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## **Innovative Web Design and Accessibility**

How are accessibility guidelines considered with aesthetic driven web design?

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**ABSTRACT:**

Aesthetic approach to web design provides a visually pleasing experience for the user. Some exploratory features can also enhance the experience, leaving a lasting image on the user. However, these features might significantly hinder the accessibility of the said websites, resulting in a dilemma between the visual aspects and accessibility guidelines. The aim of this master's thesis is therefore to investigate the potential conflict between aesthetically inspired web design and web accessibility. A total of ten websites are analyzed using an automated accessibility checker tool. The sample pages are selected using a framework, ensuring their "innovativeness" to be fit for the study. The results are then examined together with the design principles and current design trends, from where an answer to the following research question can be formulated: "How are accessibility guidelines considered with aesthetic driven web design?"

The thesis starts with a theoretical portion covering the two main themes of this thesis, web design and accessibility. Web design is further divided into an aesthetic approach and an accessibility approach. The theory around web accessibility revolves around WCAG guidelines and success criteria. The research is conducted through qualitative content analysis, which allows for a flexible approach to the research question. It is also suitable to the exploratory nature of the research, as this study enters a fairly understudied research area at the intersection of innovative web design and accessibility. The two aforementioned themes form the research lenses utilized in this thesis. In the data analysis phase, the findings are analysed through these lenses, resulting in a comprehensive answer to the proposed research question.

The key findings indicate that a slight trade-off between innovative web design and accessibility exists. First, the analysis through the design principle lens reveals some prevalent trends. Visual design principles are found to be dominant, while less attention is paid to interaction principles. An automated accessibility evaluation tool is subsequently run on the sample webpages. The results provide data on both the quantity of the accessibility violations as well as their types. Findings show that the most frequent violations are related to visual features, particularly in the form of contrast, navigation and non-textual content. As a result, the interactability of the pages is found to suffer from this. Lower interactability in turn affects the accessibility of the pages.

This study is conducted with a limited sample size due to limited resources. With a larger sample size, multiple evaluation tools and potentially a user-testing phase, the results would be more conclusive. Future research is able to build upon the groundwork produced in this study. The dual-lens approach is found to be suitable for this kind of study and is replicable method for future. The framework for selecting the sample pages can also be utilised.

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**KEYWORDS:** Web accessibility, web design, user experience, design trends

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**TIIVISTELMÄ:**

Visuaalisuutta painottava verkkosuunnittelu kykenee tarjoamaan käyttäjälle uniikin tai muuten mieleenpainuvan käyttäjäkokemuksen. Hyödyntämällä erilaisia toiminnallisuuksia tai suunnitteluvaihtoehtoja, käyttäjiin pyritään vaikuttamaan, ja sitä kautta lisäämään sivun kiinnostavuutta. Tämänkaltaisen suunnittelu saattaa kuitenkin heikentää sivun saavutettavuutta, johtaen ristiriitaa visuaalisen verkkosuunnittelun sekä saavutettavuuden välillä. Tämän työn tarkoituksena on tutkia tätä dilemmaa analysoimalla yhteensä kymmentä verkkosivua automaattista tarkastustyökalua hyödyntäen. Otokseen päätyneet verkkosivut valitaan tietyt kriteerit käyttäen, jolloin varmistetaan sivustojen luonteen olevan tutkielman kannalta sopivat. Tuloksia peilataan sekä suunnitteluperiaatteisiin että ajankohtaisiin trendeihin, minkä pohjalta vastaus tutkimuskysymykseen saadaan muodostettua: ”Nykyisten verkkosuunnittelutrendien vaikutus saavutettavuuslakien noudattamiseen”.

Tutkielma alkaa teoriaosuudella. Kaksi pääteemaa, verkkosuunnittelu sekä saavutettavuus käsitellään tässä osiossa perusteellisesti. Teoria saavutettavuudesta keskittyy WCAG saavutettavuusohjeisiin ja sen sisältämiin kriteereihin. Verkkosuunnittelusta tunnistetaan sekä visuaalinen että saavutettavuuslähtöinen näkökulma. Tutkielma toteutetaan laadullista sisällönanalyysiä hyödyntäen. Metodi sopii työn jokseenkin eksploraatiiviseen luonteeseen, antaen tutkimusprosessiin joustavuutta. Työn fokus visuaalisen verkkosuunnittelun sekä saavutettavuuden risteyskohdassa on suhteellisen vähän tutkittu aihealue, joten edellä mainittu metodi tukee tätä erinomaisesti. Tutkielman pääteemat muodostavat kaksi tutkimuslinssiä, joiden kautta tutkimuskysymykseen saadaan vastattua kattavasti.

Työn keskeisimmät tulokset osoittavat lievän negatiivisen yhteyden innovatiivisen verkkosuunnittelun sekä saavutettavuuden välillä. Analyysivaiheessa tunnistetaan ensin vallitsevia trendejä verkkosuunnittelussa. Tutkimusotoksessa visuaaliset suunnitteluperiaatteet osoittautuvat dominoivan, kun taas vuorovaikutus- ja käyttäjälähtöiset periaatteet jäävät vähemmälle huomiolle. Automaattista saavutettavuustyökalua hyödynnetään niin ikään otoksen analysoinnissa. Tulokset osoittavat saavutettavuusongelmien painottuvan visuaalisiin ominaisuuksiin, kuten kontrastiin, navigaatioon sekä ei-tekstilliseen sisältöön.

Tutkielman otoskoko on suhteellisen pieni johtuen rajallisista resursseista. Jatkotutkimuksia ajatellen otosta verkkosivuista olisi hyvä laajentaa. Toisen saavutettavuustyökalun lisääminen analyysivaiheeseen voisi lisätä tulosten painoarvoa ja vähentää niiden mahdollista puolueellisuutta. Tässä työssä hyödynnetty kahden tutkimuslinssin metodi osoittautui tutkimukseen sopivaksi, ja tulevaisuutta ajatellen metodia on mahdollista replikoida.

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**AVAINSANAT:** Saavutettavuus, verkkosuunnittelu, käyttäjäkokemus, suunnittelutrendit

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## Abbreviations

ISO	International Organization for Standardization
W3C	World Wide Web Consortium
WCAG	Web Content Accessibility Guidelines
UX	User Experience

## 1 Introduction

The rapid development of internet usage has made it possible for more and more services to be accessible online. Traditional services such as grocery stores, banks, government agencies and newspapers have all had to move some, if not all, of their services to the internet. This development also means that every new business must focus clearly on their online presence. A significant aspect of maintaining this presence is through aesthetically pleasing and memorable website design. Some of the more established and "old-school" institutions merely aim to provide a digital version of their physical service, whereas new businesses might want to try and stand out with aesthetically pleasing web design. As with any form of marketing, businesses want to leave a lasting impression on the potential customer, and in this case, the website user. However, with innovative web design comes a responsibility that is often forgotten in favor of immersive features and effects: accessibility. While the visually impressive features might seem functional and harmless, it is also a real possibility that some assistive technologies struggle with such features. Therefore businesses and web designers need to find a balance that can accommodate a variety of assistive technologies while also maintaining their own personal image and characteristics.

However, it is important to note that aesthetic web design is prone to subjectivity. The features that one user might find visually pleasing might not have the same effect on someone else. Therefore, for the purpose of this research paper, a framework concerning the aesthetic features of a web page needs to be formulated. Having a structured framework will help in defining what we consider as aesthetically pleasing and what features might be considered less desirable. The definitions are formed according to current web design trends and relevant research around the topic. This framework will be further introduced and explained in a later chapter.

Accessibility on the other hand is much less subjective. The generation that has grown up alongside internet will reach the point where age-related impairments become relevant, which in turn highlights the importance of web accessibility in the near future

(Pelzetter, 2020, p. 1). As mobile devices have become an everyday tool for the majority of people, accessibility issues have reached the user base without any accessibility impairments. For example, contrast issues can affect any user when operating under sunlight (Martins & Duarte, 2023, p. 12). Temporary impairments, such as injuries to the dominant hand also showcase the universality of accessible websites (Pelzetter, 2020, p. 1). Therefore, the issue of accessible web design shouldn't be limited to only concern certain disabilities, but rather aim to accommodate everyone, thus following the principles of universal design.

### **1.1 Aim and scope of the study**

The aim of this thesis is to study the potential conflict between innovative web design and its ability to follow the accessibility guidelines. The chosen sample websites can be said to represent aesthetically driven and innovative web design. For the purpose of this thesis, the sample sites are referred to as "innovative". The selection process of the websites is explained in chapter 4.2. First, the websites are manually analysed according to the design principles introduced in chapter 2.3. Through research papers and articles, key design principles in web design are identified. These findings will be formulated into a framework, which is then used to analyse the chosen set of target websites. The analysis will be run on each of the websites' front pages. The outcome will produce data on the webpages' compliance to the said principles, enabling trends to be recognized. Subsequently, the selected websites are analysed using an automated accessibility evaluation tool. This analysis evaluates the selected websites according to a standardized set of guidelines. These results are then compared against big-scale studies, which gives an idea on whether the trends in innovative web design are aligned with universal trends.

The motivation for this research paper stems both from the author's preassumption of the trade-off existing between innovative web design approach and accessibility as well as prior literature suggesting a trend supporting the aforementioned assumption. For example, Mbipom & Harper (2011, p. 147) recognize a common assumption among web designers that accessibility-driven design hinders creativity. In addition, Aizpurua et

al. (2016, p. 21) argue in their study that: "Web aesthetics should be conceived beyond the visual representation and content of websites. In order to increase the aesthetic perception of websites the information architecture and the quality of texts should be paid attention." This argument would further suggest that web design is often only concerned with the visual aspects, and that accessibility design principles are given less attention. To further enhance this argument, a study by Martins & Duarte (2023) found that out of more than two million web pages included in the study, only 0,5% had no accessibility errors detected. Furthermore, over 60% of the web pages exhibited at least ten errors. These numbers underline the lack of understanding and focus towards web accessibility among modern web designers. This research paper aims to study the gap between aesthetic-driven web design and accessibility guidelines, and thus provide an answer to the following research question: *How are accessibility guidelines considered with aesthetic driven web design?*

The scope of the study is based on the framework introduced in chapter 4. The subjects chosen for this research are considered to represent innovative web design. In total, 10 websites are chosen and analysed using an automated accessibility checker tool. The analysis is limited to concern errors and contrast errors only (figure 4). Regarding the accessibility guidelines, this thesis will follow the international standard Web Content Accessibility Guidelines (WCAG). The guidelines work as a technical standard that will be the basis of the analysis phase.

