Responsive Web Design and its Impact on Web Accessibility

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Abstract

Responsiveness and accessibility are two characteristics that are crucial to the usability of a website. While the first one refers to the flexible adaptation of the layout to the various devices with which a website can be accessed, the focus in the latter is on the inclusion of as many audience groups as possible, by taking the diversity of the users into account. The goal is that everyone has access to the contents of a website, no matter which device is used and regardless of the individual abilities of the users.

The foundation of a functional and aesthetically pleasing website is formed by the principles of the Responsive Web Design paradigm and Web Accessibility. Considering their best practices as well as the case studies which were carried out in this paper, it can be seen that a large number of different factors must be taken into account during the development process. Creating a web page that is best viewed on different devices is a start, as it solves some accessibility problems, but it does provide support to people with special needs or disabilities, such as users with different types of vision or hearing impairments. As a result, issues concerning, for example, contrast, typography, text alternatives for visual content, the reading order or the navigation have to be considered. Furthermore, the separation of content and representation benefits accessibility and Responsive Web Design. It can be avoided that information is conveyed only by visual means, and the semantic meaning is accessible to assistive technologies as well as the style sheet can include media queries to define the layout rules for a range of devices, which enhances the user experience for more people. In addition, it becomes clear that the creation of a simultaneously functional and accessible website is possible without giving up an appealing design.

Keywords: Responsive Web Design, Mobile First, Progressive Enhancement, Graceful Degradation, Web Accessibility

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API	Application Programming Interface
AWD	Adaptive Web Design
CSS	Cascading Style Sheets
CTA	Call to Action
HTML	Hypertext Markup Language
MF	Mobile First
RWD	Responsive Web Design
WCAG	Web Content Accessibility Guidelines
W3C	World Wide Web Consortium

1 Introduction

1.1 Problem Statement and Relevance

Mobile devices today are omnipresent, and thus people access websites and interactive Web applications in various ways, usually either from their desktop computers, tablets or smartphones. All of the used devices have different characteristics and special requirements. Due to the variation of screen formats the interface of mobile websites differs from the classic desktop view. Aspects like the information architecture (Sitemap), the interaction mechanisms (typically mouse and touch screen), the textual content and pictures are determined by the medium and have to adjust to it. Consequently, different designs for the user interface are needed (Nielsen, et al., 2013) and therefore the optimization regarding the representation of the website's content is of great importance. The main challenge is to create the website in such a way that, despite the fundamental technical differences, an optimal User Experience across all formats can be achieved and maintained. This raises the question of how to implement a dynamic, responsive website that is able to adapt to the users' expectations regardless of which device he is currently using. One approach for the design and technical process of creating websites is called "Responsive Design," which indicates that the design should be able to respond to the user's environment (Marcotte, 2010) to enrich the User Experience by tailoring the interface dynamically to a variety of devices. The attempt to expand the availability of one site for multiple devices is complex due to the aim of supporting the viewing experience for more than one device.

Besides the interchangeability of a website on any device, it is important that all users have the opportunity to access the content similarly, due to the World Wide Web's role as an important resource in numerous parts of daily life which among others includes areas like education, commerce or employment. Therefore the aim during the whole implementation process should be the inclusion of as many users as possible, regardless of their abilities to ensure a coherent and equal user experience to all who access the provided content. Consequently, the vision of the potential audience should be widened and consider different kinds and levels of disabilities. Including, for example,

partial and complete visual impairments, learning and cognitive disabilities or motor restrictions.

Given the technologies available today providing equal access to a website, but if not taken into account that there are individuals relying on assistive technology like screen readers or text to speech tools in order to interact with the website, these groups get excluded and the content is reached by a smaller audience is reached as it could be.

The commonality between Responsive Web Design and Web Accessibility overall objective of reaching out as many users as possible, but they are two independent ways aiming to increase usability in order to have a more flexible and easy to use the website. Even if Responsive Web Design can address some accessibility problems, it was not specifically created as a solution for these, and thus a website can be the most responsive one without containing accessibility features then if the underlying semantic structure is not optimized, there will still be accessibility issues.

There different paradigms add a significant value and are complementary to every website. Responsive Web Design makes an optimal presentation of the content on all devices possible while Web Accessibility aims to achieve the inclusion of all users. This implicates that the optimal website should be both, accessible and responsive.

1.2 Purpose of the Paper and Structure

The basic goal of this paper is to answer the question to what extent Responsive Web Design has a beneficial impact on Web Accessibility and the other way around. In this context, it will also be examined to what extent Responsive Web Design strategies and best practices have a positive or negative impact on the implementation of accessibility and what aspects have to be taken into account during the development process when the focus is placed on both functionality and visual representation. For a better understanding, case studies are conducted and a highly responsive and accessible website is analysed.

A further central part of the paper is to give an overview of the basic concepts and of the design paradigm Responsive Web Design with its different design approaches and strategies. For this reason, the second chapter describes the theoretical framework of

design paradigm for websites while the third chapter deals with the importance and principles of Web Accessibility. These two chapters provide the basis for the representative case study in the fourth chapter.

2 Design paradigm for creating websites

Evolved from the Print Medium, the design for the Web is influenced by pre-existing conventions. Designers came used to work within the given constraints of the medium, since a printed page has boundaries, as well as newspapers and posters, have limited physical dimensions, designs using fixed parameters are the result. Applied to the web, this means, that the screen resolution determines the dimension in which the design is precisely applied to by mainly using fixed pixel values for essential elements like font or image size. However, unlike print media, a browser is a dynamic medium and the websites innately responsive until the designing process for the content's presentation begins. This leads consequently to static and inflexible websites (cf.Allsopp, 2000). Within the defined dimensions the website behaves optimally, but if they change, layout and design cannot react to the changes properly, which has a negative impact on the user experience. The progressively growing variety of devices to surf the internet increases consequently the need to develop solutions that are able to meet the requirements of the diversity of browsers and display sizes. As a website should be perceived on any device and browser with the same quality, a more adaptive approach is needed (Marcotte, 2011).

