Challenging the face of the web:
An experimental interface approach.

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Contents

1. Introduction

Worldwide, there are more than 750 million people with disabilities. As we move towards a highly connected world, it is critical that the Web be usable by anyone, regardless of individual capabilities and disabilities.

– Tim Berners-Lee, 1997[1]

The freedom of people with disabilities[2] to access information and communicate on an equal basis with others, including via the internet, is considered a human right (UN 2006, Art. 21). This access to information and communication is crucial for all people to meaningfully participate in civil society. And among all communication and information media at our disposal, the internet is often suggested to be the great equalizing medium realizing this equal access for all. Thus, media access is an essential first step for facilitating democratic participation through mediated discourse. And indeed, internet technologies, and especially Web 2.0 platforms, have enabled people with disabilities to become better connected to their community and social discourse as a whole. However, while the web does provide many people with disabilities with increased access to information and social interaction, this is not true for all (Ellis and Kent 2011, 1–2; Ellcessor 2016, 7). In fact, only 54 percent of American adults with disabilities used the internet in 2010, in contrast to 81 percent of able-bodied Americans (Fox 2011, 3).

Central to the continuous failures to enable people with disabilities to freely participate in culture and society are the assumptions and norms governing the way contemporary websites are constructed. Too often websites and technologies are designed for a normative user position and with certain preferred use cases or tasks in mind. These implicit assumptions about the user realize themselves as disabling factors for users with physical or mental impairments (Ellcessor 2016, 22).

To exemplify this problem, I will challenge these implicit norms of web and interface design with an experimental website. The website will aim to replace the primarily visual interface designed for the paradigmatic able-bodied user position with one that emulates the interface used by blind people. I will focus on the internet use of blind people because a project like this can never encompass the endless variability of the human body and the non-visual interface provides the greatest disruption to the mainstream use of the web. The goal of the project is

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[1] W3C 1997

[2] How to speak and write about people with disabilities is subject to political debate and individual identity. In this work, I am following Ellcessor's choice to use primarily person-first language, like "people with disabilities", to prioritize the individual and not their abilities. However, disability advocates and scholars propose different ways of addressing disability and every individual might have their own preference and disability identity (Ellcessor 2016, 11, 206). I want to emphasize that I am writing from a position of respect for everyone affected by this text, even if my language choices might be flawed in some instances.

not to present a new interface suited for conventional websites – that would be antithetical to universal accessibility efforts. The intention is rather to create a piece of critical software (as defined by Fuller (2003, 22)) that experiments with the interface and provokes readers and users without disabilities to recognize their own user position and think about the web and its design differently.

1.1 Current State of Research

The most important theoretical contribution to this project is the field of disability media studies. While media and disability were discussed in combination before – notably in Goggin and Newell's "Digital Disability" (2002) or Ellis and Kent's "Disability and New Media" (2011) – Ellcessor and Kirkpatrick (2017) coined the term disability media studies in their eponymous book. There, they propose this new field of research by combining existing concepts of disability studies and certain streams of media studies, especially those oriented to the critical humanities. Out of this complex, the most significant source for my work is Ellcessor's "Restricted Access" (2016). In this book, Ellcessor provides a thorough theorization of media access and accessibility as fluid and relational phenomena and proposes a so-called "access kit" useful for the investigation of access from five different perspectives.

Further fields of research influencing this work are new media and software studies. Here I rely on classics rather than on recent literature. In "The Language of New Media" (2001) Manovich provides a fundamental theory of new media, including five principles governing new media objects that provide the theoretical basis for practical accessibility efforts. I examined Gaboury's "Image Objects" (2021) that offers a far reaching analysis and genealogy of computer graphics. Gaboury elaborates on interactivity, some of Manovich's theories, and argues that the computer is not, in essence, a primarily visual medium. Ultimately, however, Gaboury's work does not fit this project as well as "The Language of New Media," which is why I returned to Manovich. Fuller's "Behind the Blip" (2003) serves as a software studies contribution to the work at hand. It lends support to theories and demands made by disability media studies scholars and provides the term critical software to describe the practical undertaking of this project.

Among the recent work in the field of web accessibility are the fundamental Web Content Accessibility Guidelines (WCAG), a widely accepted international standard published by the World Wide Web Consortium (W3C). The current WCAG version 2.1 was published in 2018 and presents an important reference for the evaluation of current web accessibility practices. Several current studies warrant continued efforts to increase the accessibility of the web. They often use technological tools to evaluate whether websites conform to the standards of the WCAG. The most recent of such studies include Alismail and Chipidza (2021) and Bai et al. (2020). Both examined official government websites in the US and found that the vast majority of them had WCAG conformance failures. Notable as well is Hanson and Richards' (2013)

long time study examining changes in the accessibility conformance of one hundred website from 1999 to 2012. An even larger sample is studied by the "WebAIM Million" (WebAIM 2022), a yearly survey of one million top websites conducted by the initiative Web Accessibility in Mind.

1.2 Structure of this Project

This introduction is followed by four chapters. In the next, the theoretical context of this work will be presented. This is, mainly, the field disability media studies with its main contributions of the social model of disability, the normative user position, and the emphasis on everyday lived experiences made by people with disabilities. In chapter 2.2 Manovich's new media theory will be connected to Ellcessor's work on access, building the foundation for web accessibility practice. Fuller's critical software and his contribution to software and interface design are discussed in this chapter as well. The next sub-chapter covers the theoretical basis for web accessibility from a technological and design perspective.

The third chapter encompasses the practical aspects of this work. In the beginning, the field research I conducted in the form of two interviews is introduced. This leads to a review of the state of web accessibility in chapter 3.2. The assessment of the unsatisfactory state of accessibility provides, together with the theoretical context from chapter 2, the basis for the website concept detailed in chapter 3.3. The resulting project website is presented next (chapter 3.4), before its design and development process is discussed in chapter 3.5. There, I go into detail about the features I implemented on the site and the aspects of the development that did not work as planned (chapters 3.5.1 to 3.5.3). Later I describe the content creation process (3.5.4) and features I ultimately did not develop (3.5.5).

The finished website as the main result of this project is discussed in chapter 4, where limitations of the practical work and potential future research opportunities are considered as well. Following the discussion is only the conclusion, where I recapitulate this project and acknowledge limitations of the thesis I have identified.

2. Theoretical Context

2.1 Disability Media Studies

To critically examine the way disability and media interact, the combination of both the studies of media and disability is needed. The result of this joint undertaking is the field of disability media studies. One case for the characteristics and benefits of this field is made by Ellcessor and Kirkpatrick in their foundational volume titled "Disability Media Studies". They present their case in three steps: They first discuss central concepts of disability studies and then introduce the media studies streams they see as particularly relevant to disability media studies. In the

end, Ellcessor et al. identify concepts found in both fields and elements that they can each contribute to the field of disability media studies (Ellcessor et al. 2017).

The central concepts of disability studies the authors present are the social model of disability, the description and critique of the "normal" or normative, and the emphasis disability studies place on the lived experiences of people with disabilities (ibid.). The social model of disability was conceived by activist movements in the mid-1970s and further developed by the emerging field of disability studies in the early 1980s. In rejection of the individual model of disability that views disability as an individual tragedy or the sole focus on a medically diagnosable condition the social model considers the society in its analysis of disability (Oliver 2013; Ellcessor 2016, 4). Underlying is the differentiation between the terms "impairment" and "disability". The former is defined as a physical attribute like a "defective limb, organ or mechanism of the body" (UPIAS and DA 1975, 14) while disability is identified as the experiences and disadvantages imposed on top of the physical impairment by society. Consequently, the social model of disability views people with disabilities as an oppressed group that is disabled by a society unable or unwilling to accommodate their physical or mental differences (ibid.; Ellcessor 2016, 3).

The social model is not without criticism, however. The strict differentiation between impairment and disability is criticized by poststructuralists Michel Foucault and Judith Butler. They argue that not only disability is a social construct – impairment is as well. After all, the term impairment only gains meaning when contrasted against bodily norms that in turn are constantly changing in time and context. Ellcessor et al. provide as an example vision "impairments" in contemporary literacy-reliant Western society that would be considered in the realm of the "normal" in medieval societies. It is crucial, however, to apply this theory cautiously. While there are many lived conditions that would be perceived as part of the norm in other contexts, not every impairment can be reduced to social construction. Pain, Susan Wendell criticizes, is part of many disabled people's lives and a fundamentally subjective experience (Ellcessor et al. 2017, 7–8).

What these positions have in common is the focus they place on the social and cultural level in their analysis of disability. This "social constructionism" (ibid., 7) is the basis for much of the work done by disability media scholars (see Ellcessor (2016), Ellcessor et al. (2017), and Ellis and Kent (2011)).

Foucault's and Butler's criticism leads to the second important concept of disability studies: The identification of the "'normate' subject position" (Ellcessor et al. 2017, 7). This notion expands the poststructuralist critique by insisting that not only disability and impairment are subject to social determination – the concepts "normal" and "able-bodiedness" are, too, propagated and upheld by "material, social, and cultural institutions" (ibid.). The "normate" (a term introduced by Garland-Thompson; Ellcessor et al. 2017, 8) references here an idealized body

that serves as the embodied standard in a certain society. The description of this otherwise invisible norm makes it possible to analyze how it is reproduced by social actors, mediated discourse, or built environments. Further, it enables a discussion of these norms without having to rely on equally fluid terms like disability – the term "cis" has a similar function in gender studies (ibid.).

In disability media studies this concept is transferred into the "normative user position" by Ellcessor (2016, 25). This user position is then too often placed at the center of media technology design and discourse. When certain uses, specific tasks and standardized user positions are assumed in the thinking about and the production of media, minority groups like people with disabilities are marginalized. They are denied access to media technologies and, crucially, to powerful modes of civil participation (ibid., 5, 22–25).