## **1.2 Method and structure**

This study utilizes a qualitative research approach. The nature of this study benefits from a qualitative method, which allows a flexible approach to the research question introduced in the previous chapter. As the topic of this thesis involves themes that are somewhat based on subjective perception, the selected research method needs to be able to accommodate this. Therefore a qualitative approach is well-suited to explore the issues regarding web designers and users respectively, enabling a flexible but comprehensive overview of the issue. The data utilized in this thesis is gathered with an automated

accessibility checker tool. The data is then analysed through two different lenses, as explained in chapter 4.4.

The thesis is structured as follows. The two main areas involved in this research paper, web design and accessibility, are introduced in detail through a literature review. Chapter two will cover the literature and research around the topic of web design and chapter three covers web accessibility in more detail. In chapter four the qualitative research approach is explored more closely. The frameworks and the data analysis method used in this paper are also introduced here. In chapter five the results of the research paper are presented. Key findings are visualized in the form of tables and figures. Finally, chapter six concludes the paper with a discussion, containing an overview of the results and their relevance in future research. The findings of the thesis are also reflected with previous literature around the topic. Limitations and future research possibilities are also recognized.

## 2 Web design

Ever since the internet became a household staple, there has been a need for web design. In the late 1990s web design was mostly concerned with the actual creation process of websites, and the visual aspects were not prioritized. Following up on this, literature around web design started to concentrate on creating design principles, with the visual aspects of a website becoming increasingly more significant (Goree et al., 2023). This can be said to be the result of the emergence of smart, portable devices. Before, the focus was on training the users on how to use the system, whereas after the change the system was expected to meet the user expectations (Hartson & Pyla, 2018, p. 6). As the field of web design experiences rapid development, so do the existing design trends. Engholm (2002) highlights that the trends tend to follow other contemporary art forms and trends such as interior design and graphic design. However, designers might have different ideologies on how to approach and utilize these trends. Goree et al. (2023, p. 18:3) refer to a study by Engholm, where the author highlights the different frameworks for approaching the design process of a website. The different approaches can vary from a purely aesthetic-driven approach to a usability-oriented approach, also with approaches from somewhere in between. Key aspect therefore in successful website design is to be able to accommodate to the users' needs with functional and relevant features, while also providing enough visual features to keep the user engaged (Walker & Beard, 2020, p. 10).

In this chapter, two different approaches to web design are covered. First, the aesthetic-driven design approach and the significance of visual stimuli in websites is explored. Subsequently, functionality and usability are also examined in the context of web design. The chapter will also cover some design principles that are generally considered a standard. Finally, the most prominent current trends in web design are identified.

## 2.1 Aesthetic approach

Web design can take an aesthetic-driven approach, where the emphasis will be put on the visual characteristics of a website. These characteristics can span from a single typed word to colour choices and text display methods, but the end goal for all these elements is to communicate with the user (Thorlacijs, 2007, p. 63). For instance, colour choices can be used to evoke certain emotions, and different typographies might be an indication of the nature of the website. The unifying factor however is the end goal of providing an experience that is either pleasing or appealing to the user, no matter what the specific features are (Schmidt et al. 2009, p. 632).

One of the key characteristics of an aesthetic-driven design approach is its ability to adapt to both the genre of the website as well as to the target audience. Firstly, the genre of the website can have a significant effect on how it is designed. Actors in industries such as the entertainment industry are expected to have visually stimulating and aesthetically pleasing features that immediately convey the purpose of the site to the user. Art museums and design stores need to convey their themes and characteristics through their websites as well. Plain and purely functional sites of this nature might easily lose credibility, if the site does not match the set expectations (Thorlacijs, 2007, p. 67-70). The target audience of the websites play a significant part in formulating these expectations. In addition to thematically matching the site and the industry, web designers have to also take the user base into consideration. Culturally different user bases can have different preferences, and therefore expectations for the website (Faisal et al. 2016, p. 847).

As the name suggests, aesthetic web design puts an emphasis on the visual aspects of a website. Some of the most prominent attributes in the aesthetic approach can be said to be related to typography and colour (Faisal et al. 2016, p. 849). The former is concerned with text, and more specifically the visual features of the text. The font choice is one of the simpler ways to influence the text on a website. Typography also includes the spacing of letters and words as well as their arrangement on the website. Proper

typography allows the user to perceive the content both more efficiently and with better ease (Kuzu, 2010, p. 880). By doing this, the user is able to understand and comprehend the content more quickly, which can become a factor in customer trust building and retention. In addition, appropriate typography leans into accessibility by facilitating users with visual impairments. The second attribute, colour, can be used to further enhance the readability of the content. It is a key factor in forming the first impression that a user has on a website. Particular colours have the potential to evoke emotions, or they can be used to convey certain messages or intentions. Depending on the purpose of the website, colour choices can have a significant effect on the user (Bonnardel et al., 2010). In a study by the aforementioned authors, the different emotions felt by the users played a key part in the length of the visit on the website. In addition, the information was found to be better received and retained when the website was thought to be more appealing. Finally, a study conducted by Schmidt et al. (2009, p. 642) demonstrated a trend among some of their participants, that to some extent, aesthetic features were preferred over technical ones.

## **2.2 Usability approach**

Usability is crucial during the whole user lifecycle. From the first impression to regular use, usability ensures that the user is both able to learn the system as well as remember it the next time. In order to maintain the user base, the website needs to ensure that the website is easy to use, that it communicates its purpose immediately, that users cannot get lost on the site, and that relevant information is easily accessible (Nielsen, 2012). The international standard ISO 9241:18 defines usability as "the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO 9241:11, 2018). Effectiveness, efficiency and satisfaction are also mentioned in the context of learning and frequency of use. Learning in this instance refers to the website's ability to be intuitive and thus accommodate new users in understanding the service as quickly and easily as possible. Frequency of use highlights the reusability features of the website, such as saved preferences or consistent layouts. Also referred to as memorability, it focuses on

the user's ability to restore their proficiency on the website after taking a break. These two components are included in the key components of usability listed by Nielsen (2012). Other components include efficiency, satisfaction and errors, where the first two are also mentioned in the ISO standard. Efficiency refers to the speed in which the users can perform tasks while satisfaction measures the pleasantness of the experience during these tasks. Low satisfaction and efficiency can push potential users elsewhere, especially if they have a better experience somewhere else (Garrett, 2022, p. 13). Finally, errors that occur on the website can be handled differently. An usability-driven website is able to limit the amount of errors and handle them accordingly. In addition, the severity of the errors is also reduced (Nielsen, 2012).

### **2.3 Design principles**

When approaching web design, it usually is in best interest to utilize both aforementioned approaches. Functional websites with well presented information and proper layering will not be effective, if the site is otherwise visually underwhelming or unattractive. Same goes with visually impressive designs where the functionality and intuitivity is disregarded (Walker & Beaird, 2020). Users need be able to complete tasks that the webpage intends them to without having to go out of their way to achieve them (Garrett, 2022, p. 12). Trends in web design are under constant change, and new ideas and techniques emerge constantly. That being said, certain design principles tend to stay in fashion. These principles offer a foundation for the design process and can be helpful in guiding the process into a cohesive end result. Unger & Chandler (2023) introduce some universally recognized design principles, which are further explored in this chapter. The authors categorize these principles into visual, interaction and psychological. Support for these principles is provided through other relevant literature. While many more principles obviously exist, those covered here can be said to represent the most common and universally accepted ones. The key findings are gathered into a table at the end of this chapter.

### 2.3.1 Visual

The first set of principles are concerned with visual design. Visual aspects are the first features that the user interacts with and therefore are crucial in forming the first impression. The balance between unity and variety is something that the website design has to take into consideration. Unity aims to create connections between certain elements, highlighting their association. Garrett (2022) describes this as information design, where "the information facilitates understanding". Variety on the other hand is used to keep the features distinctive and to provide a visually stimulating experience. Unger & Chandler (2023) use the Google icons as an example of the dilemma between the two. In figure 1 the top row represents the pre-2020 logos. Below are the unified versions of the same logos. The aim was to unify the icons with similar shaping and colouring. This rebranding received a lot of criticism for making the icons too similar and taking them further away from their real-life purposes, which ultimately resulted in Google going back to the old design on the 4th icon. The outcome highlights the importance of finding the right balance and not leaning too much into one direction.

The visual representation of elements such as text and icons only partly contribute to the overall visual outlook of the website. The way in which these elements are arranged determine what the user will see and focus on when first landing on the page. With hierarchy, the designer can dictate what elements it wants the user to see first and thus pursue certain actions or reactions from the user (Wang, 2024, NNGroup). Another way to gain the user's attention is through dominance. The elements that the users are wanted to focus on can be enhanced with sizing and colouring, and together with proper location users can be directed towards the desired elements. Removing any unnecessary elements is also a way to direct the user. By only having relevant content on the website the user does not become distracted and is therefore more likely to find the desired elements. This is referred to as simplicity (Unger & Chandler, 2023).