One approach creating websites that adjust their design to different environments is the "Adaptive Web Design" (AWD). The main idea of this paradigm is to create an optimal user experience, where the website can be accessed without any technical restrictions. It is based on actions with certain pre-specified screen resolutions and layout variations. Therefore it uses a template that optimally adapts to the used device by using defined breakpoints, so that depending on the device the page is called up, the server returns the page with an appropriate layout and content. This has the advantage that several variations of the website can be created where unneeded content will not be loaded for this presentation. For example, text passages for a mobile version get reduced to the bare minimum or content sections are left out completely. Alternatively, as far as illustration files are concerned, these can vary depending on the display's resolution. Thus this server-side customization has a beneficial effect on the site's performance. Which on the other hand also means that, during the designs process, not the

information itself is the primary aspect, but rather the particular device type. By understanding the visitor's expectations and needs when accessing the website on a specific device a more user-centred experience can be implemented. As a result, this also means a higher technical effort and maintenance because for every conceivable device an optimal data set has to be defined separately. Due to the variety of existing devices with different dimensions, AWD is not able to take all of them into account which can lead to misrepresentations (Hellwig, 2018).

A different design strategy to accomplish the same task, but with different methods is the “Responsive Web Design” (RWD). The concept is that a single design with one set of code automatically confirms fluidly to changes in the viewport’s dimensions (Marcotte, 2011). Since this approach is more flexible than AWD, in the following chapter, the principles of this design paradigm are described in more detail as well as some general development concepts. Afterwards, the topic of Web Accessibility will be dealt with including the impact of Web Accessibility on Responsive Web Design and the implications of this for User Experience and Usability.

2.1 Responsive Web Design

The term “Responsive Web Design” term was established by Ethan Marcotte and describes a design paradigm that includes conceptual and technical aspects, for the implementation of a website, which reacts dynamically to the characteristics of the device being displayed on. Therefore ‘responsive’ means that the appearance of a webpage alters automatically regarding the dimensions of the given viewport. The layout adapts flexibly to the constraints imposed by the screen-size to optimize the viewers experience on different end devices. In addition to dynamically changing content, this includes, for example a condensed navigation, optimized images and correct padding and spacing. Since the elements are able to rearrange themselves differently, change their size or even change their appearance to fit the used device regardless of the screen size. Besides the advantage that each display size is taken into account which theoretically covers dimensions of future devices, no page mirroring for mobile devices is required and

content can be maintained centrally for all devices. Moreover the need for just one design and set of code, which fits desktop computers as well as mobile devices provides a consistent user experience across all devices (Marcotte, 2011).

2.2 Principles of Responsive Web Design

The foundation of RWD is flexibility. All site elements including images, tables, videos and paragraphs have to adapt flexible. For this reason, according to Marcotte, a responsive website has the following three key features: A flexible grid layout, flexible media elements and the use of media queries (Marcotte, 2011 p. 9). This section considers these three core principles.

2.2.1 A fluid grid-based Layout (Flexible Layout)

The basis of a responsive website is a fluid layout that unlike a static one doesn't remain rigid to the arrangement of columns and content, but rather adapts to the circumstances under which the site is used. In adaptive grids, dimensions are static and defined by fixed pixel-values, which have to be adjusted manually for certain platforms. Fluid layouts, on the other hand, are dynamic and use pre-defined proportions, expressed as percentage values, to scale the website elements (Marcotte, 2011 p. 23).

In order to adapt a layout to various platforms, appropriate strategies are necessary to reposition or alter elements. Luke Wroblewski provides an overview of layout patterns used for RWD. For example, "Mostly Fluid" (s. Figure 1) describes a multi-column layout strategy that uses percentages to define the width of site elements. Within the content containers, the layout is able to stretch or contract flexible until a pre-defined

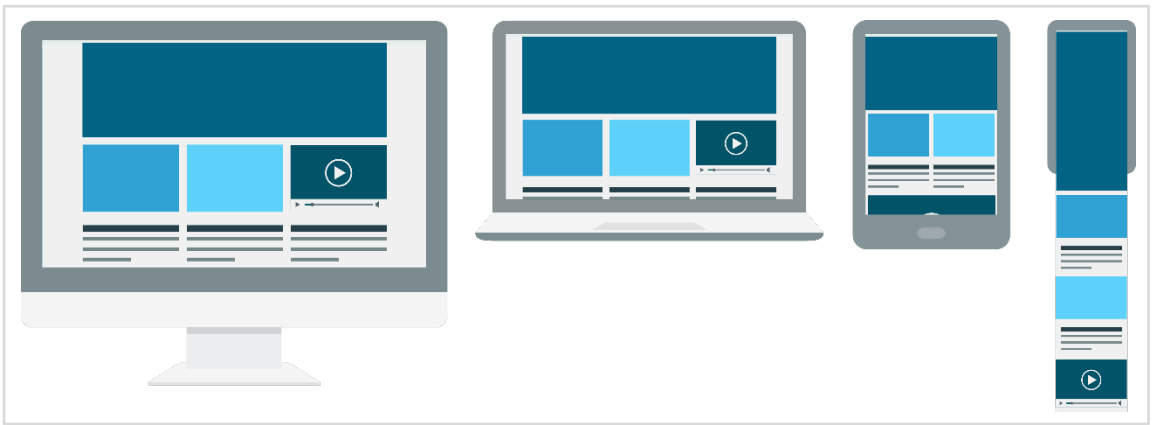

Figure 1 "Mostly Fluid" layout pattern

breakpoint. The results are websites that have larger margins on screens with higher resolutions. Thus the layout structure doesn't change until the breakpoint is reached and the columns are getting stacked vertically. Another broadly used approach is the pattern called “Column Drop” (s. **Figure 2**), which also has a single column layout for the smallest defined screen size and a multi-column presentation for bigger screens. Compared to Mostly Fluid, the size of elements stays more consistent due to fixed-sized content containers and grid columns. If the viewport size isn’t compliant with the intended layout, the columns rearrange below each other. Consequently, this pattern has a need for more breakpoints in order to stack column containers. Both examples show that commonality for layout patterns is that with decreasing screen size, they tend to stack content vertically and that the available screen space is crucial for layout adjustments.