The criticism of the poststructuralist view on socially constructed impairments and this disability of civil participation have one thing in common. It is the valuation of lived experience in disability studies. The restrictions people with disabilities face in participating in public discourse also limit their abilities to contribute their experience and expertise on the topic of disability. At the same time these contributions are vital for a meaningful discussion, as shown by Wendell's criticism. For this reason, disability studies emphasize the subjective knowledge of people with disabilities as a valuable source of evidence. They take seriously subjective accounts of pain, to stay with the above example, or individual experiences of oppression. This sentiment can be condensed in the activist slogan "nothing about us, without us" (Ellcessor et al. 2017, 8). For disability media studies, as well, it is therefore essential to include the views of people with disabilities in all research, as they are the "experts on their own lives" (Ellcessor 2016, 14).

In their work Ellcessor, Hagood, and Kirkpatrick further provide two aspects of media studies that are important to disability media studies in general and this project in particular. They see media studies traditions rooted in the "critical humanities" (Ellcessor et al. 2017, 11) as relevant because they analyze media to understand social, political, and economic power relations. The investigation of everyday popular culture by media scholars is another aspect where media and disability studies follow similar approaches. That is, to learn about "power and oppression" (ibid., 12) in society from everyday artifacts and everyday life. However, what lacks in current discourses of media is a consideration of disability among other aspects of analysis such as class, gender, race, and sexuality. Aspects where normativity and marginalization are already discussed within media studies (ibid., 11–17). This has concrete consequences for digital accessibility as well. Goggin and Newell (2002) argue that full accessibility of the internet can only be achieved, if disability is considered as a social identity "in the same way as class, gender, and sexuality" (Ellis and Kent 2011, 2).

The second aspect of media studies raised in "Disability Media Studies" is the "integrated approach" (Ellcessor et al. 2017, 14) of the discipline. This means that media artifacts are not studied in isolation. Rather, media artifacts are studied embedded in the conditions of their production, the "social, political, and material contexts" (ibid.) of their consumption and the ways audiences negotiate their meanings. Especially the studies of audiences and of the media industry are relevant to this project. Their inquiries use sociological methods like interviews and ethnography to investigate media objects (ibid., 14–15).

Both aspects show the holistic approach media studies already apply to their methods, research objects and categories of analysis. Still, as shown above, media studies too often fail to include disability into their work. Especially at the material level, disability media studies can improve this by focusing on the physical interactions with media and the dynamics of media access (ibid., 18; Ellcessor 2016, 16).

This is what Elisabeth Ellcessor does in her book "Restricted Access". She uses a disability media studies framework to study the concepts of media access and accessibility. An important contribution is her definition of access as a "relational" and "unstable phenomenon" (Ellcessor 2016, 16) that becomes meaningful in the interaction of "bodies, technologies, cultures, and practices" (ibid., 92). She rejects the idea of access as a binary outcome. The question is not whether someone either has access or has not, it is about the specific relations and context of a situation. Different impairments may exert various limitations on the degree of media access a user has and apparent trivialities like the time of day or bright sunlight can all influence the extend of access users experience – whether they are commonly considered *with disabilities* or not. A fluidity assumed from the endless variation of the human body. "Accessibility" is then defined by Ellcessor as the ability of an individual with "one or more disabilities to make meaningful use of a media technology" (ibid., 11) with the help of assistive technology or by using modified mainstream media. Here, again, accessibility is described not as a binary property – a website, a technology can never be called "accessible". Only accessible to certain users in certain conditions (Ellcessor 2016, 7, 12-13).

To study access in a disability media studies context, Ellcessor proposes a so-called "Access Kit" (ibid., 17). Influenced by new media theory and especially Lev Manovich's work regarding the variability of new media, the Access Kit is a framework consisting of five analytical categories that each have three main questions to guide the inquiry. The five categories are regulation, use, form, content, and experience. Ellcessor intends the Access Kit to be used flexibly in the way that makes the most sense for a given study. Then it can help research tensions and relations of power in media access. For this work, the categories use and form are the most relevant (Ellcessor 2016, 16–21).

To have access to a medium or technology requires certain basic requisites. What is accessed, first, has to be available and affordable. Then access depends on the ability to convert this availability into usability (Ellcessor 2016, 9). Ellcessor's approach to the investigation of use relies on the concept of the normative or "preferred user position" (ibid., 69) introduced above. She defines the preferred user position as a set of "normative relations between bodies and technologies" (ibid.) arising from the prevalent representation in media, ads, and discourse of the standard user as adult, male, usually white, and able-bodied. Leading to a dialectic in which able-bodied user positions, are *dominant*, but also too easily assumed to be *the only ones*. This assumption creates a hegemony in which interfaces and hardware are designed based on this unquestioned standard of bodily, mental, and cultural abilities. These media and technologies, in turn, perpetuate the hegemony of the normative user position through their sheer existence as the default (ibid., 69–77). Condensing this theory, the guiding questions Ellcessor proposes to uncover the dynamics of use and users in a particular medium are:

> What is a given medium "for"? How is it meant to be accessed and used, and by whom?

> What are the assumptions or defaults of the user position in this case, in terms of bodies, cultures, and technologies?

> What alternate uses and user positions are there, and how are they found, negotiated, or discouraged? (Ellcessor 2016, 64)

Overcoming the feedback loop of the normative hegemony from the perspective of production and design happens at the site of form. Form means the "technological and material structures" (ibid., 90) that determine media access. To study form is to study the hardware, code, and interfaces that make up media objects and form the presentation of its content. Understanding these technological elements is valuable for the study of access, as they can either increase or restrict user's access to a medium. To further this understanding, Ellcessor provides the following leading questions:

> By what means does one access a medium in this case?

> What material, technological, cultural, or social structures shape this medium's material, technological, or designed components?

> How do these means of access, or structures, interact (or interface) with the bodies of those who use them? (Ellcessor 2016, 93)

At the technological level of form, accessibility innovation can be applied that makes media usable for people with disabilities. Essential for this and digital media accessibility in general to work is the separation of form and content. It enables software to mediate between

inaccessible mainstream forms and assistive technologies, so that the same content can be presented by alternative interfaces like screenreaders. This is an example of the principle of variability in new media, identified by new media scholar Lev Manovich, that will be expanded on in the next sub-chapter (Ellcessor 2016, 23, 90; Manovich 2001, 37).

2.2 New Media Theory and Software Studies

Media scholar Lev Manovich provides a fundamental theorization of digital media in his book "The Language of New Media". Of the five "principles of new media" (Manovich 2001, 27) he identifies, three are especially relevant to this project: "modularity", "automation", and "variability" (ibid., 30, 32, 36).

As an example of the modularity of new media objects, Manovich shows how websites are made up of discrete elements on different scales. Several pixels will form an image; images, text, and other embedded media are composed into a webpage that is in turn part of a larger site. Meanwhile, each component still maintains its own independence. This makes it particularly easy to cut objects from such a composition or to interchange or manipulate them (ibid., 30–31).

That digital media allows for automation is relevant for its effects on media access and accessibility. Automation allows screen reader programs, for instance, to use the provided text of a website and convert it into a format more accessible to the user (ibid., 34) – a process also reliant on the above-mentioned principle of variability.

Based on the way new media is stored digitally and modular in its form, the variability of digital media results in the ability to generate diverse media objects from the same data and to keep decisions regarding their design forever open. These media objects can be entire websites that are generated from a database or interfaces that are customized according to the needs of the user. Building on modularity and automation, the principle of variability illustrates the crucial concept of the separation of form and content and makes digital accessibility feasible (Manovich 2001, 36–37; Ellcessor 2016, 23).

Matthew Fuller supports the call of disability media studies scholars for the inclusion and valuation of the knowledge and experience of users with disabilities from a software studies perspective. He criticizes the field of interface design for dealing with preconceived, standard models of the user and cites the practice of "participatory design" (Fuller 2003, 13), which is grounded in user-designer collaboration, as an improvement of the discipline. Later, Fuller extends this argument, writing that the conventions of using averages and supposedly typical users as reference for interface design exclude people that are not "ideal users" (ibid., 46). Then, every user is suddenly "ideal", simply because others "won't be a user at all" (ibid.).

Which, in turn, reinforces those same conventions and is an example of Ellcessor's notion of the normative hegemony.

Writing about the free software movement, Fuller attests the movement a "submissive relationship" (Fuller 2003, 25) with proprietary software like Microsoft Word and the user model its design is based upon. While independent developers have the means to reinvent the common conventions of – in his example – digital writing, they simply imitate established software and subscribe to its normalized user model. As a solution, free software developers should find and collaborate with users outside of the models of established proprietary software (Fuller 2003, 13–14, 25–26, 46). Embedded in the discourse on software studies and software criticism, Fuller's critique strengthens Ellcessor's criticism of the normative user position and underlines the necessity to consider the abilities of all future users in the design of a media object.

2.3 Web Accessibility and Design

> *For me, working on the computer, or on the Internet, always takes a lot of time. Because there is this W3 standard. Not all of them adhere to it. Many don't know what it is.*
>
> – Rolf Schilling[3]

After discussing the theories of access and digital media in the sub-chapters above, this section is dedicated to the technological and design considerations shaping web accessibility and its practical implementation.

The shift from early text-based operating systems to graphical user interfaces (GUI) mimicking a familiar desktop through metaphors of folders and trashcans increased the usability of computers for many users.[4] While the GUI was a relief to many, it meant major challenges for blind users. Existing text-to-speech software, screenreaders, used to read out text on the screen did not work with the new interfaces and users with disabilities feared they would be left worse off by this disruption (Shneiderman and Plaisant 2005, 32; Ellcessor 2016, 96). This sentiment is also apparent in Mr. Schilling's first-hand accounts (A3, 34). This neglection of people with disabilities makes apparent a general problem of (digital) design. When working on a digital design, be it a single webpage or the GUI of an operating system, designers often have to create a single design for every user. Trying to design for the average user is rejected by design scholar Donald Norman because there is none, he claims. And indeed, while using average body measurements as reference for a design already discriminates people on the

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[3] Appendix 3, 2. Translated by the Author.
[4] See Fuller (2003, 100) on the limits of the metaphor in user interfaces.

extremes, averaging between blind and seeing users is impossible. Instead, Norman argues that designers should strive for flexibility in their work (Norman 1990, 161–164).