**Figure 1:** Google apps rebranding. (Unger & Chandler, 2023).

### 2.3.2 Interaction

After the initial visual scan of the website, the user has to interact with it. Unger & Chanler (2023) consider interaction to "start with a desire to act and understanding what can be acted upon". This means that the visual aspects have to be done in a way that conveys their purpose clearly. One way to enhance this is to create associations with real life. Search function can be portrayed as a magnifying glass and settings as a mechanical cog. While the icons might not describe the functions perfectly, they aim to create enough association to get the message across. This also applies to labelling links, where the button should convey its target clearly instead of using vague descriptions such as "click here" (Wang, 2024, NNGroup). Once the user is ready to proceed, the issue of movement becomes relevant. The size and location of the object determine how fast the user is able to interact with it. Larger icons are easier to click and being predictably located makes the interaction more efficient. Fitt's law supports this as it states that the selection time of an element decreases as the size of it increases (Yablonski, 2024, p. 16). This can be applied for example in mobile devices, where the clickable surface area of the target is expanded beyond the perceived borders, increasing the chance of success. Finally, the way in which the website reacts to the interaction tells a lot about its usability. When an action is performed, the user expects certain things to happen. Meeting or exceeding these expectations are characteristics of a proper user experience while not meeting the expectations severely hinders the experience. Giving feedback on the performed actions reduces uncertainty as the user is kept updated (Unger & Chandler, 2023).

### 2.3.3 Psychological

In addition to the visual aesthetics of the design, the emotions that these design choices evoke can be used to improve the user experience. More pleasing design is often found to be associated with ease of use and consequently increase user engagement (Hamidli, 2023, p. 6-7). When the design is perceived as attractive, it makes people feel good and consequently makes them more efficient at problem solving (Norman, 2003, p. 1). In other words, if the user encounters problems on the website, they are more likely to overcome them when they are satisfied with the design and thus find the site easier to use. This also builds trust between the user and the website as a well-thought-out design is seen to correlate to other areas as well (Unger & Chandler, 2023). Trust towards a service can also be achieved through social proof where people faced with dilemmas consult other users through reviews and other statistics.

**Table 1:** Design Principles.

Visual	Description	Sources
Unity	Creating connections between elements	Garrett (2022); Unger & Chandler (2023)
Variety	Creating enough variety between elements to maintain engagement	Unger & Chandler (2023)
Hierarchy	Placement of the elements can be used to influence certain actions	Unger & Chandler (2023); Wang (2024)
Dominance	Certain elements can be enhanced with size and colour	Unger & Chandler (2023)
<b>Interaction</b>	<b>Description</b>	

Associa- tion	Link between real world and the web elements. Conveying the purpose of actions with labelling.	Unger & Chandler (2023); Wang (2024)
Move- ment	According to Fitt's law, selection time of an element decreases as its size increases. Elements with predictable locations make it easier to interact.	Yablonski (2024)
Re- sponse	Feedback on performed actions reduces uncertainty and confusion.	Unger & Chandler (2023)
<b>Psycho- logical</b>	<b>Description</b>	
Attrac- tiveness	Association between visually pleasing design and ease of use. Positive emotions increase engagement.	Hamidli (2023); Norman (2003)
Trust	Websites that follow most of these principles are found to be more trustworthy.	Unger & Chandler (2023).

## 2.4 Current trends

UX Collective, an independent publication, compares the current trends to late-stage capitalism. In short, this is portrayed with "market saturation, heavy focus on financial growth, commoditization, automation, and increased financialization" (UX Collective, 2024). For the purpose of this thesis, these characteristics and other related trends are further explored. At the end of this chapter, the findings are summarised in table 2.

With the rapid emergence of artificial intelligence (AI) enhanced tools, automation is perhaps more relevant than ever. The role of a web designer is shifting from a solely creative role to one where AI is utilized to facilitate user needs and preferences efficiently (Xu et al. 2024, p. 99). As the AI-enhanced tools are able to analyse user data unlike ever before, web design seems to be taking a more user-centric approach. Personalized experiences can be created by utilizing data such as user profiles and transaction history (Xu et al. 2024, p. 99). By being able to provide relevant and targeted experiences, the users feel more engaged, increasing the overall user satisfaction (Paneru et al. 2024, p.

109). In addition to artificial intelligence, other features such as immersive technologies and voice recognition further highlight the user-centric mentality (Paneru et al. 2024, p. 108). Therefore the features around voice technologies are also becoming a part of the emerging design trends (Azarenkov & Svintsova, 2023).

Financialization in the context of web design refers to the profit-first approach to the design process. UX Collective (2024) describe this trend in their yearly publication as: "Designers who work at for-profit companies are not helping users as a public service, but because happier users will generate more business for the companies that hired us in the first place." Xu et al. (2024, p. 99-100) on the other hand highlight the traditionally complex nature of financial services. Therefore a trend towards UX design that aims to simplify this complicated information is on the rise. Data visualization, interactive charts and dashboards can help the user in digesting information. In addition, according to the aforementioned authors, gamification features such as progress bars and achievements can be beneficial in maintaining user engagement. These can also be referred to as microinteractions, which can make the experience more dynamic and intuitive. By bridging the gap between the website interface and the user, the whole experience is made to feel more personal (Azarenkov & Svintsova, 2023, p. 145). Unger & Chandler (2023) also recognize a trend towards simplification with a shift away from skeuomorphic design. The practice takes inspiration from the real world and aims to bring familiarity into the design. A move away from this trend indicates a need to present the vast amount of information in a more digestible manner.

According to a WebAIM report (2024), the complexity of website home pages has increased steadily for the last five years. Complexity in this instance refers to the amount of elements that are found on the page. While certain elements are simplified, their quantity is on the rise. Because automated design tools are accessible to practically anyone, sufficient results are easy to achieve. The popularity of these tools leads to more and more similar designs, which big companies tend to prefer. This is because familiar design interfaces are much easier to scale due to their predictability and familiarity (UX

Collective, 2024). UX Collective describe this as commoditization. As a result, in order to be able to stand out from the commoditized designs, the design solutions need to become increasingly nuanced and context specific (UX Collective, 2024).

**Table 2:** Table of trends.

<b>Trends</b>	<b>Description</b>	<b>Sources</b>
Personalization	Utilizing user data to customize increase user engagement and retention.	Xu et al. 2024; Paneru et al. 2024; Azarenkov & Svintsova, 2024
Data Visualization	Transforming complex information into more digestible format.	Xu et al. 2024
Gamification/Microinteractions	Game-like features to increase and maintain engagement.	Xu et al. 2024
Simplification/Unification	Removing unnecessary clutter to create a visually cohesive experience.	Unger & Chandler (2023)
Increase of Elements	Trend suggesting a growth in interface elements. Might increase page complexity but also offers more design options.	WebAIM (2024)
Familiarity	Increasing predictability with familiar patterns and layouts. Making webpages more intuitive.	UX Collective (2024)

### **3 Web accessibility**

Abuaddous et al. (2016, p. 172) define web accessibility as "making a website navigable and tractable by various user categories, especially those who have disabilities and normally face obstacles when interacting with the web via electronic devices (e.g. blindness)." The end goal is to provide a website that disabled people are able to perceive, understand, navigate and interact with (Abuaddous et al. 2016, p. 172). As internet, and therefore websites have become more and more a daily commodity, the need to accommodate all kinds of user bases has increased. Different disabilities have to be taken into consideration and failing to do so leave the websites in a severe disadvantage. Martins & Duarte (2023, p. 2) refer to a study that recognized a trend towards an increase in accessibility knowledge already back around the 2010s. The findings suggested that from 2009 to 2013 in the selected websites, the awareness regarding accessibility guidelines went from zero to at least a basic level of knowledge (Rau et al. 2014). This finding among many suggests a trend toward a more conscious approach to web accessibility.

This chapter begins by introducing some common accessibility barriers. Whenever web accessibility is concerned, some sort of accessibility guidelines need to be referenced. This chapter explains the Web Content Accessibility Guidelines in detail. Following up on this, some of the most widely used assistive technologies are explored. Lastly, the accessibility evaluation study by Martins & Duarte (2023) and the report by WebAIM (2024) are used to recognize some of the most frequent accessibility violations.

#### **3.1 The Four Principles of Web Accessibility**

WCAG stands for Web Content Accessibility Guidelines, with a purpose to provide a single standard for web accessibility. With a standardized set of principles, the aim is to provide a clear and structured path to a universally accessible web experience. The guidelines are comprised of four primary principles: perceivable, operable, understandable and robust. These principles are explained in more detail in this chapter.

### **3.1.1 Perceivable**

The first principle, perceivability, is concerned with the information and user interface components being presented in a perceivable way. This can be achieved by using text alternatives. The non-text content such as images and other multimedia need to have an alternative text that can transform the content into other forms such as speech or larger text. Alternatives are also needed for time-based media. This refers to multimedia that can be audio-only, video-only or a combination of the two. In such cases accessibility is achieved by providing an alternative to the media. Audio-only media needs to have a textualized version of its contents whereas video content can be either similarly textualized or presented in an audio format. (W3, 2023).

Adaptability aims to ensure that the content can be adjusted and reformatted in a way that does not affect the information on the site. If the content is available in a reachable format, it can also be presented in alternative ways that accommodate various assistive technologies. To achieve this, the website components need to be layered in a way that they can be reached by a software. Failing to do this leads to at least a partially inaccessible website. In addition to proper structuring, the content also needs to be distinguishable. Colours used in the design need to be contrasting enough to distinguish the contents from one another. To ensure this, the WCAG guidelines include minimum contrast ratios for proper distinguishability. (W3, 2023).

### **3.1.2 Operable**

Operability aims to ensure that the website components are operable and function correctly. The website needs to be operable for all users regardless of the technology that is used. This means that all the functionalities need to be achievable via keyboard, either directly or indirectly (e.g. keyboard through speech). Keyboards in this instance refer to both physical and virtual keyboards such as emulators and other related software. Also, the mode of input might change at any time, meaning that multiple types of inputs have

to be supported. In addition to being able to interact with the components, users requiring a screen reader need to be able to identify their current location on the website. This can be ensured by a logical and ordered website structure and by limiting unintuitive features and functionalities. Lastly, time-based content needs to be in a format where it can be adjusted or turned off completely. (W3, 2023).