Figure 2 "Column Drop" layout pattern

The “Off Canvas” (s. Figure 3) pursues a different strategy. Content or navigational elements will be hidden until there is more screen space available or a user takes action to expose it. Hence this will temporarily hide less important content outside the display area (Wroblewski, 2012). Since the choice of a layout pattern always is determined depending on the content, there is no general answer regarding the advantages and disadvantages.

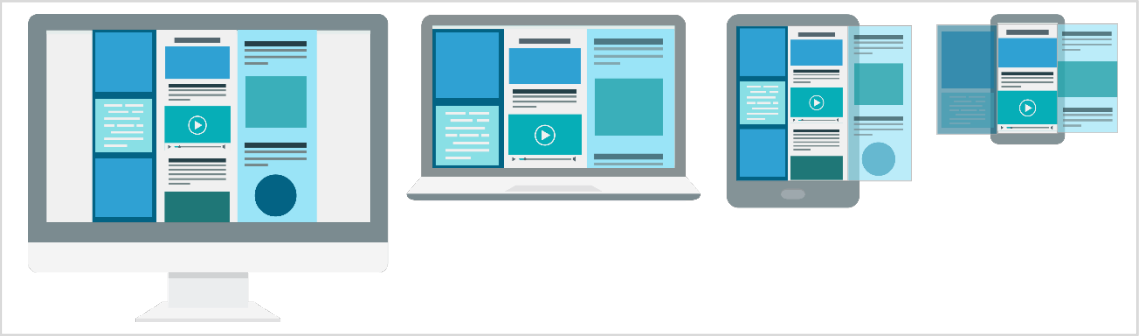

Figure 3 "Off-Canvas" layout pattern

2.2.2 Flexible Media

Due to their usually high volume of data, media content such as images and videos have a strong influence on the latency (reaction time) of a website. Layouts based on percentage values resizes according to the viewport. Therefore it has to be ensured that the content elements within a site, regardless of which media type they are, adapting at the same time. The presentation of the images and videos should be flexible based on the available viewport. At the same time, their amount of data should be optimized for the device used and the available network (Kadlec, 2013).

Text sections flow effortlessly within a flexible container. Media objects like videos and images have a defined default size, and the simplest form for adapting is the percentage scaling using the max-width CSS-property in the combination of the height value set to “auto.” The specification of a maximum width overrides the static width dimension of, e.g. the image and relies on the dimensions of the enclosing element instead. Specifying the automatic height will scale the image additionally, preserving its proportions (W3Schools, 2019).

2.2.3 Media Queries

Media Queries is a CSS3 module that allows altering the representation for different output media based on conditions such as media type or width, orientation and resolution. For example, in the context of responsive design, it is possible to set breakpoints, mostly the width, at which the layout of the site should alter from a multi-column to single-column presentation for a smaller browser window (W3C, 2012).

2.3 Development Concepts

For a website, not only the realization of a flexible layout is important, Browser Compatibility, the information structure, and the performance have an impact on the website's success. The two approaches “Graceful Degradation” and “Progressive Enhancement” are two strategies for the browser-compatible development of web-sites. Both consider how well the design of a site works in diverse environments, but their point of view and procedure is different.

2.3.1 Graceful Degradation and Progressive Enhancement

Graceful Degradation refers to a web design approach that focuses on building a website for modern advanced browsers. Applied to the lack of browser support for particular features, the fully-featured version will be gradually slimmed down, until only the core information and functions are available (Nebeling, et al., 2013). The incorporated complexity of the developed pages for high-performance systems and large screens is getting decreased by removing the certain style and functionality elements in order to support older browser versions or smaller devices. By stripping away, for instance, the latest technologies and effects or elaborate layout features, a lower user experience that targeted is the consequence, but ensures that the essential site functionalities are enabled for all devices equally (Gustafson, 2011 p. 7).

Unlike Graceful Degradation, the principle Progressive Enhancement focuses on the content, not on the presentation and thus has greater content and contextual parts. The Content and core functionalities of the website must always be guaranteed, only then the user experience can be improved at a later stage, and the adaption for different display sizes along with the appearance will be considered (Hellwig, 2019). This design methodology can be considered as multi-layered, wherein the web technologies build on each other with each development-step from the rudimentary version to the advanced website to enable cross-browser compatibility (Gustafson, 2011 p. 7). First, an elementary level of user experience is going to be established by making sure that the same content and basic functionality is accessible to all browsers. First, an elementary level of user experience is going to be established by making sure that the same content

and basic functionality is accessible to all browsers. This usable website can now be extended with more complex technologies and extensive layouts that will be automatically available to advanced browsers (Hellwig, 2019).

Basically, there are three different layers of Progressive Enhancement - the content (HTML), the presentation (CSS) and the behaviour (JavaScript) layer. The first layer is the plain content of the web page, structured in rich semantic HTML-Markup, which is sufficient to meet the elementary requirements of a website and conveys the information to the end user. At this state the contained information a ready to be distributed and consumed by the user without design, which offers a basic user experience. This can be enhanced by adding the second layer in the form of CSS, which focuses on the visual representation of the website's content with the aim of a more user-friendly design. As an additional layer, "engaging JavaScript-driven interactions" enables optimum usability and user experience, assuming the user agent is capable of using it (Gustafson, 2011 p. 7ff.).