This flexibility is what powers accessibility on the web, where it can be attributed to the form-content separation discussed by Ellcessor and Manovich. In practical terms, web accessibility is governed largely by the Web Content Accessibility Guidelines (WCAG) developed by the World Wide Web Consortium (W3C). In their latest released version 2.1, they function as the international standard for web content accessibility (Ellcessor 2016, 38–42). Content, in this case, encompasses the information on a site as well as the underlying code structure and presentation (Henry 2022). The WCAG 2.1 is organized along the four core principles "perceivable, operable, understandable, and robust" with subordinate guidelines that are each concerned with one aspect of accessibility. The guidelines in turn can be evaluated by testing corresponding "success criteria". In this, version 2.1 extends its predecessor WCAG 2.0. The principle, guideline, success criteria structure was developed for version 2.0 – for WCAG 2.1 some guidelines and success criteria were added, maintaining backwards compatibility with WCAG 2.0. WCAG 2.1 provides eleven guidelines and a total of 79 success criteria structured by three conformance levels ranging from AAA, the highest, to AA and A (W3C 2018).

While the WCAG is technology-agnostic, many features that make it easy to implement its guidelines were included in HTML5. As the basic markup language structuring the web, HTML (hypertext markup language) is one of the most important sites for web accessibility. For example, in its fifth version, HTML was extended by so-called "semantic elements" like *<header>*, *<nav>*, or *<article>* (W3Schools n.d.) that convey information about their contents to, for instance, screenreaders and other assistive technologies. One of the most important accessibility features of HTML is the *alt*-attribute of image elements. In it, web authors can provide alternative text describing the image presented on the page to users that access the web through a non-visual interface like a screenreader. Another aspect where HTML, related web technologies, and associated coding practices improved to become increasingly accessible is the adoption of stylesheets separate of the HTML document. Using CSS (cascading style sheets) files, the presentation of the website is separated from content and structure. Previously, websites were often structured by table layouts. An imperfect method of organizing content for different reasons, one of which is the cumbersome navigation of these tables with assistive technologies (Hanson and Richards 2013, 22–23).

That accessibility features were included in HTML enables websites to present the same content to diverse groups of users through a closely related set of forms (Ellcessor 2016, 99). In contrast to the desktop GUI, Ellcessor praises HTML as a successful example of "mainstream forms" (ibid., 106) that become increasingly accessible.

3. Technical Project

> *For blind people, the internet is always a nuisance. Because it is made by sighted people, it is sometimes made so crude by sighted people. By such mouse pushers.*
>
> – Rolf Schilling[5]

3.1 Introduction and Field Research

After building the interdisciplinary understanding of disability, media, and access described above, I conducted a review of the state of web accessibility detailed in the following sub-chapter. To further enhance my understanding of the field, I conducted two interviews with blind internet users. Putting into practice disability studies' demands and critical media studies' approach of applying and valuing the experience and knowledge of users with disabilities in research (see chapter 2.1). The concept for my technical project described in chapter 3.3 is based on the conclusions drawn from the web accessibility review, the interviews, and an analysis of the normative and alternate user positions on the internet guided by Ellcessor's Access Kit. In chapter 3.4, I present the resulting website, before discussing its design and development process in chapter 3.5.

Both conversations, about 35 minutes each, were conducted as semi-structured interviews, guided by my questions but open for the participants to stress issues important to them and for divergences into insightful themes that I had not anticipated. The interview guideline was informed by my ideas for the technical project detailed below and Ellcessor's guiding questions for the analyses of use and form. The guideline can be found in the appendix (A1). As the interviews were held in German it is also written in German. Björn Beilfuß and Rolf Schilling both expressed their wishes to be named in this work, the German-language transcripts of their interviews can be found in A2 and A3, respectively. Without taking away from their experience and expertise on web accessibility for blind users, it is important to regard their input as subjective knowledge. Especially people with other disabilities likely have differing experiences of access and thus perspectives on the themes discussed below.

In addition to the interviews, I experimented with the use of a screenreader myself. Using the Narrator software included in Microsoft Windows, I visited several websites to develop a sense of the way blind people use the internet and how this kind of software works. The problems I immediately encountered myself were a frustrating confirmation of the accounts in literature and first-hand testimony.

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[5] Appendix 3, 2. Translated by the Author.

3.2 The State of Web Accessibility

The technological conditions for accessibility on the web can be considered a good example of working digital media accessibility. From a theoretical perspective the separation of content and form made possible by HTML and other web technologies is a prime example of the goals of accessibility. And Mr. Schilling, with some experience in web development, agrees that the proper implementation of existing accessibility standards like the WCAG and use of existing technologies like HTML would be sufficient for satisfactory accessibility on the internet (A3, 2, 30-32).

However, the practical implementation of this technological potential is lacking. Both interviewees expressed frustration in the degree of accessibility they encounter on the web. Mr. Beilfuß additionally expressed his impression that web accessibility has improved in recent years but is still inadequate overall (A2, 24). Users with disabilities in general and blind users in this case present, in Ellcessor's terms, alternate user positions in their use of the internet (see her third guiding question on use, page 7). The interview participants are "discouraged" (Ellcessor 2016, 64) in their use of the internet by concrete technical accessibility problems they encounter regularly (A2, 26; A3, 15). Both could spontaneously list several examples of websites they could not use properly or at all. And simultaneously broader social and cultural conditions hinder their access to the internet (see also *form* question two on page 7). For example, both interviewees reported contacting companies whose websites were inaccessible to them and receiving no or dismissive answers.

That accessibility on the internet is inadequate is a sentiment supported by numerous empirical studies. A common method to determine the general accessibility of a website is to evaluate the website's conformance with the WCAG due to its role as international standard and its testable success criteria, some of which can be tested by programmatic tools. Hanson and Richards (2013) studied the accessibility of popular and government websites over a fourteen-year period and measured at least minor improvements in all metrics. Still, they concluded that in 2012 only few sites conformed to the low accessibility requirements they measured against, the test criteria being only those six out of 25 WCAG 2.0 level-A success criteria that could be tested for automatically. Interestingly, Hanson and Richards suspect that the employment of new technologies, improved coding practices, and increased search engine optimization are responsible for a considerable amount of the measured progress, not increased awareness for accessibility issues. In a more recent study Bai et al. (2020) analyzed 342 websites of local governments in the U.S. for their conformance with WCAG 2.0. They also used an automatic tool that investigated the homepage and ten randomly selected subpages of each website. However, the researchers did not state how many success criteria the tool was able to evaluate. Under a third of websites were declared partially conforming to the W3C guidelines and no website in the sample did fully implement the standard. Bai et al. also concluded that a

higher financial budget was not a predictor for a more accessible website. The initiative Web Accessibility in Mind (WebAIM) provides a yearly report on the accessibility of one million popular websites. The authors use the accessibility checking tool WAVE to query the sample for accessibility issues that indicate a failure in WCAG level-A or AA conformance. In 2022 WebAIM detected such failures in 96.8% of all websites in the sample (WebAIM 2022). The evaluation methods of these studies are clearly imperfect, meaning that they can only provide an approximation of the state of web accessibility. However, this approximation is likely an overly optimistic one considering that the studies above only evaluated subsets of the WCAG success criteria.

The reasons for this unsatisfactory degree of web accessibility are not as clear. Following Hanson and Richards, there is little evidence for rising attention to accessibility issues in website design and development. While Hanson and Richards' study was not primarily focused on this kind of investigation, Moser and Wieland conducted a survey of web developers that researched this topic. They found that 80 percent of developers did not pay attention to the accessibility of their projects and over half of the queried developers could not specify who benefits from accessible websites. Interestingly, most developers who did consider accessibility issues in their work did so out of an intrinsic motivation and not solely because of project demands (Moser and Wieland 2011, 20, 25). This indicates that an understanding of the necessity and of the implementation of accessibility measures is a deciding factor in improving the state of web accessibility. Similarly, the interview participants identified a lack in knowledge on and awareness of this topic in the web development industry and demand a change in attitude among professionals (A2, 27; A3, 20). The existing mindsets around accessibility in the industry are examples of the social and cultural structures Ellcessor aims for in her inquiry into *form* (Ellcessor 2016, 93). The interviewees repeatedly criticize these structures as promoting a prioritization of appealing visual design over usability and accessibility. They condemn prevalent prejudices that accessible web design would be detrimental to visual design, more expensive or time consuming (A2, 22-24; A3, 2, 22). Evidence for such prejudices was also found by Moser and Wieland (2011, 19–20).

3.3 Aim of the Web Project

Starting from this base of knowledge, I want to present a practical work that can be described by Fuller's notion of "critical software" (Fuller 2003, 22). He defines critical software as a means to critique software production from within, as software written to "pull the rug" (ibid.) from beneath the coding mainstream. One of the ways in which critical software critiques other software is the fundamental transformation of mainstream applications. So that the critical software mimics its object of critique while exposing its underlying approaches to interfaces, data structures, or, crucially, its preferred user positions. Critical software aims to highlight the many

normalizations at play in mainstream software applications and production (Fuller 2003, 22–23).

I intend to develop a website that makes explicit the assumed, normative user positions on the internet and challenges users occupying them to recognize the ways in which people with disabilities are disabled and discouraged in their use of the web. The work will focus on the internet use of blind people. Reasons for this are the necessity to narrow down the scope of the project to be realizable in the extend of this thesis and the great disruption this alternative user position presents to the normative use of the internet as a visual medium.

The engagement with alternate user positions in media is encouraged by Ellcessor and Fuller, who proposes to strip visual information from the user interface to investigate its design discipline (Fuller 2003, 46). Ellcessor stresses that it is essential for cultures and scholars to engage with the outsides of a preferred user position, everything else would be "limited, and limiting" (Ellcessor 2016, 87). As it is there that the most interesting innovations in digital media take place and where the researcher can gain a more comprehensive understanding of digital media, access, and participation (ibid.).