### **3.1.3 Understandable and robust**

The third main principle is understandable. It is concerned with the content and its perceivability. Text-based content can contain various instances, where screen readers alone do not convey the message completely. Such cases can be abbreviations, special terminology or alternative pronunciations. In such instances, additional mechanisms are provided to convey the message to users with reading disabilities. Also, regarding the content, it needs to be consistent and react to changes without losing its meaning and logic. With consistent design, navigation elements remain in the same order and have the same functionality, unless the changes are initiated by the user. Input errors are automatically identified, and suggestions are made available. (W3, 2023).

The final principle, robust, assures that the content is accessible with different kinds of devices and assistive technologies. This can be achieved by creating the content in a way that can be programmatically detected. Support for various technologies needs to be up to date and follow the constantly changing and developing standards. (W3, 2023).

## **3.2 Assistive technologies**

The International Organization for Standardization (ISO) define assistive technologies as: "Hardware or software that is added to or incorporated within a system that increases accessibility for an individual". These can include braille displays, screen readers, screen magnification and eye-tracking devices (ISO 13066-1, 2011, p. 2). This chapter provides further background to web accessibility by introducing some of the most common assistive technologies.

The purpose of a screen reader is to assist users with severe visual impairments to interact with computers and related devices. It works by translating visual information into speech using text-to-speech software (Nicolau & Montague, n.d., p. 6). The information is usually interacted with keyboard shortcuts or touchscreens. Users with some levels of vision might benefit from other visual assistive technologies such as screen magnifiers, larger text size and adjustable colour and contrast settings. Finally, speech input can be used to perform various tasks via commands, enabling a hands-free alternative to keyboard dependent assistive tools.

Users with limitations to their physical abilities need to have alternative ways to interact with the website interface. Nicolau & Montague (n.d., p. 7-8) highlight the expressive nature of modern web design, making the websites more difficult to interact through assistive technologies. Gestures and other immersive features may be harder to access than the more traditional single-click features. One of the tools that can cater users with physical impairments is switch access scanning, which works by scanning each page element individually, and with each element the user can choose to interact with it via a switch (Nicolau & Montague, n.d., p. 8). The method however is slow, and with a continuing increase in graphical elements the method can become quite cumbersome to use.

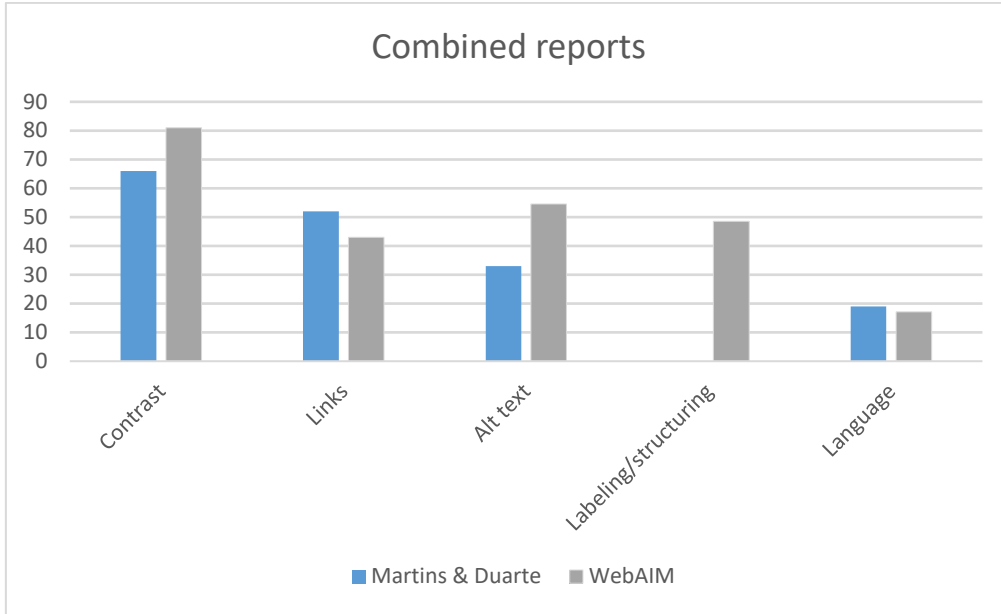
### **3.3 Common accessibility barriers**

Accessibility violations can appear in many different areas. They can refer to visual issues as well as to functional and logical errors. Martins & Duarte (2023) analysed almost three million websites in their study and were able to recognize the most common issues. With a substantial sample size, these findings can be said to formulate a certain kind of trend. In addition, WebAIM's report from 2024 is consulted. A combined table of the two reports containing their overlapping findings is presented at the end of this chapter.

Almost 80 percent of the analysed websites contained issues related to text contrast. Similar results were also found in a report by WebAIM (2024) where the world's top one

million home pages were analysed. With an insufficient contrast ratio, some users might find the information difficult or even impossible to understand. Therefore, the WCAG guidelines include a threshold that aims to ensure a sufficient ratio.

Martins & Duarte (2023) found problems related to user interface components on almost 70 percent of the websites. The problems refer to success criterion 4.1.2 which states that the website components need to have names, values and roles that can be referred to with assistive technologies. Related to this, both aforementioned reports found missing alternative texts as a significant violation. Alternative text refers to a textual representation of non-text elements such as images. The text ensures that screen readers are able to convey the purpose of the image to the user (WebAIM, 2024). Images can also be used to access links, which becomes a problem if the said images don't have a name that can be referred to. Therefore the webpage and its elements need to be properly labelled, so that assistive technologies are able to process the webpage logically. This can be achieved for example via headings, nesting, non-duplicate names, and unique IDs (Martins & Duarte, 2023). Finally, issues related to the document language were present on just under 20% of the pages. The language of the page needs to be programmatically determinable.



**Figure 2:** Combined reports (Martins & Duarte, 2023; WebAIM, 2024).

## 4 Qualitative research method

This thesis is conducted via a qualitative research method. The selected method can be described as quite broad and within it exists different types of approaches. Therefore it is beneficial that this thesis does not blindly follow a specific path but rather is allowed to take elements from different approaches. Silverman (2017) describes qualitative research as an answer to the questions *what* and *how*, which would be inline with the research question of this thesis. According to Juhila (n.d) some of the characteristics of qualitative research include *a suspicion towards the obvious* and *recognising the importance of subjectivity*. The latter suits the subjective nature of web design and especially its visual elements while the former addresses the preassumptions that one might have towards the definitions of accessible web design.

A refined version of a qualitative approach called qualitative content analysis is the primary method used in this thesis. Patton (2002, p. 453) describes content analysis as any form of qualitative data reduction and analysis with the aim of identifying core consistencies and meanings from the data collected. Finding patterns and themes in the data are also referred to as core meanings, which in the end are tied to the research questions. The data gathering process can also be described as directed, where the researcher is immersed in the data, allowing themes and patterns to emerge (Zhang & Wildemuth, 2005, p. 2). With this approach, the end goal is to find validation or extension to the predetermined frameworks or theories. Elo et al. (2022, p. 216) highlight the versatile nature of content analysis, stating that the method can be utilized to analyse practically any type of data, as long as it can be sensibly documented.

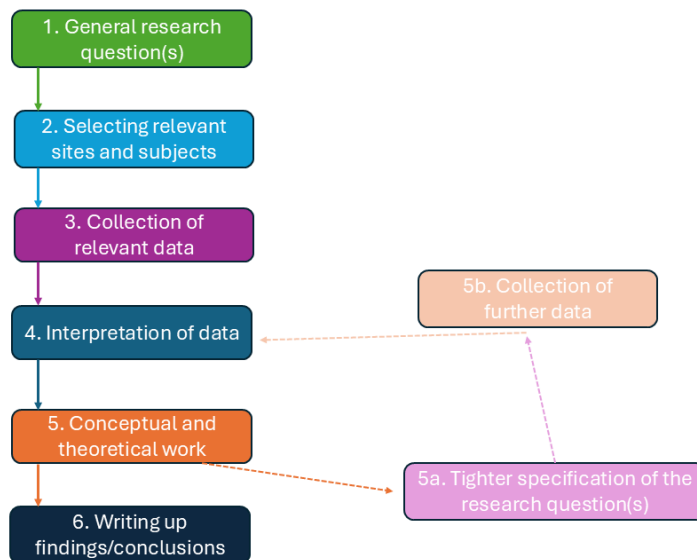
The nature of this research study can be deemed to be at least somewhat exploratory. Due to the related literature around the topic being relatively scarce, an exploratory approach is justified for several reasons. First, the primary goal of the thesis is to identify trends, patterns and relationships that might exist within the intersection of innovative web design and accessibility. The proposed research question is formulated to align with the said goal by being relatively open ended, allowing flexibility in the analysis phase.

This is crucial, as the outcome of the research is not expected to be definitive, but as explained before, produce findings from a fairly unexplored area of research. The data utilized in this thesis is both qualitative and quantitative in nature which further highlights the exploratory elements that are present.

Exploratory research allows the search for ideas, insights, and clarification (Stevens et al. 2006, p. 53). Stebbins (2011, p. 2) describe it as something to "study, examine, analyse or investigate". In the context of this thesis, exploratory research is appropriate as the goal is to gather insights and investigate a relatively unexplored research area of innovative web design and accessibility. Prior literature offers some indications and data, but at its core, the purpose of exploratory research is to create the basis for other more definitive studies. Stevens et al. (2006) mention the following as one of the objectives of an exploratory research: "Establishing priorities for future research or determining the practicality of conducting some research." The objective is in line with this thesis and its goal to study the intersection of aesthetic driven web design and accessibility.

## 4.1 Research structure

Figure 3 shows the general outline of a qualitative research project. The process begins by defining the research question.