Thus Progressive Enhancement starts with a very basic functioning version of a website and provides the possibility for a constant extension to future technical functionalities of the browser environment, while Graceful Degradation starts by building websites for the most capable, browsers. The complexity of the finished website will be gradually slimmed down until only the core functionalities are available (cf.W3C, 2015) .

2.3.2 Mobile First

The technical approach Graceful Degradation illustrates that web designers and developers were used to approach a strategy focused primarily on the desktop and laptop use, with the design for the mobile web as aftermath. But with today's shift to mobile use, the priorities and demands of the user change accordingly. Therefore the traditional "Desktop First" workflow may not be the best way to meet the demands of the mobile experience (Wroblewski, 2011 p. 1). The concept "Mobile First" is a design strategy that focuses on mobile experience first. This means, optimizing the appearance of a website for the mobile view before adapting it to other screen sizes (Wroblewski, 2011).

Starting with the smallest layout version the development process takes place within the naturally given constraints of a mobile platform. Due to limitations in performance

and screen size this implies the need for a content-related focus, entirely in line with Progressive Enhancement (Hellwig, 2019). But it goes one step further by taking in addition to older browser environments also smaller display sizes and a lower performance into account. This rises the need to focus on the essential and to keep the website simple. Only elements that are absolutely required and relevant to all users, regardless to the device they are using, should be added to the site (cf.Wroblewski, 2011 p. 19). It must be decided which content and features are going to be displayed initially and how the content can grow along with the enlargement of the viewport. The prioritization of content and design elements ensures a clean information architecture on mobile devices as well as on desktop computers (cf.Wroblewski, 2011 p. 28f.). Related to this, a clear and easy-to-understand navigation structure is achieved by minimizing the number of subpages and thus the depth of the navigation (Hellwig, 2019). A clear and easy-to-navigate site structure enables the user to find the wanted information faster. The limitations of a small screen can, therefore, be seen as an opportunity to improve the entire web experience, for both, mobile and stationary platforms (Wroblewski, 2011 p. 18).

3 Web Accessibility

As part of the original idea of the World Wide Web, Tim Berners-Lee describes the principle of universality as the main factor. This means that services and information offered through it should be designed in a way that all people are able to access and use them, regardless of their hardware and software configuration. Due to the web's ubiquitous role in many areas of daily life for most people it should further be ensured that an exclusion based on language, location, or ability is avoided. Thus Web Accessibility is about universality and essential to provide qualitative web services that are accessible to all people equally despite disabilities or difficulties they may have (Berners-Lee, 2010). For this reason, the following section deals with the importance of Web Accessibility and the core aspects which should be considered during the development process of a website.

3.1 The importance of Web Accessibility

The web has a major impact of all on the everyday life as more activities at home, school, and work or on the road take place online, wheatear it is making appointments, transfer money, shopping, research for a paper or plan a vacation, etc. It affects parts of our social life and helps to stay or get in contact with people as well as find and create communities that may not be easy in the physical world. Moreover, as an information medium, it allows almost unrestricted access to knowledge and everyone should have access to this electronically provided content, but also to use digital commination technology and other web services. The "UN Convention on the Rights of Persons with Disabilities (CRPD)" actual states that access to information and communication technology, which includes the web, is a human right (UN, 2019).

However, it happens that users are simply not able to access the provided content in a conventional way. Around 15 percent of the world's population lives with a form of disability (WHO, 2018). These may be impairments in the areas of mobility and motor skills, hearing or cognitive and learning impairments. These physical and psychological characteristics have a bearing on the ability to interact with technology. A blind person may experience significant accessibility problems when the information can only be displayed on the screen visually and is inaccessible for screen readers. The same applies to

a user with a motoric impairment when the interaction requires mouse clicking and the use of assistive technologies like voice recognition software isn't possible. Therefore different technological possibilities for input and output have been developed that go beyond the standard equipment (desktop computer with keyboard and mouse, tablet, smartphone).

The design approach of accessibility is inherently flexible and able to adapt to the user's environment. It allows content to be used across different platforms, devices, assistive technologies and operating systems and tries to meet the needs of the diverse set of site visitors (Rush, et al., 2018). By taking this into account, while developing the web presence, more people are able to receive the content; consequently, a much larger audience will be reached and the potential market reach increases.

In addition, improving the accessibility of the website benefits for all users, because the constraints resulting from different forms of impairment, can result in inventive ideas and solutions, which have an additional beneficial value for non-disabled users (Girma, 2017). Thus accessibility has the potential to drive innovations to provide products that benefits everyone. For example the target group for features like text to speech, voice controls or VoiceOver where initially people with disabilities, but they found a much broader usage. Another functionality, for instance, are the contrast minimum guidelines, which are primarily aimed at visual impairments like low vision or colour-blindness to enable the user to read content on the screen, benefits everyone when reading on the smartphone in bright sunlight (Brownlee, 2016). Which is an example of how accessibility features in products and services can solve unexpected problems (Rush, et al., 2018) and the incorporation of accessible design thinking leads to an overall better product. Removing barriers expands the variation, breadth and flexibility for users to interact with web applications and websites. This can benefit the overall usability and user experience. If accessibility is seen as an overall more human-centred, contextual and more intuitive use of digital services (Girma, 2017). Therefore web accessibility features not only improve the aspects like the effectiveness, efficiency, and the degree of satisfaction a user can achieve when interacting with the website for people with disabilities, but for all users.

Thus, accessibility seems to be an important factor for usability and the overall user experience. Therefore, the following section addresses the basic components of guidelines designed by the World Wide Web Consortium to ensure the accessibility and usability of websites of people with impairments.