The normative user position in case of the web is the able-bodied, technologically literate adult that can understand and use all technological conventions, interfaces, and apps with which they are presented. This idealized user is the unquestioned default websites are built around. Returning once again to Ellcessor's Access Kit, the assumptions on the user position in this case, are interrogated in the questions on use (Ellcessor 2016, 64, 73–74). They include that the user's sense of sight is within certain norms and that they can read, both in terms of literacy and of vision, what is on screen without assistive technologies apart from glasses. Further, it is assumed that internet users can manipulate a mouse to interact with websites and use a keyboard for text input while working on computers. On mobile devices, the normative user can precisely use a touchscreen to navigate webpages and to interact with interface elements like small buttons or text links. These properties are identified not only in literature but also by the blind users interviewed for this project. The normative user position can be narrowed down by identifying blind users' alternate user positions. As evident by the many difficulties they face using the web, they are certainly not part of the assumed group of users.

Blind users rely on screenreader programs to scan websites (and other interfaces) and present their contents through synthesized speech or braille displays. These displays consist of a line of eight-dot braille segments that can represent a single character. The braille cells on the display then render a line of text delivered by the software. Different to the standard six-dot braille cells, this extended version of the writing system can also display capital letters and special characters that are important for computer input and online communication. Some braille terminals also include switches associated with each cell that can direct the cursor to

the displayed character. By this method, it is possible to edit text precisely but also to activate links and buttons. Another method of input is the common keyboard. Various key combinations control properties of the screenreader and the tab and arrow keys are used to navigate the interface (A2, 2-5; A3, 6-9). Thus, problems in using the web often occur, when blind users cannot navigate a webpage by keyboard input because it is improperly structured or when there is no text alternative provided for non-text content like icons and images – violating the WCAG principles *perceivable* and *operable.* According to the problems listed by both inter-viewees, these seem to be the most common accessibility problems for blind users.

Following the analysis above, the project website will aim to present users without (vision) impairments with an interface operable only by keyboard and perceivable by audio output. This way, users can get an approximate impression of the way blind users navigate websites with-out knowledge of the field of accessibility or practical experience with screenreader software.

3.4 Presentation of the Project Website

In this sub-chapter, I will introduce the project website I developed following the concept out-lined above, including its structure, interface, and content. The development process and rel-evant design decisions are detailed afterwards. The website can be visited through the files in the digital appendix and on *niclashedemann.de/ba/project-website.html*.

Realizing my plans, I succeeded in developing a website that conveys its content solely through synthesized speech. Visually, the site appears as a blank white page. Only the URL and the page title are visual hints towards its content. When the homepage is loaded, the page title "Challenging the Face of the Web - Project Website" is announced by the text-to-speech system similarly to how a conventional screenreader would work. The user navigates on the page via keyboard, using the *Tab* and *H* keys in combination with *Shift*. The first element on the homepage is a short introductory note explaining the blank page and the keyboard navi-gation:

> Welcome, this page is intentionally without visual content. Use the Tab Key, and the command, Shift plus Tab, to navigate the page. On macOS, use option plus tab to focus inline elements like links. Press Escape to pause and resume the audio narration. By using the H Key, and, Shift plus H, you can jump between headlines within a page.

This note is followed by the navigation area with links to three subpages. The first link in this section enables users to skip directly to the main content area, bypassing the navigation menu. This is a practice recommended by experts and requested by Mr. Beilfuß in our interview, facilitating quick page navigation for keyboard users (WebAIM 2021; A2, 15). When the focus is placed on the navigation area, marked by the *<nav>* tag, the narrator announces it as "main

navigation area", emulating the behavior of usual screenreaders. This is done to help users orient themselves on the page. When moving the focus into the navigation are, each link title is read out preceded by the signal word "link" to convey the option for interaction to users. For Safari users, focusing inline elements like these links requires the command *Tab + Option*.

The menu is followed by the main content area, which is announced as such and defined by a *<main>* tag. Here, the webpage's content is structured by several headlines and paragraphs that can each be focused individually. They are then read out by the text-to-speech function. For each headline, its text content is preceded by an announcement of the headlines place in the hierarchy of the page. The first headline, for example, is read out as "Headline level 1. Challenging the face of the web: An experimental interface approach." Content-wise the homepage briefly introduces the project and its goals. After the second level-two-heading, the contents of the subpages are described and linked. The navigation area is repeated on the bottom of the page, so that users do not have to navigate back to the top of the page to access the links provided there.

The three subpages are structured in the same way as the homepage, just the introductory note at the top is omitted on them, as users are expected to have encountered it before. Generally, the subpages outline the theoretical and empirical foundation of the project: disability media studies, an introduction to web accessibility, and the state of web accessibility. I mostly used texts from the corresponding chapters in this thesis and edited them for a broader audience. That meant focusing on the most important concepts and theories and reducing some more complex arguments. The website's structure can be represented as follows:

Homepage
   → Disability Media Studies
   → Introduction to Web Accessibility
   → The State of Web Accessibility

The page "Disability Media Studies" covers the field's concepts most important to this project: the social model of disability and the normative user position. Introducing users to this way of thinking about disability lays the foundation for an understanding of the importance of accessibility in general and in digital media in particular. The "Introduction to Web Accessibility" is split into three parts. The first is titled "Why is Accessibility Important" and discusses the human right of equal access to information and communication. It further highlights the important role of the web in providing this participation in society. The second part is about concepts and terms important to the topic. First, I provided Ellcessor's definition of accessibility and then described her notion of access and accessibility as relational and unstable phenomena as discussed in chapter 2.1. Lastly, the separation of form and content and its importance is explained with references to Ellcessor's concept of form and Manovich's principle of variability. The normative user position on the web and the alternate internet use by blind users is

described in the third section on important concepts. Here, I provided a short summary of the analysis in chapter 3.3. On the subpage on "the State of Web Accessibility" chapter 3.2 is presented in condensed form. I decided to only discuss the studies by Hanson and Richards (2013) and WebAIM (2022) to focus on the most recent and most relevant evidence. Moser and Wieland (2011) are still used to illustrate the reasons for the inadequate implementation of accessibility measures.

Because the primary goal of the project website is the confrontation with the unusual (at least for mainstream users) interface, the content of the site was not the main concern. However, furthering the knowledge of and awareness for accessibility in the site's users through the presentation of important parts of my thesis became a secondary goal.

I originally planned to include a fourth subpage on the practical aspects of web accessibility like semantic HTML and more details on the WCAG. I decided against writing a fourth page because the topic is not immediately important to the project. Writing about technical details would reach further than the project's secondary aim and would only be relevant to a specific audience. Also, since the technical details of accessibility are not covered in detail in this work, there was no text that could be adapted for the webpage, and I prioritized other parts of the project.

3.5 Development and Design Process

In this chapter, I will discuss the development process of the project website including my original plans and the technology I used in the end. Important design decisions are explained as well and I write about observations made while working on the site and aspects that did not work as planned.

3.5.1 Text-to-Speech Function

The text-to-speech (TTS) functionality was the most challenging part of this project. Because conventional screenreaders are used to navigate the complete GUI of an operating system including the web browser, there are no solutions dedicated to a screenreader functionality for single websites. There are browser extensions that can read out text on a website, an example being Read Aloud *(https://readaloud.app/)*. However, my goal was to require as little initiative as possible from the users. This excluded additional software users would have had to install.

Most modern operating systems include a screenreader program, for example Microsoft's Narrator and Apple's VoiceOver. But the use of these programs would have required significant effort from users as well. Users would have had to familiarize themselves with a software they never used before. Therefore, I decided to develop a custom screenreader functionality for the project using text-to-speech software implemented on the website. The original plan was to use TTS libraries for Python and embed them in a website built with the Python web framework

Flask. I researched several TTS libraries for Python and experimented with them. The most promising ones were gTTS (short for Google Text-to-Speech) and pyTTS. gTTS uses the text-to-speech API of the Google Translate service to provide audio output in mp3 files (Durette n.d.). The usage of the library is simple. However, it would have required a separate library to play the generated audio on the website. pyTTS in contrast works offline and uses text-to-speech the functionality of the respective operating system. pyTTS can also play the generated audio directly from the Python console (Bhat n.d.). What both libraries lack is a convenient way to interrupt or pause the audio narration, a feature I wanted to include in the site, but had no high priority. While it was still unclear how the integration of one of these libraries in Flask would work, I found another way to realize text-to-speech on the website. The Web Speech API provides speech synthesis and speech recognition possibilities for JavaScript. It's specification was released in 2020 and is currently in draft status (WICG 2020). However, the speech synthesis interface is supported in the browsers Chrome and Safari since early 2014. In late 2016 it was implemented in all major browsers (Caniuse.com n.d.). The speech synthesis interface makes it possible to generate and play synthesized audio from text within a website's scripts. This solution was better suited for the project because my previous knowledge of JavaScript was more advanced than my experience with Python and because of the API's seamless integration into JavaScript which makes the intermediate steps of integrating TTS libraries into the website obsolete. The API's *SpeechSynthesis* interface also relies on text-to-speech voices already installed on the user's operating system, providing a high quality of synthesized speech. Its documentation, which I relied on for the development, can be found under MDN contributors (2022). Several other pages of the MDN Web Docs served as reference for my script, the most significant ones are listed under MDN contributors (n.d.) in the references.

3.5.2 Keyboard Navigation

The Web Speech API is the main tool the project website relies on. Additional code is needed to emulate the behavior of a conventional screenreader. Common software allows the user to operate various shortcuts and key combinations to navigate on a website like jumping from link to link or from one headline to the next. Additionally, for the screenreader to be practical users must be able to focus elements like individual paragraphs and links that are then read out. To enhance the user's orientation, screenreaders also interpret HTML elements and announce their meaning to the user. For example, headlines are announced together with their level in the document hierarchy, links and buttons are labeled as interactive, and relevant content blocks like navigation menus or footer sections are declared as such. This is, in large parts, possible because of semantic HTML tags like *<nav>, <footer>,* and *<article>*.

