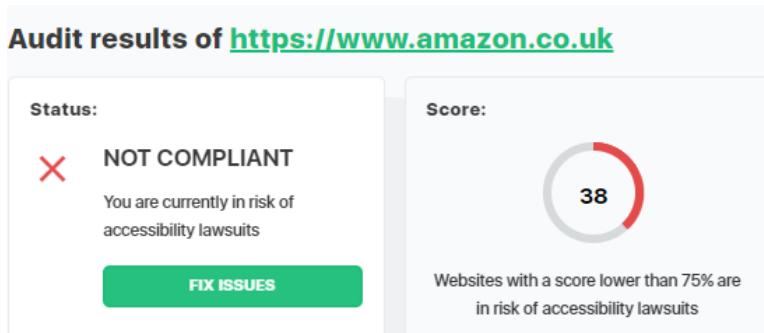


Figure 16.1 - Amazon's Accessibility Audit (Accessibility Checker, 2022).



Figure 16.2 - Shein's Accessibility Audit (Accessibility Checker, 2022).

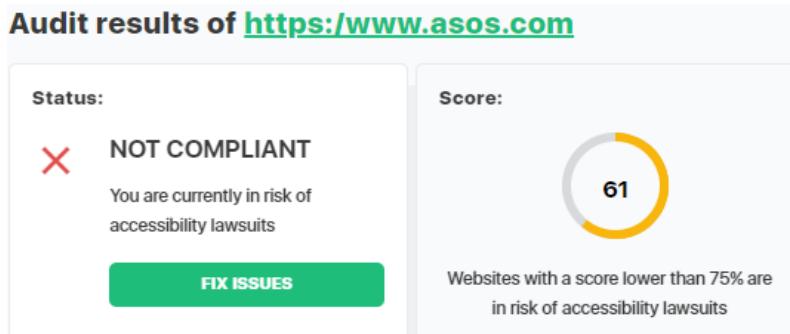


Figure 16.3 - Asos's Accessibility Audit (Accessibility Checker, 2022).

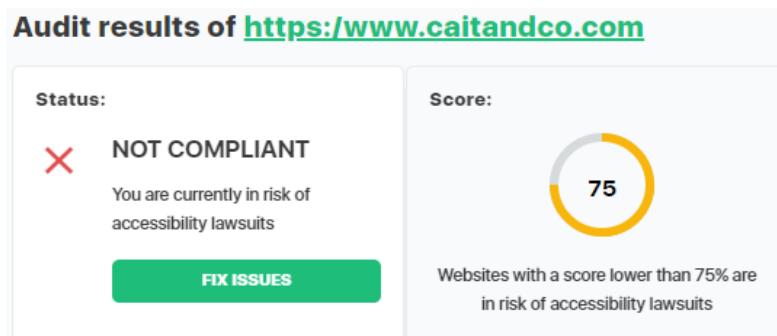


Figure 16.4 - Cait + Co's Accessibility Audit (Accessibility Checker, 2022).

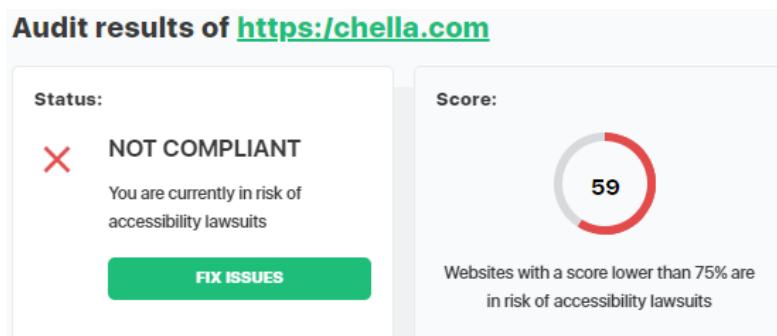


Figure 16.5 - Chella's Accessibility Audit (Accessibility Checker, 2022).

As seen in (Figures 16.1, 16.2, 16.3 and 16.5), these companies are not compliant with the WCAG and therefore at risk of legal action. In comparison, Cait and Co's website is the only one to reach the minimum required to avoid legal action but is still not entirely inclusive (Figure 16.4).

The practical component ends with an audit by two sites, which combined both: Accessibility Checker's and Site Improve's toolkit, to validate the site's accessibility. The results of these audits show that this site has been successful in achieving the Priority 3 rating, awarded by the two sites.