3.2 Principles of Web Accessibility

The World Wide Web is only accessible by people with visual, auditory, motoric or cognitive impairments if appropriate design and development guidelines are taken into account when building a website. These requirements are specified by the W3C in the "Web Content Accessibility Guidelines (WCAG) 2.0". This recommendation states specific techniques and requirements for developing an accessible website including the content architecture and layout basics. In this context the level of success of the implementation of Web Accessibility for website elements is categorized in the three levels of conformity: A ("must be"), AA ("should be") and AAA ("would be good") (W3C, 2008).

Therefore websites must be perceivable, easy to operate, understandable and robust (W3C, 2008). These four core principles build the foundation for Web Accessibility and people with disabilities, who mostly are the ones using assistive technology, are dependent on the compliance of these guidelines to have a successful interaction with a web presence.

3.2.1 Principle One: Perceivable

The first principle states that "information and user interface components must be presentable to users in ways they can perceive". Based on the conjecture that not all individuals are relying on the same senses while browsing the web this means that the presented content must be available to at least one of their senses. A person with visual impairments may need to be able to adjust the appearance of the site like resizing text elements or increasing the contrast without losing content or functionality. Furthermore, colour should not be used as the only visual element to convey information since it can cause difficulties for people suffering from colour-blindness. Others, like a blind person, may rely on assistive technologies like a screen reader to access the material.

These should be able to read out the content and provide the user with a suitable representation. Another example is that, if a person is deaf and the website contains audio content, it should be ensured that there is a text representation available (W3C, 2008).

The variety of non-textual content ranges from images and visual graphs to audio-visual material and forms. For that reason, the first guideline refers to alternative representations of non-textual elements and demands equivalent text alternatives. In HTML, for example, images have a required “alt” attribute that specifies an alternate text, if it cannot be displayed and which are read out loud by screen readers. Other examples of possible alternatives are descriptive captions or well-ladled forms. Due to the fact that audio and video content provides a different form of conveying information, it is necessary to guarantee that the containing information can be accessed regardless of disability or used device. Hence audio descriptions that convey important visual details or embedded captions (subtitles for live audio con-tent) can provide the user with the content even if the video cannot be seen or the sound is not audible. This benefits everyone in a loud or quiet environment regard-less if the person is disabled or not. The same applies to an inserted transcript which further enables the user to perceive the content at their own pace. Which alternatives are to be provided depends on the desired degree of conformity and whether they are recordings or live streams (W3C, 2008).

Besides providing alternatives, it should be possible to present the content in multiple ways without the loss of structure or information. This means that as part of the development process also considerations regarding the website’s presentation, in the case being provided without any styling.

3.2.2 Principle Two: Operable

The second principle describes the need to be able to operate the website. Not every user operates via a mouse and relies on the keyboard to interact with the webpage. People with mobility impairment may be forced to use the keyboard navigation or speech recognition software. Consequently, this means that access to all functionality including user interface components must be given to the keyboard or a keyboard interface to enable the site to be successfully utilized by different assistive technologies like

speech. Thus keyboard accessibility is a possible way to provide an operable website for all users (W3C, 2016).

Necessary requirements are that used tools, like the browser, have keyboard support the occurrence of keyboard traps is avoided (W3C, 2008). A user should always be able to enter and exit an element or component via the keyboard navigation and should not be forced restart the browser in order to regain control and navigate to another part (W3C, 2008).

Another success criteria is that the site should be navigable, which means there are ways to guide the user navigating, finding content or determining in which section the user is currently on. To do this, a well-structured content helps with orientation. Therefore, a website should have an easy-to-understand website architecture consisting of pages with clear titles as well as descriptive section headings and (visually) distinctive Links whose purpose is clearly recognizable. This principle also recommends that the user is provided with a possibility to bypass content blocks that are represented by, enhancing the page navigation for example with skip links. Furthermore, the focus of the keyboard navigation, should be visible and the content should be positioned based on the underlying markup structure so that the focus is able to follow a meaningful order (WAI, 2019). Consequently, the user should be able to easily navigate, find content and determine their current position on the page.

3.2.1 Principle Three: Understandable

The definition of this principle states the fundamental requirement to understand the operation of the user interface and presented content. People have a range of cognitive abilities and some medical conditions affecting these abilities. For example, the language-based learning disability dyslexia can cause reading difficulties. It is essential to make content readable for all user groups. Therefore a clear and simple language which is easy to understand and follow should be used for all textual, but also for visual content like illustrations, or videos to ensure the meaning of the content is clarified (W3C, 2008). The use of unknown foreign words and abbreviations should be avoided as far as possible and sentences in text passages should be kept relatively short. If the use of unusual

terms or phrases cannot be avoided, definitions should be provided accordingly, for example by linking to explanations or providing a glossary (W3C, 2016).

Moreover, people can use websites more intuitive and efficiently if the webpages are consistent and predictable. Accordingly, it should be ensured that the user interface is consistent constructed and operable in a predictable manner. This means that the main navigation should be a constant site element with clear denotations and a uniform position across all pages (W3C, 2008). Especially when using screen readers, a consistent page layout is beneficial for the usability of the site. To avoid further potential confusion a dynamic change of the content such as launching a new browser window should be done only at the explicit request of the user (W3C, 2016) .

Although every user can make mistakes when entering information in an interactive element, such as a form, for some users it is more challenging to recognize in-correct inputs and therefore input assistance should be available. There mistakes should be identified in multiple ways, for example through colour and through a specific textual error message to aid users who have a visual impairment like colour-blindness where a purely visual identification would be insufficient (W3C, 2008).

3.2.1 Principle Four: Robust

The fourth principle states that “content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.” This means that the back-end of the website and the content must be built in a way that enables a maximum possible compatibility with the current and future technologies that people are using to interact with the website including assistive technology. The more control users have over the technology they can use, the more likely they access the content in a manner that suits their individual needs more properly (W3C, 2008).