**Figure 3:** Main steps of qualitative research (adapted from Bryman & Bell, 2024).

Defining it in the beginning is crucial as it helps to guide the literature review phase, the choice of research method, the approach to the data analysis phase and finally, it defines the boundaries of the research, preventing any ventures outside the scope (Bryman & Bell, 2024, p. 79). In the second step the sample subjects are chosen. For this thesis, the selection was made by first limiting the potential subjects to websites considered to be innovative. Second limiting factor was the up-to-date nature of the websites. This is crucial as the purpose of this thesis is to analyse contemporary themes and trends and their relation to accessibility guidelines.

The following steps are concerned with the actual data. This phase begins with collecting the data. This is done by running the automatic accessibility assessment tool, Wave, on each of the selected websites. The data is then analysed through the two research lenses

introduced in chapter 4.4. Findings from this phase are combined, and conclusions related to the research question can be made. During this phase the said research question can be further specified. Finally, the discussion chapter ties the key findings together, offering a comprehensive overview of the thesis' outcome and contributions. At this stage, the limitations of the study are also reflected upon. By recognizing these limitations, recommendations for future research can be formulated.

## **4.2 Sample Websites**

The selection of the sample websites consisted of few key criteria. First, the websites are deemed to be industry-acknowledged in terms of their visual design practices. This can be ensured for example by scrutinizing various industry-related communities or organizations. The websites listed on such sites are often either peer-reviewed or selected by professionals or other jury members. The recency of the sample sites is also crucial, as the aim is to investigate contemporary trends. Once the sample has been chosen, the sites need to be surveyed to make sure that they are reviewable by the automated accessibility tool, as some sites might contain features that the tool is not able to analyse. That being said, the goal is to select the sample sites with as little interference as possible.

The websites chosen for this research used their website design as a way to stand out. The selected websites can be described as innovative, including unique design choices and visually impressive features. An organization and community called Awwwards, and their listing of "sites of the year" was used in the selection process. The organization hosts competitions and conferences related to web design. In addition to their annual competitions, they also hold a "site of the day" campaign on their website where the featured websites are chosen by professionals and jury members (Awwwards, 2024). By having the target websites from this kind of source, they can be said to represent both the contemporary trends in the field as well as innovative approach that is a key component of this thesis. The nature of the sample pages ranges from personal portfolios to product or brand marketing. In regard to their size in their respective industries, the

pages varied from well-established actors to smaller individuals. The sample websites are listed in table 3 below.

**Table 3:** Sample Websites.

<b>Websites</b>	<b>Link</b>
Lusion	<a href="https://lusion.co/">https://lusion.co/</a>
Noomo Agency	<a href="https://noomoagency.com/">https://noomoagency.com/</a>
Mana Yerba Mate	<a href="https://en.manayerbamate.com/">https://en.manayerbamate.com/</a>
KPR	<a href="https://kprverse.com/">https://kprverse.com/</a>
Pangram Pangram Foundry	<a href="https://pangrampangram.com/">https://pangrampangram.com/</a>
Star Atlas	<a href="https://staratlas.com/">https://staratlas.com/</a>
Chungi yoo	<a href="https://www.chungiyoo.com/">https://www.chungiyoo.com/</a>
Mammut	<a href="https://eiger-extreme.mammut.com/en">https://eiger-extreme.mammut.com/en</a>
Synchronized Digital Studio	<a href="https://synchronized.studio/">https://synchronized.studio/</a>
Pioneer	<a href="https://cornrevolution.resn.global/#testing">https://cornrevolution.resn.global/#testing</a>

To minimize any biases that may occur in selecting the websites, they were chosen simply by their ordering on the list. The 64 websites listed under the "site of the year" category were ordered by their recency, which in this case sets the range of the selected sites between 2020 and 2023. Sites that were in the first ten but couldn't be reviewed with the evaluation tool were excluded. These were sites that had either videogame-like landing page or a video as their primary element. Otherwise, the selection was conducted without personal biases.

The data analysis phase is limited to the data produced by the accessibility evaluation tool WAVE as well as to both the Study by Martins & Duarte (2023) and the report by WebAIM (2024). In addition, the manual evaluation of the pages is guided by the design principles listed in table 1. The principles are constructed based on the book by Unger & Chandler (2023), together with other related research studies. These limitations define

the framework of this thesis, ensuring that no irrelevant or otherwise unwanted data is included.

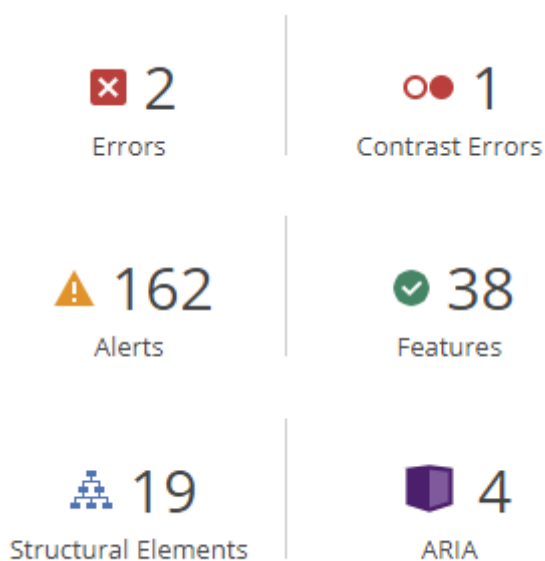
### **4.3 Data gathering method**

The data utilized in this thesis is generated by analysing the selected websites with an automated accessibility checker tool. The chosen tool, Wave, is used to run automated tests of the target websites, providing data about their accessibility levels. The tool is able to identify the different elements of a website and give feedback on whether they meet the accessibility guidelines (WCAG). However, it is important to note that only the guidelines that can be formatted into code can be included in the analysis (Abascal et al. 2019, p. 481). In the context of this thesis, the main focus of the analysis will be on the visual elements. Having recognized the prevalent web design trends in chapter 2, the results of the accessibility analysis will be paired up against these with the purpose of recognizing a relationship between certain design trends and their level of accessibility. Furthermore, the analysis will answer to the preassumption where aesthetic-driven web design is expected to hinder the accessibleness of a website.

The outcome of the analyses is a report on the potential barriers that exist between the websites and the WCAG guidelines. Figure 4 shows the different types of issues that the tools are able to find. The yellow icons can be interpreted as recommendations that should be manually checked. The green icons refer to features that could improve the accessibility of the site if implemented in a certain way. Rest of the icons are other points of interest that the tester is advised to look at (Wave, n.d). As some of the found issues can be up to interpretation or require further manual inspection from the tester, manual run-through of the analysis is often required (Abascal et al. 2019, p. 484).

The tool chosen for the analysis was found to be among the most popular and comprehensive. The study by Kumar et al. (2021) analyses ten different automatic accessibility evaluation tools. The findings of this study were utilized in the selection process of the tools used in this thesis. WAVE by WebAIM was found to be easily comprehensible and

to have a high performance when measured with Coverage Error Ratio (CER) score. The score is based on a metric coined by Alsaedi (2020, p. 8) which is "the ratio of number of errors detected by a given tool to the total number of errors detected by all tools (Kumar et al. 2021, p.2). In addition, the tool takes manual inspection into consideration by having a visual representation of the accessibility issues directly on the website. This feature helps the evaluation process considerably, as the specific issues do not need to be manually located.



**Figure 4:** WAVE icons. (Wave browser extension, n.d).

#### 4.4 Data analysis

The data analysis phase of this thesis consists of two lenses through which the collected data will be analysed. First, the design principles presented in chapter 2.3 and in table 1 are used to assess the compliance of the target websites with these principles. In addition, the recognized design trends listed in table 2 are taken into consideration in the analysis. The outcome will provide an idea of how closely design principles are followed in innovative web design and how the current design trends are implemented in such websites. Secondly, data about the level of accessibility is generated with the selected automated assessment tool. This analysis will provide data of the accessibility levels and

potential accessibility violations found on the site. This data will also be presented in tables for more clarity.

The data collection and analysis in qualitative content analysis can take different forms. In the context of this thesis, the process can be said to take elements from inductive and deductive approaches. The former takes the data as it is, with the purpose of generating patterns and conclusions from the data. This means that it does not have a predetermined hypotheses or other expectations (Flick, 2018, p. 4). Deductive approach takes an opposite approach, where the said predeterminations are used as the basis of the analysis. The data is analysed to test previous theories or to see whether it supports the set expectations (Elo & Kyngäs, 2008, p. 113). In this thesis, the deductive approach becomes evident with the evaluation of the webpages and the accessibility conformance analysis. Meanwhile the data is also expected to produce indications of trends and patterns of the relationship between innovative web design and accessibility, thus demonstrating elements of an inductive approach.

The sample websites are manually reviewed according to the design principles listed in table 1. The websites are given a rating on each principle, allowing trends to be recognized. The scale that is used for the evaluation is low-medium-high, with a scoring range 1-3 respectively. Maximum score from this analysis is 30. While the design principles have descriptions and certain characteristics, this analysis is inevitably subjective. To balance things out, the most subjective principles categorized as psychological, *attractiveness* and *trust*, are left out of this analysis. Pandir & Knight (2006, p. 1363) came to a similar conclusion, where they deemed attributes *pleasure* and *interestingness* to be highly subjective, and thus highlighting that preference can be difficult, if not impossible to generalize.

As an idea of the compliance levels of the target sites in regards of the principles and trends is gained, the findings can then be examined with the accessibility guidelines in mind. The outcome of this combined analysis will provide an answer to the research

question “*How are accessibility guidelines considered with aesthetic driven web design?*” With an expectation of a trade-off between innovative web design and accessibility, the analysis will produce an answer to this research question.