All these functions had to be replicated for this project. To make the individual elements focusable with the keyboard, all elements that are of interest to the screenreader function are provided with a *tabindex* value of 0. At first, they received an incremental index that also serves

as an identification marker for the headline jumping function described below. I changed that after finding expert recommendations that explicitly discourage this use of the *tabindex* attribute. Instead, the tab order should be defined by the actual element order in the HTML document to avoid the confusion of different element orders provided by keyboard navigation, screenreader narration and visual presentation. Adding *tabindex=0* makes an element focusable but still leaves the focus order to the document structure. On the project website, this would likely not have caused problems as the elements were indexed along the HTML structure. Still, following general recommendations is good coding practice (WebAIM 2020).

When an element of the types *h1, h2, h3, p, a, nav,* or *main* is focused by the user, the text-to-speech function is executed via the *onfocus* event handler. The *innerText* of the HTML element is passed to an instance of the Web Speech API's *SpeechSynthesisUtterance* object class as its *text* property. This object is in turn handed to the *SpeechSynthesis* interface that handles the actual speech synthesis and speaks the provided text. Before the elements content is passed to the utterance object, the announcement of element types is implemented. If the focus handler function is called on a headline, link, *nav*, or *main* element, the *innerText* is prepended with the respective element description, such as "headline level one" or "main content area". The main functions responsible for this behavior, *elemFocus()* and *speakText()* are displayed in Appendix 4.

The functionality for jumping between headlines was included to increase the speed with which users can navigate the website and quickly scan a page's content by accessing only the section headlines. When pressing the *H* key, the next headline element in the document order is focused and when using the combination *H + Shift*, the previous headline is focused. As mentioned above, the function first relied on the *tabindex* value of the currently focused (or active) element and the indices of the document's headlines. They were compared to find the nearest headline in the document, which was then focused. After the *tabindex* for all elements was set to 0, I reworked the function to work independently of *tabindex.* It now uses a *NodeList* of all focusable elements. In it, the active element is identified, and its key is stored as before. Next, the locations of all headlines are collected in an array. Their locations are then compared to the active element's location, finding the headline next to the active element in the direction indicated by the keyboard command. The final implementation of this function is depicted in Appendix 5.

3.5.3 Pause and Resume Feature

Because the TTS system reads out whole paragraphs at a time, I wanted to include the option to pause and resume the audio output. On the finished website, this is done by pressing the *Escape* key. The code required for this is not complicated. However, the development of this function still took longer than expected. The *SpeechSynthesis* interface provides *pause* and

resume methods. On a press of the *Escape* key, the function checks via the *paused* and *speaking* properties whether the TTS system is speaking at that moment and pauses or resumes the audio accordingly. This works without problems on the Windows computer and Firefox browser I developed on. In the Chrome browser on Windows and Firefox on macOS, the system also works as intended. When testing the website on macOS's Safari, however, I encountered a bug in this feature. The *pause* and *resume* methods did not work reliably. However, it was unclear what caused them to behave differently than expected. Because it seemed to be connected to an incorrect reading of the *speaking* and *paused* properties, I introduced the *utteranceState* variable. It stores the state of the *SpeechSynthesisUtterance* object and is updated when the object's *start*, *pause*, *resume*, and *end* events are fired. This variable is queried as well when the play/pause function is determining the text-to-speech system's state. This led to the intended result, the function is now executing the *pause* and *resume* methods at the right times. Still, in Safari, the speech synthesis output is not paused in all intended situations. After some investigation, I was able to reliably reproduce this bug. When the TTS utterance is aborted by skipping to the next element, which is then read out, the *pause* and *resume* methods stop functioning. Only a page reload fixes this. If the utterance of the first element is completed and the user then navigates to the next element, the feature works as planned. On *Escape* the utterance is paused and resumed on a second press. To better illustrate this problem, the console outputs I used for debugging are left in the script. In the JavaScript console of the browser, users can track the correct output of "pausing" and "resuming" logs that are not accompanied by the intended effect in the cases described above. The code for the play/pause feature is displayed in Appendix 6, the updating of the *utteranceState* variable can be observed in Appendix 4 as well.

This seems to be a bug or inconsistency in Safari's implementation of the Web Speech API's specification. This may be, as the specification still has draft status. However, all relevant parts of the *SpeechSynthesis* interface have been marked as supported without notes or limitations since Safari 7, which was released in 2013 (WICG 2020; Caniuse.com n.d.).

Another browser behavior where Safari differs from Firefox and Chrome is the *Tab*-navigation. In Firefox and Chrome, using the *Tab* and *Shift* + Tab commands, the focus jumps from on element to the next strictly along the element order in the HTML document. When an inline element like a link is placed inside a paragraph, the link is focused after the parent paragraph. In Safari, the focus omits inline elements and instead jumps from paragraph to paragraph. This also leads to the omission of the main menu's links at the top of each project page. To enter a block element and focus the links, user have to use the commands *Option* + *Tab* and *Option* + *Tab* + *Shift* respectively. This was unexpected for me, and I considered overriding Safari's behavior to align with the navigation experience of the other browsers. I decided against this for similar reasons as described in connection with the *tabindex* value: Overriding the browsers

default behavior might produce unexpected and inconsistent results and confuse users that are already accustomed to Safari's *Tab*-navigation. Instead, I added an explanation of this behavior to the introductory hint at the beginning of the homepage.

3.5.4 Content Creation

After developing the TTS interface and making sure the website would (largely) work as planned, I finalized the content of the homepage and created the subpages. As described above, I used excerpts from the corresponding chapters of this thesis as basis for the page's contents. While adapting the texts for the website, I paid attention to two main requirements for the content. First, that it had to be comprehensible when listened to, and second, it was supposed to be understandable to an audience other than that of my thesis.

In practice, both goals often intertwined. I found in testing the website that comprehending longer sentences via audio output was harder for me than reading them. I assume this is comparable for other users unfamiliar with this kind of interface. Therefore, I tried to reduce the complexity of the arguments and shortened the paragraphs so that the amount of text read out at a time was better to understand and remember. User can then control the interval after which they jump to the next paragraph or repeat the narration of the text. I also put more effort in structuring the text and providing relevant headlines so that users can quickly orient themselves and jump to the sections they find most interesting. Finetuning the texts for the TTS interface, I added commas in position where English punctuation does not call for them. An example of this is the introductory note on the homepage quoted on page 15. This was because the synthesized speech includes short pauses when reaching a period or a comma. With this method, the pronunciation and emphasis of important terms could be improved. This procedure is of course not suitable for larger or general audience sites, where some users would also read the provided text content. In summary, the adapted texts are better comprehensible and explain the most important concepts of this work in a language better accessible to readers (or rather listeners) not familiar with the field of accessibility, disability media studies, or academic writing in general.

3.5.5 Features Not Implemented

There are some aspects of the website that could be improved and features I thought about but did not realize in the end. Conventional screenreaders include several ways to navigate a text. In Windows' Narrator, the arrow keys can be used to read out one word or even one character at a time, with the *Tab* key used for jumping between interactive elements. I decided against this more complex method of navigation because the *Tab* variant is simpler and thus more intuitive for unfamiliar users and faster to implement. It is also sufficient to handle the project website's comparably low level of complexity. Another feature I decided not to implement in the end is an adjustable speaking rate of the TTS system. The Web Speech API

supports the manipulation of the speaking rate via the *SpeechSynthesisUtterance.rate* property. Screenreader programs typically include such an option as well. This was again an instance where the limited scope of the project did not necessitate this level of customization and complexity. It would have required even longer instructions at the top of the page and increased users' effort needed to familiarize themselves with the unusual interface. Due to the small number of subpages, it was possible to write the HTML for each page by hand. For a bigger website, the manual conversion of text content into marked-up HTML would be inefficient. In such a case, the use of a templating engine would be practical, so that both page structure (in the HTML template) and each individual page's content (in text or, for example, markdown files) can be more easily edited at any time.

4. Discussion

After discussing the development and design process of the project website above, this chapter will evaluate the resulting website as a completed work. Grounded in the theoretical work detailed in chapter 2, the goals for the project website are described in chapter 3.3. The website was conceptualized to confront users with the normative user positions the design and construction of the web is based upon by explicitly providing an opposite user experience. A second goal was to generate an increased awareness for the disabilities imposed upon blind internet users. To this end, the website was to provide an interface based solely on keyboard navigation and text output via synthesized speech. By fulfilling these goals, I wanted to present a work located within Fuller's concept of critical software.

As described above, the website forgoes a visual interface and can only be navigated by keyboard input. For the output of information, I successfully realized a basic text-to-speech functionality. Further behavior of conventional screenreader programs – like keyboard navigation, announcement of structural and interactive elements, and headline jumping – was emulated as well. Compared to conventional screenreaders, the project's TTS engine only lacks certain advanced features. This "fundamentally twisted" (Fuller 2003, 23) experimental website successfully exposes the normative user positions underlying its mainstream relatives and can thus be described as a piece of critical software.

Restricting the accurate representation of the internet use of blind people is the focus on the audio interface. As discussed in chapter 3.3, blind users also employ braille terminals as input/output devices. Of the users interviewed for this work, one uses the braille terminal only for input and the other uses the braille display as main output device only supplemented by audio output. This restriction has practical reasons as it is not possible to emulate the braille terminal for mainstream users missing the required hardware and knowledge of the braille writing system.

The website's content presents key concepts from this thesis and seeks to educate users about the importance and theoretical context of digital accessibility. To what extent the project actually increases the knowledge of and awareness for the field of digital accessibility in its users was not studied as part of this work. It can be argued that the unusual interface discourages sighted users from engaging with the website and its contents – much like inaccessible websites deter blind users from using them. To avoid that, the introduction at the top of the homepage could be displayed visually, giving sighted user an explanation and instructions in a familiar form. However, this approach would require compromising the consequent implementation of the experimental interface. This provides an interesting opportunity for further research investigating the immediate impact of the project and other approaches to increase the awareness for disability and accessibility in digital media.

What might limit the impact of the project is the focus on a desktop use of the website. The features described above only work correctly when accessed on a device with attached keyboard. There are satisfactory screenreader programs for smartphones – Apple's VoiceOver was praised by Mr. Schilling, for instance (A3, 34) – but the development of a custom screenreader feature for both desktop and mobile devices and potentially iOS and Android phones separately was deemed too time intensive.