One step to realize a website that is compatible with different browsers, assistive technologies, and other user agents is to create semantic markup that can reliably be interpreted (markup validity). This means writing code according to established conventions and standards. Besides, the interactive elements like links and forms as well as widgets must be semantically tagged that the information like name, role, and value can

be correctly transferred to the user agents API, which includes assistive technologies (W3C, 2016).

Due to the aim of maximizing the compatibility with current and future user agents the Responsive Web Design approach can be seen as a design example for including robustness to a web presence, because it involves a cross-browser compatibility and the need for content consistency, which means the content of the website shouldn’t change depending on the user’s technology.

4 Case Studies

In the following chapter, a case study is carried out, in which representatively two websites are analysed by defined criteria, which are divided into the two categories Web Accessibility and Responsive Web Design. The objective of the case study is to determine the extent to which the selected websites have both responsive and web accessibility features. It should be shown that a responsive website also has the possibility to be accessible and a website that sets the focus on accessibility equally responsive. For this reason, the selection of websites was based on the criteria shown in the following section.

The responsive site, being examined for accessibility, is the Disney website (https://disney.co.uk/), which is an example for a site with media complexity, showing that a smaller viewport does not mean that cuts must be made in terms of content and position. The UX design agency Nomensa has demonstrably accessibility taken into account when creating the website. As it is similarly complex in terms of content as the Disney website, it is therefore examined for responsive web design properties.

4.1 Criteria

4.1.1 Responsive Web Design Criteria

Content Hierarchy. The positioning and the organisation of the content should be based on the importance of the information, so that the essential content appears before other supporting elements and the user gets directed to these first. Furthermore, it has to be ensured that the prioritized content appears on all devices equally, whereas the option exists to hide supporting content.

Navigation A well-structured, intuitive and operable navigation builds the basis for a satisfying user experience. It helps the user to orientate on the site; hence navigation elements must not overflow edges of the screen. An essential principle for the implementation of the navigation is “Content over Navigation“ (Wroblewski, 2011 p. 49), which means that content must have a higher priority and thus take up more space than the navigation. Therefore the navigation on smaller viewport sizes should be realized either in the form of a Drop Down/ Select Menu or using a “Hint-and-Reveal” navigation with a menu icon, for example the commonly used hamburger menu icon or a textual

equivalent. Depending on the orientation (portrait or landscape) of the screen, a different positioning of the navigation is required due the changes in placement of the thumb.

Interaction The interaction with the website takes place in different ways like keyboard mouse, fingertips or styluses (Touchscreen). For mobile devices common touch gestures: (e.g. scrolling, swiping, scale down and up, drag n drop etc.) are supported. Furthermore elements like forms, buttons or links are touch friendly sized with and spaced so there is no chance the user triggers an action accidently positioning of the navigation is required due the changes in placement of the thumb (UXPin, 2015 p. 45).

Visual Display. When looking at a screen, the height is proportional to the screen width. This sense of proportion remains even if the size of the screen changes. If the screen becomes, narrower more vertical space is required to display the full content. Therefore the content must be displayed and scrolled appropriately across devices. The layout should adapt to different screen sizes and if possible, relative values should be used for layout blocks as well as text elements and visual content must be aligned accordingly.

Fluid Images and Responsive Video. Images remain the same size and orientation for all viewports unless defined otherwise. Responsive or fluid images adapt to the container they are in, which should be scaled in relation to the viewport's size, the same should be considered for video content.

Typography. Not only should the percentage definition of whole layout blocks be considered, but also of typography. Relative measures should be used to create consistency in terms of the percentage information otherwise used on the page. It also makes it possible to relate font sizes across devices and ensures that all textual elements remain legible. Therefore "rem" or "em" units should be used for characteristics like line-height or font-size to ensure that measures are proportional to the screen size. Font, style and chosen font colours are consistent and easy to read in different font-sizes[1] (UXPin, 2015 p. 81).

Consistency. To enable a coherent user experience, elements such as Link and button labels, used typefaces and colour scheme should be designed to be device-comprehensive. Other elements like for example button size, the type of navigation (due to Touchscreen, etc.) or the visual layout may adapt to the different devices.

[1] Sans serif typefaces would be advantageous because they are formally reduced and therefore more clearly structured, making them easier to read on screens. If a combination of sans serif typefaces and serif typefaces is used to create a more engaging appearance, serif-fonts should only be used for headlines.

4.1.2 Web Accessibility Criteria

Understandable and Predictable (Language, Structure, Design). Not everyone interacts with a website the same way due to the fact that users vary by abilities. From the different types of learning to different cognitive and physical impairments, user approaching the content from different perspectives and with different methods of interaction. Therefore the content must be presented in a way that it can be comprehensible for a greater audience, which means in a clear and simplistic language. This includes labels for links and buttons. The purpose of each link can be determined either by context or the label. Furthermore, the site's appearance and ways to operate should be predictable and straightforward, for example, navigation elements are in the same location and order on every webpage, unexpected action like opening a new browser tab or windows are not triggered unintentionally (BoIA, 2019).

Semantic Structure (Headers, Lists and Tables). HTML-Elements like headers, paragraphs, lists and tables visually and structurally organize the webpage's content. Ensuring a correct heading structure (h1-hn) allows users relying on assistive technology to navigate the content via headers and can reach the desired content more efficiently. Therefore, it is important that the distinction between header levels is not only based on text styles or colour. This also applies to lists and especially tables, which must be tagged appropriately to be recognizable for assistive technology as such because people with visual impairments are not able to establish a substantive connection between the individual cells visually. They need to rely on the semantic structure of the web page so to finally understand the meaning of the table (W3C, 2008).