While no single type of structure to qualitative data analysis exists, the data analysis phase can be said to follow a generalized structure of

1. *Preparation of data / Familiarization*
2. *Data reduction*
3. *Data display*
4. *Report Writing*

(Mezmir, 2020; Ravindran, 2019)

The process starts with preparing the data, and in this case, the selected 10 webpages are briefly surveyed to ensure their suitability to the research. Pages that are not evaluable by the Wave tool are left out at this stage. After the data has been generated, it needs to be organized and potentially reduced in some way. Figure 4 displays how the data is categorized. The focus will be on the red icons, indicating accessibility violations. Rest of the produced data is left out of the analysis. With these limitations set, the data can finally be presented in a structured manner. The results of the accessibility assessment are displayed in a table format, from which a comprehensive report can be formulated. A scoring matrix is used in the manual evaluation, and the results are presented in a chart. By following this generalized structure, the data analysis process can be trusted to provide relevant and usable data.

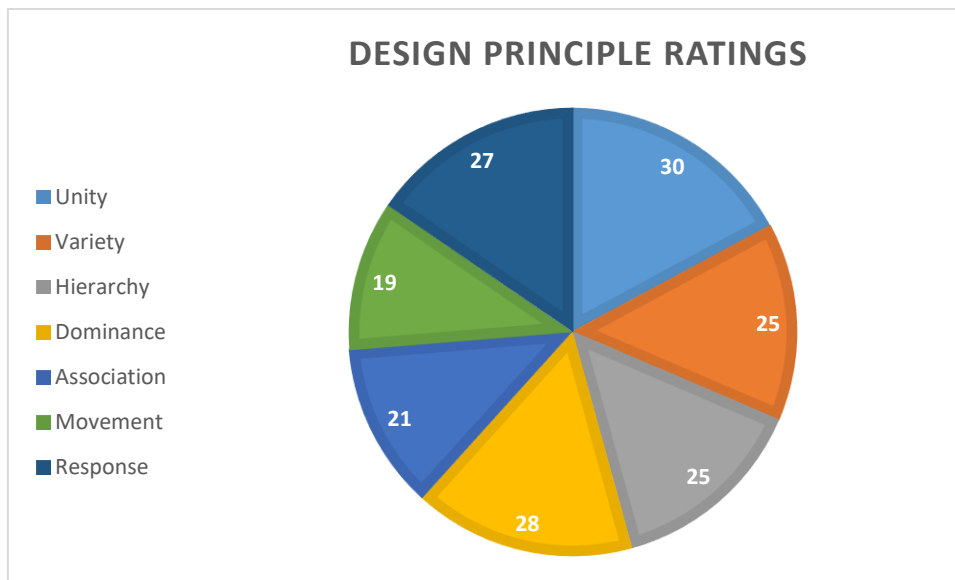
## 5 Results

This chapter contains the data analysis phase of this thesis. The selected websites are individually assessed with the WAVE accessibility evaluation tool. The results are categorized as seen in figure 4, depending on the severity of the accessibility violation. However, it should be noted that the tool used in the study by Martins & Duarte (2023) is likely to produce less errors than the one used in this thesis (Martins & Duarte, 2023, p. 1868), thus slightly effecting the comparison. Chapter 5.1 covers results of the analysis regarding the design principles and web design trends. The method for this analysis is explained in the previous chapter. This analysis provides a comprehensive overview of whether innovation in web design has an effect in the compliance to the aforementioned principles and trends. The outcome of the analysis is visualized in figure 5. In chapter 5.2 the websites are analysed with the evaluation tool, producing objective data on their accessibility levels. Finally, in chapter 5.3 the results from both approaches are combined, from which we can determine the existence of a trade-off between innovative web design and accessibility. These findings are interpreted in more detail in the discussion chapter.

### 5.1 Principles and trends

Out of the design principles, *unity* scored the highest. The principle aims to ensure that the content of the page stays coherent. All of the web pages were able to maintain their thematic structure and the elements remained unified. *Dominance* ensures that the said elements are sufficiently positioned and sized for them to have the desired effect on the user. The only principle outside the visual category scoring significant points is *response*, which ranked the third highest. This principle is concerned with how the elements respond to actions by the user. For example, these can be hover effects or click animations. *Variety* and *hierarchy* scored an equal amount of points, and they are the last two principles belonging to the visual category. Variety focuses on maintaining the user's interest by offering differing features and elements while hierarchy aims to draw the user's attention to relevant content. The last two principles, *association* and *movement* stood out

by scoring clearly the least amount of points. Noteworthy is, that these two principles are perhaps the least concerned with the visual output of the web page. The first-mentioned focuses on matching user expectations to the elements while movement aims to reduce selection time by focusing on proper element placement.



**Figure 5:** Design principle ratings.

Table 2 lists some of the prevalent trends that were recognized to be present in contemporary web design. The sample webpages maintained a thematic cohesion with unified page elements, further demonstrating the desire to create a user-centric experience. Design principles *unity* and *hierarchy* aim to achieve this. With the first-mentioned scoring the full thirty points while *hierarchy* also scoring relatively high, it can be concluded that such trends are very much present in innovative web design. Secondly, user engagement is achieved through unique features and elements. Following the design principle *variety*, gamification and microinteractions are utilized to maintain and increase user engagement by offering interactive or otherwise engaging features. At the other end of the spectrum, design trend *familiarity* is perhaps the least present. Low scores on both *association* and *movement* indicate that out of the general web design trends, innovative approach seems to follow the visual trends the most. Increasing predictability and intuitive navigation is not considered a high priority.

It has been established that the set of innovative webpages have a clear bias towards visual elements, with less attention paid to interaction principles. The desire to create unique interfaces and experiences appears to come at the cost of *association* and *movement*. These principles scored the lowest, suggesting some degree of disregard towards interaction principles. Creating associations between the real world and web elements aims to increase the intuitivity of the user experience. The analysis in the following sub-chapter revealed that around 60% of the sample webpages reported issues related to labelling, which can be used in increasing intuitivity. The positioning of the page elements can influence the selection time, which in turn affects the interactability of the page.

## 5.2 Accessibility evaluation

The automatic accessibility evaluation tool Wave was run on all of the 10 selected sites. The results are categorized according to figure 4 into errors, contrast errors, alerts, features and structural elements. This study will focus on the first two categories, as they indicate either clear accessibility violations or issues that likely hinder the level of accessibility. First, this sub-chapter will cover the WCAG guidelines and the success criteria that were found through the accessibility assessment. By recognizing the frequency of each criterion, a certain trend can already be identified. The data from the accessibility assessment is compared to the study by Martins & Duarte (2023) as well as to the WebAIM Million (2024) report introduced in chapter 3.3. The data from these studies include the most common types of accessibility violations. By comparing these findings to the data generated in this thesis, the ways in which accessibility violations in aesthetic driven web design relate to the general trends can be recognized.

The second part compares the amount of total violations between the aforementioned studies and the selected target websites of this thesis. The comparison produces further indications of how aesthetic driven web design fares against recent global design trends.

WCAG guideline conformance is divided into three levels: A, AA and AAA. The first level (A) covers the minimum accessibility requirements. Conformance to this level should ensure basic accessibility to people with disabilities (IA Labs, n.d.). The general consensus among organizations is to meet the second (AA) conformance level. At this level the webpage is expected to cater a wide variety of users with different requirements (W3C, 2020). Therefore criteria related to the third level are disregarded in this thesis. Guideline violations listed in this thesis are thus either A or AA level.

### 5.2.1 Guideline violations

Tables 6 and 7 list the errors that were found on each of the sites. Table 4 shows the amount of unique instances of each success criterion. As seen in table 4, success criteria 1.1.1 and 2.4.4 appeared most frequently when considering each violation as their own entity.

**Table 4:** Combined unique instances.

Success Criteria	Unique Instances
1.1.1	14
1.4.3	8
2.4.4	13
2.4.6	8
3.1.1	2

Success criterion 1.1.1 is called non-text content, which requires a text alternative to be present with all non-textual content (W3, 2023). It falls under the accessibility principle *perceivable*, which is concerned with interface components and their comprehensiveness. 9 out of the 10 target websites were found to have violated the success criterion 1.1.1. Table 5 shows that in the study by Martins & Duarte (2023) and the WebAIM Million (2024) report, on average the criterion was violated on around 40% of the web pages. Similar trend is recognized with the success criterion 2.4.4 regarding purposeful links. 80%

of the sample pages contained empty links whereas the large-scale studies found violations on around 50% of the sites. Errors involving headings and labels with criterion 2.4.6 showed a difference of around 10%. Most similarities were present with success criteria 1.4.3 and 3.1.1. The first-mentioned refers to contrast issues, where a sufficient contrast threshold has not been met. Finally, issues regarding the document language were found on 20% of both sets of websites. The success criterion states that the language of the web page needs to be programmatically determinable (W3, 2024).

**Table 5:** Comparison between the sets of websites.

Criteria	Innovative web sites	Martins & Duarte; WebAIM
1.1.1	90%	44%
1.4.3	80%	74%
2.4.4	80%	48%
2.4.6	60%	49% (WebAIM Million)
3.1.1	20%	18%

**Table 6:** Errors.

Target Website	Errors	WCAG Success Criteria
Lusion	Missing form label	2.4.6.
Lusion	Empty button	1.1.1., 2.4.4.
Lusion	Empty links	2.4.4.
Noomo Agency	Missing form label	2.4.6.
Mana	Missing alternative text	1.1.1.
Mana	Linked image missing alt text	1.1.1., 2.4.4.
Mana	Empty button	1.1.1., 2.4.4.
Mana	Empty links	2.4.4.
Kpr	Missing alternative text	1.1.1.
Kpr	Missing form label	2.4.6.
Kpr	Language missing or invalid	3.1.1.