It is important to note that the intention was *not* to develop an accessible website. And while the project site passes the WAVE accessibility evaluation tool without errors, it cannot be described as accessible (WAVE 2022). This is because it misses the required flexibility as described in chapter 2.3. For example, it cannot be used by deaf users because of the restrictive interface method and even blind users might have difficulties with or could simply be annoyed by the audio output that interferes with their own screenreader of choice. This is acceptable as the project is explicitly designed for users that do not experience disability on the web and do occupy a normative user position.

5. Conclusion

The aim of this project was to develop and present an experimental website that challenges the norms and assumptions surrounding the design of websites and the internet from a disability media studies perspective. Based on a theoretical understanding of digital disability, able-bodied internet users should be challenged to recognize their normative user positions and the discouraging and disabling experiences the internet presents for users with disabilities.

This intention and the importance of digital accessibility for the participation of people with disabilities in civil society were discussed in the introduction. The theoretical foundation of the project was presented in chapter 2. The most important contributions come from the field of disability media studies, including the social model of disability and the concept of the

normative user position. They are supported and enhanced by new media and software studies. To gather further insights into the field, I conducted two interviews with blind internet users. In chapter three, I used interview data and existing empirical studies to analyze the potential for and the current state of web accessibility. The result was twofold: Current web technologies provide developers with the tools to achieve a high level of accessibility in their projects. However, the practical implementation of accessibility measures on the web is inadequate. I combined this analysis with an investigation of the normative user position on the web and the alternative internet use of blind people. Both served as foundation and warrants for my practical work.

Aspects that could be expanded upon in this thesis are Manovich's work on interfaces and the practical aspects of web accessibility. A more detailed study of the theory of interfaces could have provided an additional warrant for experimenting with an audio-only website. Because I deemed the warrants described above as more impactful and relevant for my argument, this approach was left out. The sections on the practical aspects of accessible web development and the WCAG in this work were kept concise. A more detailed discussion of WCAG guidelines and accessibility practice could have been a valuable addition to the thesis. However, as the goal of the project was not to produce an accessible website – as discussed in chapter 4 – I decided against expanding this chapter.

Representing a piece of critical software, I presented the project website in chapter 3. It achieves the above-stated goal: The website is accessible only via audio interface. Its design and development process was detailed in chapter 3.5, including challenges encountered during development and potential improvements. The discussion in chapter 4 evaluates the proposed website and discusses further limitations of the work. There, I also described further research opportunities regarding the impact of the project and other proposals to increase digital accessibility awareness.

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Appendix

A1. Interview Guideline

Um das Gespräch einordnen zu können:

> Inwieweit haben Sie sich mit dem Thema Barrierefreiheit im Netz / Accessibility auseinandergesetzt? Wie viel technisches Wissen besteht?

1) Wie nutzen Sie das Internet?

> → Welche Technologien nutzen Sie dafür?

> → Welche Probleme treten dabei auf?

2) Gibt es Momente, in denen Sie das Gefühl haben, Sie nutzen das Internet/Webseiten nicht so, wie sie „gedacht wurden"?

> → Wenn ja, welche?

> → Wie gehen Sie damit um? Wie fühlen Sie sich dabei?

Wenn technisches Wissen vorhanden ist: Wie schätzen Sie bestehende Accessibility-Technologien ein? Reichen WCAG, bestehende Screenreader, etc. wenn Sie richtig angewendet würden?

3) Spekulation: Wie würde eine Website aussehen, die von Beginn an für Blinde designt ist?

4) Möchten Sie noch etwas loswerden? Weitere Fragen?

A2. Interview Transcript: Björn Beilfuß

For time management reason, not the entire interview was transcribed. Sections that were not relevant to this project were left out and marked with ellipses.

1	**I:** ... viele Webseite, aber auch vielleicht auch das Medium Internet an sich, halt gestaltet ist, designt ist, um einen stereotypen Nutzer oder die Nutzerin herum, die halt zum Beispiel nicht behindert ist und einige andere Eigenschaften hat, die man halt / die halt so angenommen werden. Von den Leuten, die das entwickeln, zum Beispiel. Und dadurch werden halt Menschen, die diesem Stereotyp nicht entsprechen, also zum Beispiel eine Behinderung haben, werden dadurch eingeschränkt, werden dadurch behindert durch diese Art und Weise, wie das gestaltet ist.
2	**BB:** Das ist richtig, es gibt einige Schwierigkeiten auf einigen Internetseiten. Das kann ich erzählen, weil ich eben da so einiges erlebt habe, in den letzten Jahren. Wobei sich natürlich schon ein bisschen was getan hat, würde ich mal sagen, in den letzten 5 Jahren. Das man schon manchmal versucht das ein oder andere ein bisschen besser hinzukriegen. Aber ich finde, da kann trotzdem noch viel getan werden. Wie gesagt, ich bin so gut wie blind, das heißt ich nutze den PC mit Hilfe der Braillezeile und der Sprachausgabe.
3	[...]
4	**BB:** Braillezeile, das ist sozusagen ein spezielles Hilfsmittel, wo immer eine Bildschirmzeile in Blindenschrift dargestellt wird. Und dann kommen die Punkte so hoch und dann kann ich mit den Fingern das Auslesen. Oder ich kann eben mit der Sprachausgabe das anhören. Und so [unv.] arbeite eben nicht mit der Maus, sondern mit Tastenkombinationen und dann muss man eben auch, gerade wenn man jetzt im Internet ist, da habe ich manchmal ganze gerne die Sprachausgabe noch im Hintergrund laufen, weil es ab und zu den Fall gibt, dass an diesem Hilfsmittel nicht alles angezeigt wird. Gerade wenn irgendwas im Hintergrund oder sowas läuft. Dann kann es manchmal sein, dass die Sprache das ansagt, aber die Zeile das nicht anzeigt. Das sind manchmal ganz kuriose Sachen. [...]
5	**BB:** [unv.] und habe auch am PC solange es ging eben mit Großschrift, mit Blindtext, gearbeitet. [...] Aber musste dann [...] umsteigen und das war für mich schon eine ganz schöne Herausforderung. Weil die Problematik ist, dass man eben an die Hilfsmittel beim Computer, da hat man eben normal nicht die Sechs-Punkt Brailleeinstellung, sondern mit acht Punkten. Das sind zwei Viererblöcke, damit man eben nicht nur Groß- und Kleinschreibung darstellen kann, sondern die ganzen Sonderzeichen eben auch darstellen kann.
6	[...]
7	**I:** Und darüber hinaus, sagst du, nutzt du die Sprachausgabe? Richtig?
8	**BB:** Ja, das ist richtig. Darüber hinaus benutze ich eben die Sprachausgabe recht viel. Weil ich / [unv.] mir eigentlich relativ zuverlässig vieles vorliest. Und gerade, wenn ich eben nur im Internet auf irgendwas - ja vielleicht auch nicht so bekannten Seite bin, wo ich mir jetzt nicht ganz so sicher bin, dann ist das für mich irgendwie so ein bisschen ne Sicherheit noch.
9	[...]
10	**BB:** Ich habe auf meinem Rechner spezielle Software, die nennt sich JAWS. [...] Diese spezielle Software ist dafür zuständig, dass mir eben der normale Text in die Blindenschrift umgewandelt wird.
11	[...] **BB:** Also es gibt ja auch normale Sprachausgaben über Windows, das gibts ja auch, das kann man auch nutzen. Aber hier in diesem Fall ist das so, dass das [JAWS-Sprachausgabe] einfach nochmal das [Braillezeile] zusätzlich unterstützt.

12	**I:** [...] Jetzt interessiert mich natürlich, was für Probleme treten dabei denn auf? Also im Internet.
13	**BB:** Ja, also so was, was relativ häufig ein Problem ist, weil ich manchmal auf eine Seite gar nicht richtig komme, schon. Da liegt es dann häufig daran, dass an der vordersten Stelle eine zu große Grafik oder ein Bild angebracht ist. Und wenn das an vorderster Front eben liegt, dann ist das häufig ein Problem, dass ich eben mit meinem Screenreader [...] das ich dann damit häufig scheitere. Wenn das nicht an aller vorderster Stelle liegt / Was man auch machen kann, aber wo eben viele Designer oder, sage ich mal, Entwickler von den Homepages nicht dran denken, dann ist das eben nicht so das Problem. Aber das ist so ein Hauptproblem und / also manchmal gibt es / oder wenn ich dann schon auch mit Leuten von den Organisationen zu tun hatte und denen das auch geschildert / dann haben die das manchmal schon versucht zu verändern, es gab dann schon Seiten, wo das so dann sich entwickelt hat, dass ich dann zumindest auf die Seite kam, aber ich manchmal dann den Text nicht finden konnte. Also er dann irgendwie nur ein Bild anzeigte, aber ich sozusagen nichts an der Zeile angezeigt wurde, weil das mit der Übertragung nicht ging. [...]
14	**BB:** Das ist eigentlich ein ganz großes Problem. Es gibt dann noch kleinere Probleme. Ich sage mal so, was ich natürlich immer ganz schön finde, ist wenn man auf einer Homepage, die jetzt, sage ich mal, recht viele Inhalte hat, wenn man da mit ner Linkfunktion jetzt von Link zu Link springen kann, das ist eine ganz schöne Sache. Das haben aber eher wenige. Ist aber durchaus von Vorteil gerade, wenn sehr viel Inhalt da ist. [...]
15	**BB:** Und was ich manchmal auch nicht schlecht finde ist [...], wenn es zumindest am Anfang eben einen Hinweis gibt, dass man - ja vielleicht - zum Text so und so weiterkommt oder sowas. Also sowas hilft manchmal auch schon. Aber auch solche Informationen sind eher sehr selten und nicht in der Regel vorhanden.
16	**I:** Ja, also so ein Link zum Beispiel mit dem man direkt zum Inhalt springen kann.
17	**BB:** Ja, zum Inhalt, wo man den Text kriegt. Oder wo man einfach dann sozusagen überhaupt da hinkommt, dass man zu einem Link kommen kann oder zum nächsten Link springen kann. Sowas gibt es ja durchaus als Funktion. Aber diese beiden Sachen sind bisher sehr wenig verbreitet.
18	[...]
19	**BB:** Eine Internetseite, die ich dir empfehlen kann, wo sie sich echt viel Mühe gegeben haben, das ist die Internetseite hier vom Quartiersmanagement Mitte Altona. [...] Und auch die vom BSHV, Blindenverein Hamburg, die vor kurzem überarbeitet wurde. Die ist natürlich auch / die hat natürlich auch ihre Sonderfunktionen. [...]
20	**I:** [...] Gibt es Momente in denen du das Gefühl hast, dass du Webseiten nicht so nutzt, ich sage mal, wie sie "gedacht" wurden oder wie sie halt gestaltet wurden?
21	**BB:** Ich denke schon manchmal, dass der eine oder andere denkt er hat die schön designt [...] und für mich ist aber das Design vielleicht gerade als Nutzer mit Handicap vielleicht jetzt nicht der allererste Punkt [...]
22	**BB:** Mein Eindruck ist: Schön, dass ein bisschen mehr Gedanken sich gemacht wird, heutzutage, wie man manches vielleicht aufbereitet oder auch gestaltet. Aber trotzdem habe ich immer noch so den Eindruck, dass manchmal nur das Design an erster Stelle erstmal steht. Und das andere [Barrierefreiheit / Nutzbarkeit] eben nicht an erster Stelle steht, unbedingt.
23	[...]
24	**BB:** ... und da hatten wir bei der letzten Sitzung den Laudehr vom Kompetenzzentrum für ein barrierefreies Hamburg auch da, der speziell dort für den Bereich Digitales zuständig ist. [...] Er hatte eben auch selbst ein paar Punkte gebracht, was er sich eben vorstellen kann, da an Verbesserungen noch und da meinte er eben auch, dass es vielleicht nicht unwesentlich sei das