Navigation. Keyboard Accessibility is an important aspect of web accessibility because not all users navigate the page via mouse or a touchpad. Some users, for example, due to motor disabilities rely on a keyboard interface to navigate (also through use of modified keyboards or other hardware). All functions must be available via a keyboard interface. The content must not only be operable via keyboard interaction it must incorporate a visual keyboard focus and avoid keyboard traps. In addition a proper tab order should be realized which directs the user through the page elements in a logical order (W3C, 2016).

Visual Display. The functionality and structure of a website must stay unaffected by whether a stylesheet (CSS) is used or not. Content should be presented in different ways without losing structure or meaning. The readability of a website must be ensured and some users may need to adapt the website's appearance to their needs. For example, they are increasing the font-size to read the content properly or override the colour scheme (e.g., via browser settings) in order to perceive the website better. Other users are not able to perceive the design and rely on assistive technology or find it easier to navigate the content without applied stylesheets. Therefore, a separation of content from presentation is essential to allow flexibility for users; no information should be lost if the stylesheets are disabled (W3C, 2008).

Colour is one of the strongest means of design; it gives the page a certain look and feel as well as has the possibility to communicate information. In order to ensure the user's readability of the content, it is important to ensure that the chosen colours of a website have a sufficient contrast to each other, especially the background and foreground colour. The minimum contrast ratio between foreground and background colour for the body text, specified by the WCAG is 4.5:1 and at least 3:1 for larger text and headings to reach level AA compliance. For level AAA, the ratios are 7:1 for body text and 4.5:1 for headings and larger text (W3C, 2018).

Low contrast causes difficulties for users with colour vision impairments like colour blindness or low visibility e.g. to read text elements. For this reason it is also vital, that colour or shapes are not the only visual means to convey significant information for example in case of a form validation. Input errors should be clearly marked and a textual message be given (W3C, 2008).

Text alternatives for non-text content elements are available

Image Alternate Descriptions. Image Alternate Descriptions. All on-page images that contain information in any way have an alternative method provided to describe their meaning. An image description is essential to ensure that these additional information is conveyed to all users including, for example, visually impaired users using screen readers. Such concise descriptions of an image's purpose can function as a replacement if images cannot be displayed or are disabled in the web browser. Possible methods are the alternative text in form of the alt attribute on an "img" element

or captions when the “alt“-text becomes too long. For more complex figures like diagrams or charts, a more detailed image description within the context of the web page should be provided (W3C, 2008).

Multimedia Content Alternatives. For audio-video and audio-only media files (time-based media) incorporated in the page, alternatives like transcripts, captions and audio descriptions have to be provided. In addition, these elements ideally have controls to enable the user to pause, stop, restart or change the audio volume (W3C, 2008). Including these functionalities will increase the user experience for all user groups and not only people who, for instance, are deaf or hard of hearing. It is also advantageous to have when the audio quality is reduced due to background noises or in cases users have difficulties to understand the spoken content.

Slideshows, Animations, Flashing, Auto-updating Elements. In General, the screen movement of elements like a slideshow or an animation can be used to animate the user to interact more with the content. Like multimedia content, it would be beneficial if moving content would contain user controls so that the user can turn it off/hide it if he finds it disturbing. Including such elements on the website, it is crucial to avoid content that blinks or flashes to excessively because this could distract the user which makes it difficult to process the given information or in individual cases could cause dizziness or inducing seizures (W3C, 2008).

4.2 Case Study: Disney

Disney has a website where the main focus of attention is photo and video content, generating a visually engaging website with a coherent design across all devices and platforms (s. Figure 4). It is basically a reduced designed website that still conveys complex content whose structure is based on clearly understandable categories. The limited number of main navigation points can be detected quickly and clearly, which makes the orientation on the site easier. The fact that the number of text content is kept minimalistic and the most incisive features is full-screen (width) background images. This indicates that the principle "Mobile First" may have been used during the development process and furthermore emphasizes the core content and the main purpose of the website Namely highlighting the imagery from Disney movies and television series and promoting the individual products of the company, including besides films, merchandise and offered leisure activities.