Kpr	Empty button	1.1.1., 2.4.4.
Kpr	Empty links	2.4.4.
Pangram	Missing alternative text	1.1.1.
Pangram	Empty button	1.1.1., 2.4.4.
Pangram	Empty links	2.4.4.
Star Atlas	Missing alternative text	1.1.1.
Star Atlas	Missing form label	2.4.6.
Star Atlas	Empty heading	2.4.6.
Star Atlas	Empty links	2.4.4.
Chungi Yoo	Missing alternative text	1.1.1.
Mammut	Empty heading	2.4.6.
Mammut	Empty button	1.1.1., 2.4.4.
Synchronized	Missing alternative text	1.1.1.
Synchronized	Linked image missing alt text	1.1.1., 2.4.4.
Pioneer	Missing alternative text	1.1.1.
Pioneer	Missing form label	2.4.6.
Pioneer	Language missing or invalid	3.1.1.
Pioneer	Empty heading	2.4.6.
Pioneer	Empty links	2.4.4.

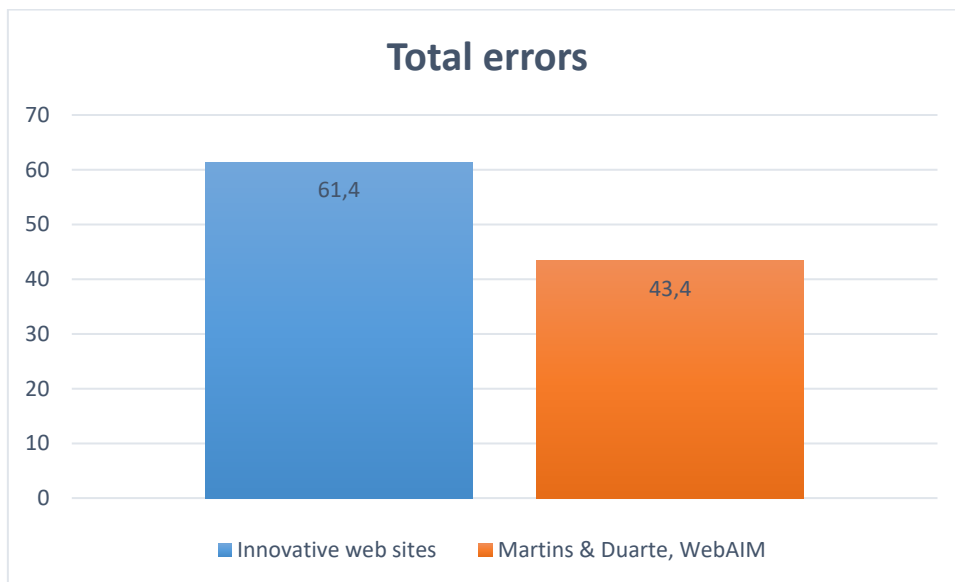
**Table 7:** Contrast errors.

Target Website	Contrast Errors	WCAG Success Criteria
Lusion	Very low contrast	1.4.3.
Noomo Agency	Very low contrast	1.4.3.
Mana	Very low contrast	1.4.3.
Kpr	Very low contrast	1.4.3.
Pangram	no contrast errors	-
Star Atlas	Very low contrast	1.4.3.
Chungi Yoo	Very low contrast	1.4.3.
Mammut	Very low contrast	1.4.3.
Synchronized	Very low contrast	1.4.3.

Pioneer	no contrast errors	-
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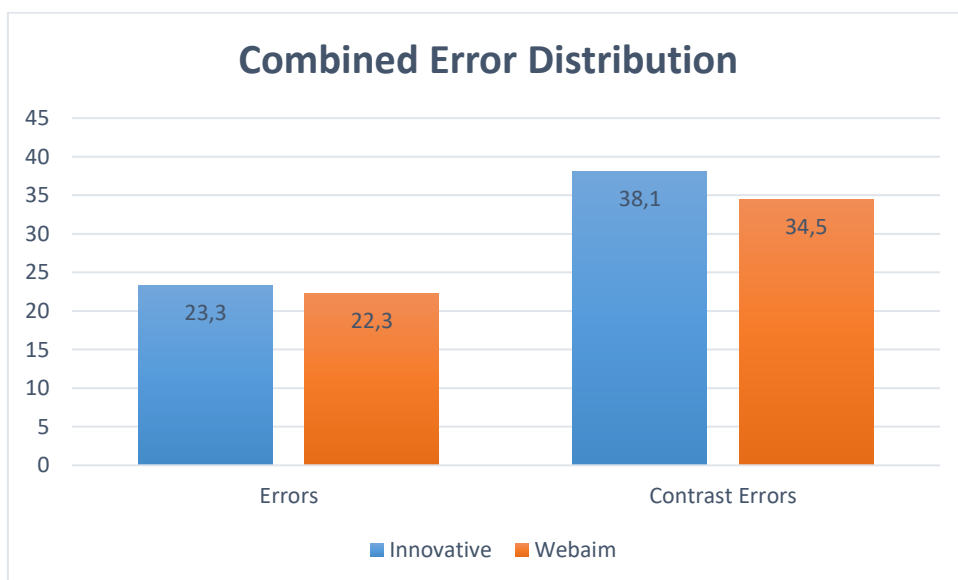
### 5.2.2 Total errors

In addition to comparing the amount of unique instances of each success criterion, a comparison of the total amount of errors is also conducted. Figure 6 shows the average amount of errors found per website. The set of innovative web pages presented 61,4 errors per site. The large-scale studies reported 43,4 errors per site. However it is noteworthy to mention that Martins & Duarte (2023) used a different evaluation tool than the one used both in this thesis as well as in the WebAIM Million (2024) report. As noted previously, Wave is expected to produce more errors than the tool used by Martins & Duarte (2023). In the WebAIM report, it produced around 57 errors per page, indicating a similar trend between innovative webpages and the WebAIM pages. That being said, the authors mention that the type of errors and their distribution remains relatively similar. Regardless of which sets are compared to the innovative pages, the amount of total errors remain at least slightly higher with the aforementioned pages.



**Figure 6:** Average total errors.

The set of web pages selected for this thesis recorded a total of 381 contrast errors meaning that on average 38 contrast related violations were found per page. WebAIM (2024) report found this number to be around 35, indicating that the nature of the web page has no significant effect on contrast conformance (Figure 7). The numbers show that contrast violations remain the leading cause of accessibility violations regardless of the level of innovation present. This, combined with the other errors leaning towards visual elements as well, indicates that accessibility conformance suffers from the heavy use of visual features in innovative web design. The most notable finding is that universal trends related to contrast issues are not significantly affected by the "uniqueness" or "innovativeness" of the page, as demonstrated in figure 7.



**Figure 7:** Combined error distribution.

### 5.3 Combined analysis

Finally, a combined analysis is conducted to gain a comprehensive outlook on the effects of innovative web design in relation to accessibility conformance. First, by analysing the websites through the design principle lens, an idea of the trends prevalent in contemporary innovative web design was gained. Subsequently the selected webpages were

analysed with an automatic accessibility evaluation tool, providing data on their accessibility conformance levels in relation to the WCAG guidelines.

The results of the scoring matrix (figure 5) regarding the design principles showed that innovative webpages are expressive in nature, with an emphasis towards non-textual content. In relation to the accessibility violations found by WAVE, the most prevalent correlation can be said to exist around the visual principles. Contrast errors covered over 60% of all the errors produced by WAVE both among the innovative webpages and the WebAIM pages. The approach to colour usage seems to have no significant correlation with the level of innovation as the amount of contrast errors is found to be similar. Design principle *unity* scored the maximum amount of points in the scoring matrix. As the principle is concerned with visual cohesion, the high amount of contrast errors does seem logical. Study by Salgado-Montejo et al. (2014, p. 644) further emphasize that congruent design choices tend to increase positive emotions in users. Cohesion can be pursued for example by using similar colour schemes or related elements. A link between contrast errors and the high conformance to the design principle *unity* can be said to exist. Furthermore, if we conduct figure 2 in chapter 3.3, the most common accessibility barriers after contrast errors are also related to visual elements in the form of links and alternative texts. As noted, visual principles exhibited high scores in the evaluation matrix, suggesting a link between innovative, aesthetic driven design and accessibility violations.

Design principles *association* and *movement* scored the lowest in the evaluation matrix. They are less concerned with the visual outlook of the page than the other principles. As established previously, issues related to missing links and alternative texts were among the most common violations in the two big scale studies. In addition, the webpages used in this study recorded the most unique violation instances related to these. Success criterion 2.4.4 focuses on purposeful links, highlighting the relationship between visual elements and their expected functions. The low scores on the aforementioned principles further suggest that innovative web design seems to prioritize visual outlook at the cost of interactability.

## 6 Discussion

The purpose of this research was to study the intersection of innovative web design and accessibility. Prior literature around the research topic was found to be relatively scarce, both giving the research an explorative nature and further enhancing the motivation for research. Literature review around the topic provided theoretical understanding of the key elements, while also highlighting the gaps in this specific research area. The research was conducted via qualitative research method, where a qualitative content analysis was found to be the most suitable approach due to it being versatile and having the end goal of finding core consistencies and meanings from the data. This was achieved by first defining the two research lenses utilized in this study. The combination of the design principle evaluation and accessibility level assessment enabled a comprehensive overview and analysis of the research area to be conducted. In total, 10 websites were chosen for the data analysis phase. A research framework was used in selecting the said websites, ensuring that they fit the "innovative" category while also being reviewable by the evaluation tool. Results provided insights on the current trends prevalent in contemporary innovative web design, and their relation to WCAG accessibility guidelines. These findings, alongside reflections to existing literature and future research are covered in more detail in this discussion chapter.

### 6.1 Key findings

This exploratory research study provided insights on the relationship between innovative web design and accessibility. By analysing the target websites through the two research lenses, answers to the proposed research question "How are accessibility guidelines considered with aesthetic driven web design?" can be found.