einfach allgemein man vielleicht mehr darauf achtet, wie kann man auf Seiten gelangen, wie kann man sie bedienen und wie kommt man an die Inhalte und nicht nur wo das Design eine Rolle spielen sollte. Ich glaube ein bisschen Veränderung ist da schon eingetreten, aber ich denke da ist immer noch weiter Luft nach oben.

25	**I:** Ja und wenn du jetzt auf so eine Seite kommst, wo du das Gefühl hast, die ist irgendwie nicht für dich quasi gemacht? Wie gehst du damit um? [...] Oder wie fühlst du dich damit dann?
26	**BB:** [...] Erstmal finde ich das natürlich nicht so ganz schön. [...] Ich kann da so ein ganz konkretes Beispiel sagen, wo ich eine Schwierigkeit hatte. Ich bin Mitglied bei Sportspaß [...] und die hatten jetzt in der Coronazeit [...] bis vor kurzem war das so, dass man sich vier Tage im Voraus anmelden musste. [...] Und die Schwierigkeit war, dass eben diese Internetseite nicht barrierefrei war. Das heißt, ich konnte auf die Seite kommen, aber ich konnte da nichts eingeben. [...] aber ich konnte ins Eingabefeld nichts eingeben. [...] Und ich habe da auch zwei/dreimal hingeschrieben [...], aber ich habe da keine Antwort und keine Reaktion gekriegt. Und das fand ich irgendwie schon ein bisschen blöd.
27	**BB:** Ich denke, das aber dazu, damit das [ausreichende Barrierefreiheit im Netz] passiert, muss einfach im Kopf und bei den Leuten, die - sage ich mal jetzt - als IT-Menschen die Seiten entwickeln oder das festlegen, muss da vielleicht nochmal ein bisschen Umdenken passieren.
28	**I:** Ja. Okay, also es geht eher darum, dass Leute sich das bewusst machen und darüber sich damit auseinandersetzten?
29	**BB:** Ja, ich denke / man merkt das ja an anderer Stelle auch, zum Beispiel vor Jahren ist das ja aufgekommen mit den Bodenindikationsplatten [...] und das ist ja auch nach und nach aufgekommen und hat sich ja dann mehr und mehr so stark entwickelt, dass heute ja bei vielen Planungen das mit bedacht ist oder mitberücksichtigt wird - was früher nicht der Fall war. Und ich glaube einfach das im Bereich der Barrierefreiheit im IT-Bereich [...] das da eben, nun ja, man eben noch nicht so weit ist, wie in anderen Bereichen.
30	**I:** Was sind so Sachen, was du dir wünschen würdest, sage ich mal?
31	**BB:** Ja das was ich eben gut fände, wenn man eben diese Funktion mit dem Link-Anspringen, was ich ja vorhin schon mal so ein bisschen geschildert hatte, sowas hätte. Das / Dann überhaupt, dass man eben, sage ich mal vielleicht, zur Funktion der Textnutzung relativ schnell kommt oder überhaupt diese Möglichkeit hat. Das gibt es auch nur bei wenigen Seiten. Das man sich das umstellen / also manche haben das ja besonders, das eben mit den Bildern und Grafiken das besonders überlastet ist oder im Vordergrund steht. Und wenn man das jetzt eben nicht haben will, dass man da eben für eine volle Funktion hat oder dass man einfach ganz allgemein relativ zügig, sage ich mal, zu den Textinhalten kommt. Und was ich auch nicht schlecht finde, das haben aber auch nur wenige Seiten, das finde ich jetzt auch bei der NDR-Seite ganz gut, eine Suchfunktion. [...] Weil man dann auch deutlich schneller gerade über eine sehr umfangreiche Seite kommt.

A3. Interview Transcript: Rolf Schilling

For time management reason, not the entire interview was transcribed. Sections that were not relevant to this project were left out and marked with ellipses.

1	**I:** Wie nutzen Sie denn das Internet? Wie bewegen Sie sich dort?
2	**RS:** Ja, wie nutze ich das. [...] Also einmal grundsätzlich: Für einen Blinden oder für Blinde ist das Internet immer ein Angang. Weil das wird von Sehenden gemacht, das wird von Sehenden manchmal dermaßen einfach gemacht. Von so Mausschubsern. Die haben dann da irgend so eine grafische Vorlage und schieben auf dem Bildschirm nur die Maus hin und her und sagen dann: Sieht gut aus. Und dann geht das los. Ob das bedienbar ist, kümmert die nicht. So ist die Situation. Für mich bedeutet die Arbeit am Computer, bzw. am Internet, immer viel Zeitaufwand. Weil es gibt ja diesen W3-Standard. Da halten sich nicht alle dran. Viele wissen gar nicht, was das ist. [...] Ja und das bedeutet, das dann die Links manchmal nicht beschriftet sind. Links und Schalter und so weiter. Das manche nicht funktionieren, weil manche die falsche Programmierung erfahren haben. Und für einen Sehenden macht das alles nichts, der schiebt da seine Maus drüber und klickt einmal drauf und dann klappt das. Ja, das ist die Schwierigkeit, die ich grundsätzlich mit dem Internet habe. Und das macht die Sache nicht unbedingt attraktiv.
3	**I:** Ja, das kann ich mir denken. Und nutzen Sie dann hauptsächlich einen Screenreader dafür oder noch andere Technologien? Wie funktioniert das?
4	**RS:** Nö, das mache ich mit dem Screenreader. Andere Technologie kenne ich gar nicht. [...] Das [Braille-Zeile] zähle ich mit zu dem Screenreader. [...] Eine Braille-Zeile habe ich auch. Aber da ich nicht / weil ich spät erblindet bin kein schneller Punktschriftleser bin, benutze ich die nur, sozusagen, als Maus. Das ist ganz praktisch. Aber damit lesen, das geht nicht, das würde viel zu lange dauern.
5	**I:** Das heißt Sie lassen sich den Text oder die Webseite dann vorlesen und nutzen die /
6	**RS:** Nur die Sprachausgabe.
7	**I:** Ja, okay. Wie funktioniert das dann, dass Sie die Braillezeile als Eingabe benutzen?
8	**RS:** Ja, diese blindentechnischen Geräte, die arbeiten ja alle zeilenorientiert. Und ich suche dann auf der Zeile nach dem Wort oder dem Link, den ich gerade meine, und dann kann ich die anklicken. Die hat auf jedem Modul so einen Knopf, mit dem kann ich direkt draufklicken und dann hat das eine Funktion wie eine Maus. [...]
9	**RS:** Mit der Tastatur, das geht natürlich auch. Manchmal ist das auch schneller, wenn ich dann mit der Tab-Taste mich da durchschlängele. Und den Fokus habe immer. Der braucht ja immer einen Fokus. Und wenn ich den habe, dann drücke ich Enter oder eben diese Tack-Taste [?] und dann habe ich den Link aktiviert.
10	**I:** [...] Haben Sie das Gefühl, dass Sie manchmal das Internet oder Webseiten nutzen / das Sie die nicht so nutzen, wie sie "gedacht" wurden, sage ich mal in Anführungszeichen? Haben Sie da vielleicht auch ein paar Beispiele für?
11	**RS:** Ja, Beispiele... Zum Beispiel, wenn ich Getränke bestelle, bei Flaschenpost. Die haben einen Button oder einen Schalter, der da sagt: In den Einkaufswagen. Den kann ich mit der Zeile oder mit einem Blindenhilfsmittel nicht erreichen. Den kann ich aber auch mit der Tab-Taste nicht erreichen. Weil, das ist so ein, was weiß ich, so ein Mouseover-System. Diese blindentechnischen Hilfsmittel brauchen einen Cursor und das / mit dem mache ich den Fokus und wenn der nicht mitkommt, dann habe ich verloren.