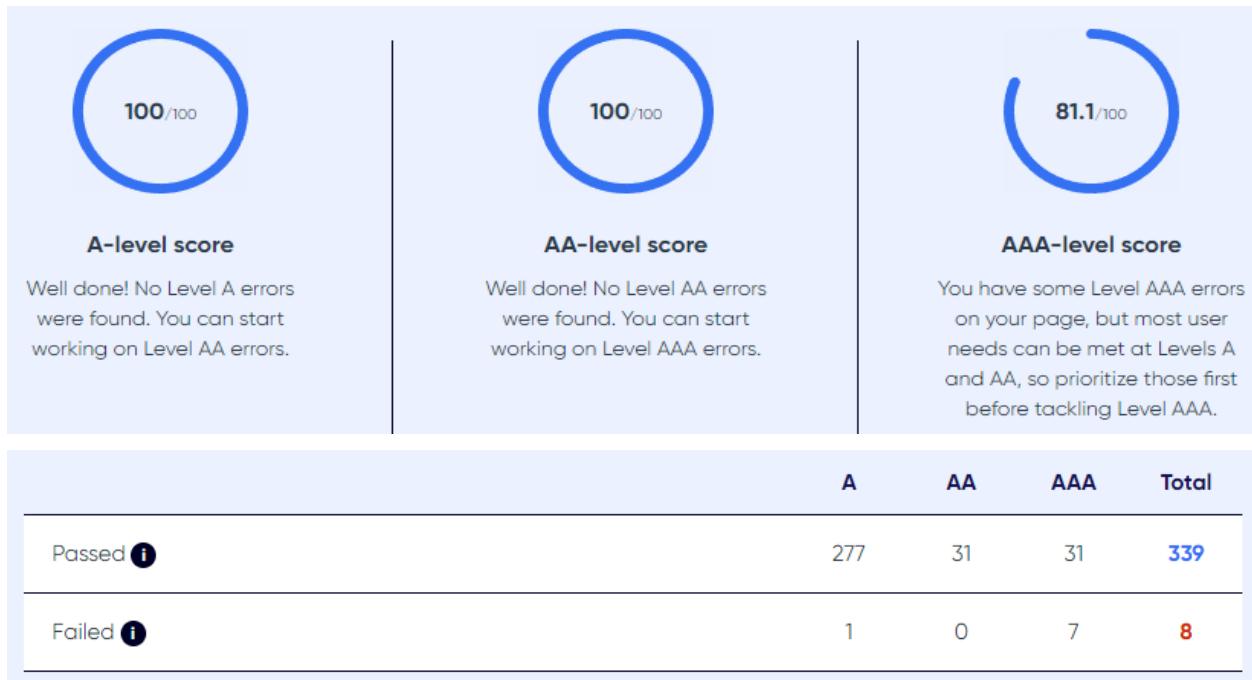


Figure 16.6 - This showcases the accessibility results of Nirvana Cosmetics (site improve, 2022).

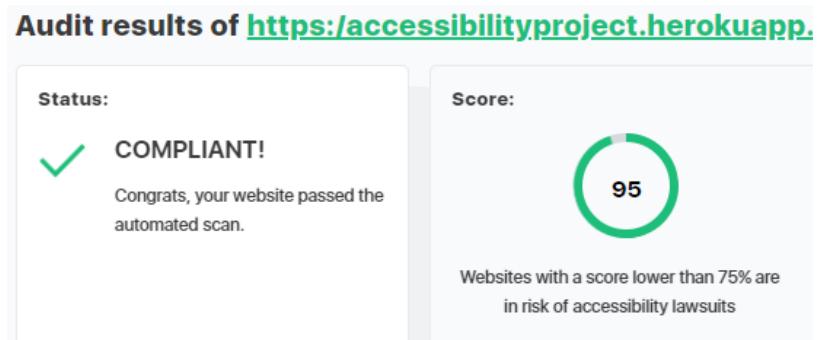


Figure 16.7 - This showcases the accessibility results of Nirvana Cosmetics (Accessibility Checker, 2022).

(Figure 16.6) provides evidence as to the number of guidelines that have been achieved per Priority. It is clear that they are to a high standard. (Figure 16.7) compares the practical component to the selected examples. The results here point to Nirvana Cosmetics being deemed a highly accessible website.

Conclusion

To conclude, the accountability for inaccessible E-commerce platforms falls to business owners as they control what product they output. The importance of accessibility in web development will only become more important as society becomes increasingly reliant on technology, and so E-commerce will need to reflect this change. The Covid-19 pandemic was a driving factor in demonstrating the usefulness of E-commerce and its potential for automating and simplifying the daily lives of consumers. However, the rush (by business owners) to move their business online acted as a double-edged sword since it drove more sales to their E-commerce website, but also highlighted the inaccessibility of these sites. This negatively impacts businesses from a legal and financial standpoint and posits the argument that, striving for accessibility as an E-commerce business is imperative to achieving financial growth. The increase in online shopping and the ever-burgeoning number of online retailers shows that businesses with accessible websites will have the advantage over those who do not. "When you do accessibility and you do things right, you change the world." Tim Harshbarger, Senior Accessibility Consultant (Deque Systems, 2022). By going against what seems to be the norm online, businesses are enhancing their relationship with consumers, and avoiding unnecessary legal action. Furthermore, they are given an opportunity to build a business that is an exemplar for others and standing on the cutting edge of a movement committed to accessible design in B2C businesses. Therefore, it is essential for businesses to provide the right environment to cultivate loyal consumers, and especially for the disabled community who are frequent users of online shopping and the drivers of innovation within this field.

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