First, the expectation that visually-driven web design has a negative effect on the accessibility level of a website gets some support from the finding that the most frequently violated success criteria were related to visual elements. These accessibility violations appeared more among the innovative webpages, which would indicate that increase in

visual elements increases the likelihood of accessibility violations. The design principle analysis found *unity* and *dominance* scoring the highest points, further highlighting the visually expressive nature of the pages. Also in regard to the design principles, interaction principles scored on average lower in the analysis. This could indicate that a trade-off between expressive design choices and accessible and predictable features exists. Trends such as gamification and visualization were recognized as current design trends aiming to increase user engagement. Also, with a continuing trend of increasing page elements, interaction features such as predictability can be said to suffer from such trends. Common and familiar page layouts may be disregarded in favour of more unique solutions. *Familiarity* was listed as one of the prevalent design trends among big companies and organizations. When the target audience is large and contains a wide variety of users, predictable design choices make sense. The contents of the sample pages varied from personal portfolios to product marketing and other brand promotions. The sample pages were notably expressive, with dynamic and interactive content. Engagement is maintained with cohesion and visual hierarchy. Users form their first impression of the webpage within milliseconds, driving the design towards aesthetic choices. Sometimes first impressions can even affect the user's perception of the page's usability, as issues with usability are disregarded if the visual design evokes enough positive feelings (Fessenden, 2021., NNGroup, n.d.).

The comparison of the sample pages and the large-scale studies indicates a few trends. Firstly, issues regarding non-textual content appeared the most among the sample pages. As these sites aim to stick out with visually impressive elements, the high number of violations in non-text features is expected. The WebAIM Million (2024) report recognizes an increase in graphical elements in web design, which would also explain the large amount of violations in this category. The second most common violation was related to purposeful links. These can also be related to non-text content for example in the forms of buttons or linked images. With these two criteria violations being the most prominent, an observation that the heavy use of visual elements in innovative design seems to hinder their accessibility can be made. Most similarities were found to be related to contrast

issues. Both sets of data presented a high amount of instances regarding low contrast, indicating that contrast issues remain among the most common regardless of the nature of the website. This criterion can be easily disregarded, as visually appealing colour-pairings are favoured over contrast-conforming pairs (BOIA, 2023). With close similarities in quantity and frequency, contrast errors can be deemed to be a universal issue that is not affected by the level of design innovation. In other words, this finding somewhat indicates that expressive visual design does not increase contrast violations despite increases in visual elements. Similarities were also found in criterion 2.4.6 that aims to ensure that the headings and labels are presented in a way that help users orient themselves on the page. The closest correlation between the data sets were about the language of the web page. As around fifth of the pages violated this criterion, it seems that regardless of the nature of the web page, language issues remain similar, although relatively infrequent.

Success criterions 1.1.1 and 2.4.4 that relate to visual elements such as images and buttons were both the most frequent and presented the most unique instances among the innovative web pages. These criteria also produced the biggest difference between the data sets, indicating that the more visually expressive elements a page contains, the more likely it is to produce accessibility violations. This finding is inline with the assumption that innovative web design has a negative effect on accessibility conformance. Referring to the research question *How are accessibility guidelines considered with aesthetic driven web design?*, it can be said that the increase in the use of visual elements hinders the implementation of accessibility features in innovative web design.

Most prominent connections were found to be related to the design principles *unity* and *association*, and the WCAG guidelines 1.1.1, 1.4.3 and 2.4.4. *Unity* and guideline 1.4.3, related to minimum contrast, exhibited similar trends that were present in the large-scale studies. While this does not directly support the expectation of a correlation, it does indicate that these issues exist regardless of the nature of the website. *Association* together with guidelines 1.1.1. and 2.4.4. exhibit the most prominent correlation. The

guidelines are concerned with features such as alternative texts and purposeful links. It was found, that with an aesthetic-driven approach to web design, the likelihood of accessibility violations related to these features increases.

To conclude, this study revealed a slight correlation between innovative web design and increased accessibility violations. Both due to the relatively small differences between the data sets and the limitations of the research explained in chapter 6.4, this outcome cannot be said to be entirely conclusive. However, it does provide insights to the relatively underexplored intersection of innovative web design and accessibility. Dominance of visual design choices is expected, but nonetheless highlights the expressive nature present in innovative web design. This in turn was found to lead to increases in accessibility violations. As a consequence, interactability was found to suffer from this, as established in the analysis phase. These issues were present in the form of unintuitive navigation and uncommon design features. Finally, a connection between the sample pages and the pages from the large-scale studies became evident through contrast errors. They were found to be unaffected by the nature of the websites or their design approaches.

## **6.2 Contributions**

The dual-lens approach used in the analysis phase is a replicable strategy in future research. First, a qualitative design principle analysis can be used to identify trends in the design choices. Combined with an accessibility evaluation phase, the outcome is expected to produce much more comprehensive results of the relationship between aesthetic web design and accessibility than when done separately. The approach can be modified according to the study in question. The design principles can be redefined, and the choice of the accessibility evaluation tool(s) can also be redetermined. However, the inclusion of two research lenses was found to be beneficial.

The selection process of the sample websites is replicable with the following criteria. First, the sample sites are industry recognized, meaning that they can be found on relevant community websites and/or listings. The recency of the selected sites also increases

their credibility in the context of this kind of study. To minimize any biases in the sample, it is selected only by the order of their recency. Additionally, if the study intends to utilize an automated evaluation tool, the sample sites need to be reviewable by it. Some features or certain types of design choices can be unreachable by the tools. Finally, having a diverse set of websites allows trends to be recognized between different use cases.

Another key contribution of this study is that it brings together the research and literature around innovative web design and accessibility. The studies used in the data analysis phase focused on large websites and their accessibility levels. On the other hand, literature around innovative web design focused on trends and design principles. Recognizing the importance of the intersection of visually pleasing web design and accessibility conformance gives reasoning for future research. Moving forward, this study provides both motivation for future research as well as a methodological framework that can be utilized in similar studies.

### **6.3 Comparing to existing literature**

The study by Mbipom & Harper (2011) explores similar themes of web aesthetics and accessibility. The authors conducted an empirical investigation where selected participants evaluated a total of 50 web pages on their visual appearance. Subsequently, the pages were heuristically evaluated by accessibility experts. The outcome of the investigation presented some similarities with the findings of this thesis. Firstly, the literature around the study exhibited a slight negative relationship between expressive web design and usability. The studies consider accessibility and usability to be closely related and therefore we can deem expressive (i.e. innovative) web design to somewhat hinder accessibility conformance. The analysis in this thesis recorded slightly more accessibility violations in innovative web design. Increase in visual features also increased the accessibility violations. However, Mbipom & Harper (2011) found a noteworthy correlation to be present only with the “cleanliness” of the website, meaning that in their study, lesser elements lead to more accessible websites.

The findings of this study were compared to the research papers by Martins & Duarte (2023) and WebAIM (2024). These studies exhibited similar results in regards to the nature and frequency of accessibility violations. Contrast issues were found to be universally present regardless of the nature of the website design. Other issues related to non-textual content were more present with the sample pages of this study. These issues, such as missing labels or empty links, were present both in the sample pages as well as the large-scale studies. That being said, they were more prevalent within the sample pages, indicating that aesthetic driven web design has a tendency to present more accessibility violations. However, as noted before, the use of different evaluation tools affects the comparison to some extent and thus allows some distortion in the comparison.

Some potentially contradicting findings were presented in the study by Aizapurua et al. (2016). The study exhibited a relationship between visually pleasing attributes, such as *creative*, *original*, *exciting* and *new*, and websites perceived as accessible. Originality was also said to represent innovation in this study. While these attributes don't necessarily mean an increase in page elements, the general consensus among the participants was that unique and unexpected features were deemed to enhance accessibility. However, the study also mentions that the correlation can be due to accessible websites being scarce, and therefore encountering one highlights their originality. The findings in this thesis indicated that increase in visual elements had a slight negative effect on accessibility, while Aizapurua et al. (2016) recognized a positive impact. This is if we assume "uniqueness" and increase in visual elements to be related. The contradicting results may be explained with the different methods used. This thesis relied on the results of the automated accessibility evaluation results while the aforementioned study included participants in the evaluation process. As the participants were visually impaired, Aizapurua et al. (2016) emphasized the role of non-visual aspects such as information architecture and text quality in web aesthetics. Thus, the comparison can be said to be somewhat inconclusive, although some implications are present.

As established, the research about the intersection of innovative web design and accessibility guidelines is scarce. When considering these separately, literature related to these can however be deemed adequate. Therefore, it is the interplay of the two that form the main contributions of this study.

#### **6.4 Limitations and future research**

The limitations of this thesis revolve around few main issues. First, different accessibility evaluation tools produce different results. The variance in results can be anything from very minimal to significant due to the tools having different approaches and evaluating methods (Ismailova & Inal, 2022, p. 58233). While the choice of evaluation tool in this thesis is given justification, lack of variety limits the study. Utilizing multiple tools would enhance the findings.

Second clear restriction of this study is the limited sample size. Due to time constraints, limited resources and the nature of the study (solo research), the sample size needed to remain manageable. Again, the selected web pages are justified, but the small amount somewhat affects the credibility of the findings. Similar studies would benefit from a larger sample size, which could enable researchers to identify more trends such as industry differences or regional variance.

Final consideration for future research would be to include user testing in the analysis phase. This would be particularly beneficial in the design principle conformance analysis, where its subjective nature could be limited by having neutral test subjects evaluate the selected pages.

For future research, it would be recommended to both increase the sample size and to utilize multiple evaluation tools. This thesis provides an overview of the relationship between contemporary web design and accessibility, but remains limited due to the aforementioned reasons. The ambiguous and subjective definition of "innovative web design" also poses its own challenges, as no single definition can be determined. Future

researchers should either take a more focused approach or increase the scale of the data analysis phase. Some relevant source material such as *A large-scale web accessibility analysis considering technology adaptation* by Martins & Duarte (2023) can be recommended for future research. It offers recent, large-scale data on accessibility of web pages. The annual report of WebAIM Million ensures recent, comparable data on accessibility issues of the top web pages. Finally, various publications by the Nielsen Norman Group can be recommended. As a well-established firm in the field of interface design and user experience, articles such as “10 Usability Heuristics for User Interface Design” is suggested.

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