12	**I:** Okay, genau. Also Sie haben jetzt gesagt, zum Beispiel dieser Button, die man nicht ansteuern kann, mit der Tastatur, das ist quasi das Problem bei Flaschenpost gewesen.
13	**RS:** Ja, genau. Das ist ganz häufig. Es gibt da / bei manchen Websites kann man sogar noch nicht einmal die Seite ganz lesen. Weil die für die Beschriftung der Links benutzen sie irgendwelche Bildchen und die schieben sie dann mit der Maus an die Stelle, wo sie ihn haben wollen. Und wenn man gucken kann, ist das kein Ding. Aber der kriegt keinen Fokus. Da kriege ich keinen Cursor hin. [...]
14	**I:** Und wie gehen Sie dann damit um, wenn Sie auf so etwas stoßen?
15	**RS:** (lacht) Ja, dann beiße ich in die Tastatur und sage *klei mi an den feud!* [?] Da gibts viele Sachen, die mache ich dann nicht. Das ist einfach zu viel Aufwand.
16	**I:** Und ja, wie fühlen Sie sich dabei? Was macht das mit Ihnen?
17	**RS:** Ja das ärgert mich, das ärgert mich und was noch ärgerlicher ist, wenn man sich dann tatsächlich mal aufschwingt und den Firmen das mitteilt, dann kommt da keine / entweder gar keine Reaktion oder so eine freundliche Mail: Ja, wir haben das weitergegeben an unserer EDV-Abteilung und das wird noch einen Augenblick dauern. Und dann können Sie warten, bis sie schwarz sind. [...] Ja, das sind so die Grausamkeiten. Aber wenn man sich da einige Webseiten anschaut, die sind wirklich mit der heißen Nadel gestrickt. Da sitzen Leute drin, die haben absolut keinen blassen Schimmer und denen ist das auch scheißegal, wie der Computer funktioniert und wie der arbeitet, Hauptsache mein Symbol, was ich das jetzt mit der Maus hingeklatscht habe, lässt sich mit der Maus wieder anklicken - mehr braucht man nicht.
18	[...]
19	**I:** Also Sie meinen, dass eher das Wissen über diese ganzen Möglichkeiten, was Barrierefreiheit angeht und sowas, dass das fehlt, bei Leuten, die Webseiten bauen.
20	**RS:** Ja.
21	[...]
22	**RS:** Achso, die Firma, die diese Homepage gebaut hat, als ich Barrierefreiheit reklamierte, haben die gesagt: Das wird viel zu teuer. Ich sage: Das kostet keinen Cent extra. Lass es eine Stunde mehr Aufwand sein, aber bestimmt nicht mehr. [...] Barrierefreie Seiten zu bauen ist nicht teurer. Das beweist mir nur, dass der der das machen soll keine Ahnung hat. [...]
23	**I:** Wie schätzen Sie denn die bestehenden / zum Beispiel die Accessibility Guidelines vom W3C oder auch die Technologie ein, die Sie zur Verfügung haben? Meine Frage ist: Reicht das quasi, sage ich mal, um ein ausreichend barrierefreies Internet zu schaffen? Oder / Wenn das richtig angewendet würde? Oder bedarf es da noch mehr?
24	**RS:** Nö, das reicht. Mit dem was zur Verfügung steht - HTML, XML, CSS - kann man wirklich so dezidiert und umfangreich arbeiten, dass daraus auch barrierefreie Seiten werden. Ohne optischen Verlust zu erleiden.
25	**I:** Ja. Also es geht wirklich nur darum, dass es richtig angewendet werden muss, was es schon gibt.
26	**RS:** Genau. Man kann ja heutzutage sogar Bilder beschreiben. Aber das ist Aufwand. [...]
27	**I:** Es muss halt dieses Bewusstsein irgendwie entstehen dafür. Ne?
28	**RS:** Ja. Aber das Interesse, sowas zu machen, ist in der Fachwelt minimal.
29	**I:** Ich würde gerne ein bisschen, ich sage mal, ein bisschen spekulieren mit Ihnen. Und zwar überlegen, wie eine Webseite aussehen würde, die - ich sage mal - von Anfang an für Blinde

gebaut ist. Und vielleicht auch gar nicht so / vielleicht auch einfach wirklich nur für Blinde und nicht für Sehende - also, wenn man das jetzt mal auf den Kopf stellt. [...]

| 30 | **RS:** Ja, im Prinzip muss man gar nicht viel anderes machen. [...] Dazu brauche ich nichts anders als HTML. |

| 31 | **I:** Okay. Also man müsste einfach eine vernünftige HTML-Struktur aufbauen und dann wäre das eigentlich schon / dann ist das eigentlich schon so gut, wie es geht, sage ich mal. |

| 32 | **RS:** Genau, wenn man diese CSS-Varianten dazu haben will, die kann man auch mit einbinden. Das ist eigentlich alles vorhanden. Man muss sich nur drum kümmern.   [...]   **RS:** Zum Beispiel diese Screenreader, die arbeiten ja auch nur mit den Accessibilities [Guidelines], ne? Früher hieß das mal MSAA, jetzt heißt das anders. Und wenn das nicht wäre, dann könnte niemand, kein einziger Sehbehinderter einen Computer bedienen. |

| 33 | **I:** Wenn es diese Richtlinien nicht gäbe, meinen Sie? |

| 34 | **RS:** Ja. [...] Ich habe mit Computern noch mit MS DOS angefangen, das war nur textbasiert. Und irgendwann kamen dann diese anderen Oberflächen, noch kein Windows, aber auch schon mit Softcursor und solchen Dingern. Da fing die Sache an schwierig zu werden. Und dann wurde auch / irgendwann wurde dann gesagt: Mit Windows kann kein Blinder arbeiten. Und da haben ein paar pfiffige Kerlchen das doch geschafft. Und das / ich bin eigentlich ganz zufrieden.   [...]   **RS:** Irgendwann [...] da hat ja Apple mit seinem iPhone dieses VoiceOver eingebaut und das ist ein brauchbarer Screenreader. Ich habe ein iPhone und von daher kann ich das beurteilen. [...] Und ich meine Windows hat sowas mittlerweile ja auch schon, nen Screenreader. [...] Ich benutze immer noch einen Windows-unabhängigen Screenreader [...] NVDA, das ist ein kostenloser Screenreader [...] |

A4. Excerpt from Project Website Script: Main TTS Functions

```javascript
function speakText(text){
    tts.cancel(); //clear utterance queue.

    utterance = new SpeechSynthesisUtterance(text);
    utterance.lang = "en-US"

    //Add event handlers to update the utteranceState.
    utterance.onstart = function(){   stateHandler("speaking")  };
    utterance.onresume = function(){   stateHandler("speaking")  };
    utterance.onpause = function(){   stateHandler("paused")     };
    utterance.onend = function(){      stateHandler("ended")     };

    tts.speak(utterance);
    utteranceState = "speaking";

}

function elemFocus(el) { //speak text and other information on focus.

    text = "";

    //Announce the Headline level befor its contents.
    if (el.tagName == "H1" || el.tagName == "H2" || el.tagName == "H3") {
        level = el.tagName[1];
        text = "Headline level " + level + ". ";
        text = text + el.innerText;
    }
    //Announce a link.
    else if (el.tagName == "A") {
        text = "Link. ";
        text = text + el.innerText;
    }
    //Announce important semantic tags (and thus, page sections).
    else if (el.tagName == "NAV" || el.tagName == "MAIN") {
        text = el.getAttribute("data-tts") + ". ";
    }
    //For all other elements speak the contained text.
    else{
        text = el.innerText;
    }

    speakText(text);
}
```

A5. Excerpt from Project Website Script: Play/Pause Feature

```javascript
function keyboardEvents(){
 document.onkeydown = function(e){ //Handles all keyboard inputs.

     […]

     if (e.key == "Escape") { //When escape is pressed, pause utterance.
                                Resume on second press.

        if (tts.speaking && !tts.paused || utteranceState == "speaking"){
             tts.pause();
             console.log("pausing");
        }

        else if (tts.speaking && tts.paused || utteranceState == "paused"){
             tts.resume();
             console.log("resuming");
        }
     }

     […]
 }
}
```

A6. Excerpt from Project Website Script: Headline Jumping Feature

```javascript
function keyboardEvents(){
 document.onkeydown = function(e){ //Handles all keyboard inputs.

    hKeys = [];
    activeKey = "";
    activeElem = document.activeElement;

    for (var key of narratorElements.keys()) { // Iterate over nodeList of
                                                    all focussable elements.

        if (activeElem === narratorElements[key]) {
            activeKey = key;
            break; // Stop if focussed element is found and store its key
                    in activeKey.
        }
    }
    for (var key of narratorElements.keys()) {
        elemTag = narratorElements[key].tagName;

        if (elemTag === "H1" || elemTag === "H2" || elemTag === "H3") {
        //Identify all headings and save their keys to the hKeys array.
            hKeys.push(key);
        }
    }

    […]

    else if (e.key == "h" || e.key == "H") { //Headline Jumping
        targetHKey = -1;

        for (var hKey of hKeys) { // Iterate over all heading keys
                                    identified above.
            if (e.key == "h") {
                // Look for next headline
                if (hKey > activeKey) {
                    targetHKey = hKey;
                    break;  //stop loop after first headline matches,
                            which is the nearest.
                }
            }
            else if (e.key == "H") {
                // Look for previous headline
                if (hKey < activeKey) {
                    targetHKey = hKey;
                    // no break; so that the last (thus nearest Heading)
          is identified, not the first that matches (which is always H1)
                }
            }
        }
        if (targetHKey === -1) {
          if (e.key == "h") {    speakText("There is no next headline.")}
            else if (e.key == "H"){speakText("There is no previous
                                            headline.")}
        }
        else{
            narratorElements[targetHKey].focus();
        }
    }
  }
}
```

A7. Digital Appendix

The digital appendix on the enclosed storage medium contains the project's source code and a MaxQDA-File including the coded interview transcripts.

A8. Affidavit

Ich erkläre hiermit, dass

- ich diese Arbeit selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe, und

- alle Stellen der Arbeit, die wortwörtlich oder sinngemäß aus anderen Quellen übernommen wurden, als solche kenntlich gemacht wurden.

- die schriftliche sowie die elektronische Fassung der Arbeit mit der Ausnahme der gem. §7 Abs. 9 Satz 2 RPO vorzunehmenden Anonymisierung der elektronischen Fassung inhaltlich übereinstimmen.

Hamburg, den 02.06.2022

Niclas Hedemann