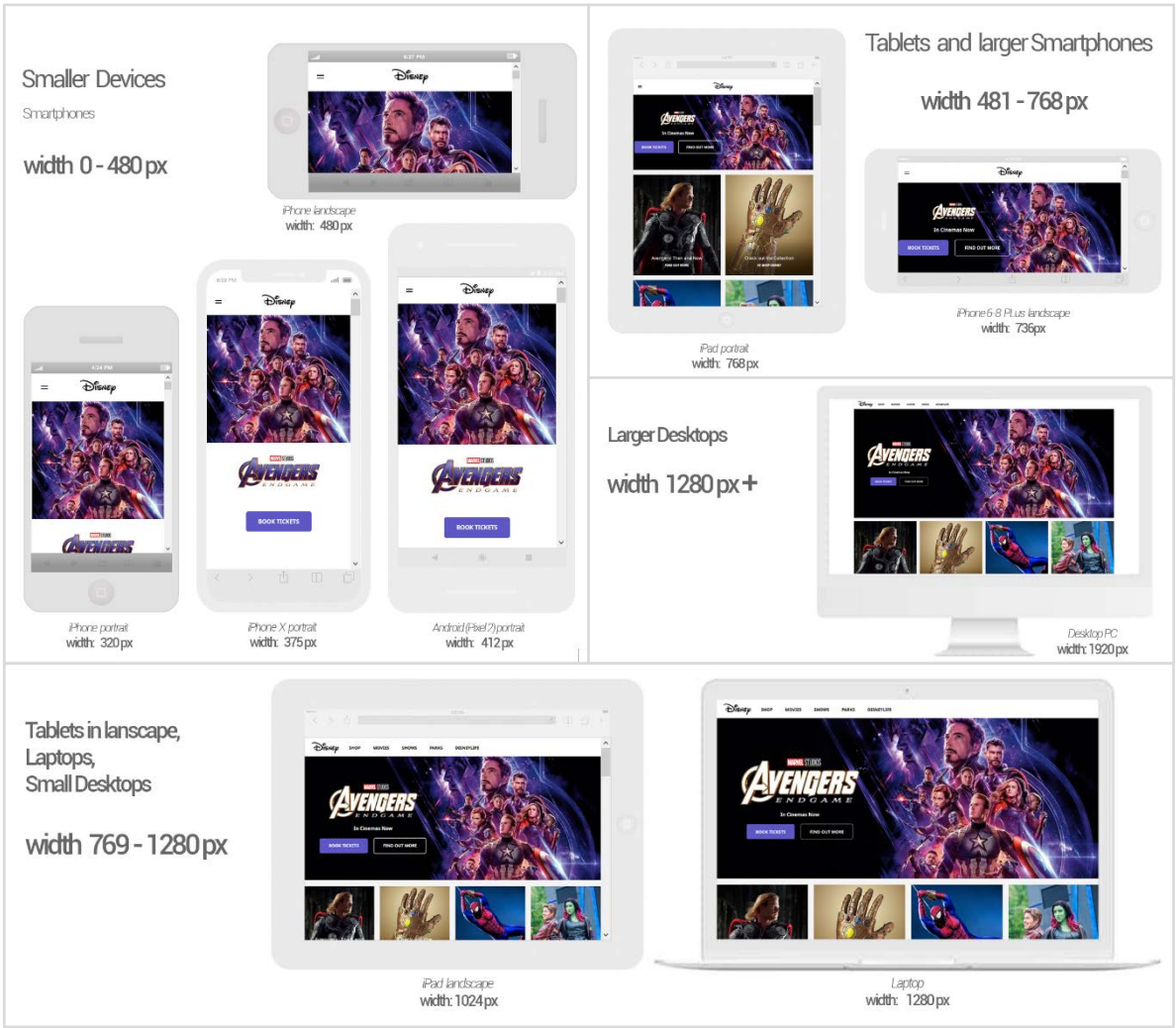

Figure 4 Disney-Website displayed on different devices

The content remains consistent across all devices, and no reduction of essential points on smaller devices can be recognized. There is ample space for all necessary content and controls in each viewport size. For example, the existing buttons are in a touch-friendly size and occupy a meaningful place in the page layout. The most important content elements are prioritized and central in the field of vision through their positioning on the page. The priority of the content does not shift no matter which device a user utilizes, meaning and order of the individual elements stay consistent. This also applies to the colour scheme as well as buttons and link labels.

For example, the home page is similar to a typical landing page. This first touchpoint itself does not contain any own content but refers to different detail pages by addressing the user via CTA-elements and hero shots. For example, the latest movie is featured through a large teaser image, which fills up the entire first section. This also consists of the logo of the movie and corresponding CTA-buttons[2]. Followed by a series of block elements that guide the visitor to different parts of the page, but which are still related to the featured movie. Including background information, merchandise in the online shop, live shows or events in the Disney theme parks. Afterwards, the visitor will gradually be guided to further general content about the theme parks and cruises, the online shop, other current or upcoming movies as well as musicals.

The navigation for smaller viewports (> 768px) is a hint and reveal navigation using the hamburger icon in combination with a select menu for the second-level pages. The layout adapts to the viewport size by following the principle “Mostly Fluid” (cf. Chpt. 2.2.1.) Content, images, and videos adapt as they transition from one arrangement to another. On smaller devices, the block elements are stacked vertically on top of each other. Regarding the typography, “rem” and “em” values are used for font-size and line-height as well as pixel values, e.g. for footer and navigation text elements. Consistently, the chosen typeface is sans-serif, thus the use of elaborate and decorative fonts was avoided, and the font-colour is matched to the background colour, either black or white.

Due to the image-heavy design, the amount of text elements is kept very limited. The existing text uses a simple language and is therefore easy to understand. In addition,

[2] *https://disney.co.uk/* accessed 27.04.2019

the meaning of the links and buttons is identifiable. The page also meets the accessibility criterion of predictability. Thus, for example, the logo positioned in the left upper corner following a very common design pattern helps the user to identify the website they are visiting when first landing on the page (Cf.Whitenton, 2016). By clicking on the company logo the user always returns to the home-page and the navigation is located across all sub-pages in the same location. It uses the most common top navigation menu as well as a footer navigation. This makes the sections (second level pages) accessible without scrolling back to the top. Links that are in the content area of the page can be distinguished visually from the rest of the text, in which they are underlined when the user hovers over it with the mouse.

Furthermore, the website allows users to interact using keyboard commands. The individual elements can be accessed sequentially in a logical order due tabbing[3] through the page follows their layout structure. This means the keyboard focus moves from left to right and top to button in columns. This is visible[4], so the user can follow along and determine its current position on the page, which provides the user with the same feedback a mouse courser would. It is possible to access all elements, including the interactive ones like forms and videos via the tab key. In the case of the videos, the user is able to start them with the help of the keyboard, but the video controls are not keyboard accessible. Apart from that, the website has the possibility to skip the top main navigation bar via a corresponding button, which will be displayed as soon as the keyboard navigation is started.

The overall semantic structure is clear and the information appears in a logical reading order. The existing text is divided into meaningful sections and thus, for example, navigation using headings (h1, h2) with assistive technologies is possible, such as a screen reader[5]. This also captures alternatives for non-text-content. Text alternatives for images are available in the form of a short description added to the alt-attributes. These given short descriptions are expressive enough to understand the meaning of the im-

[3] Using *tab* key to navigate forward and the combination *shift + tab* to move the keyboard focus in reverse order

[4] focus indicator coded by default into common web browsers

[5] Chrome extension “Silktide - Screen Reader Simulator“ was used

ages (s. Figure 5). The samples showed that the aim of providing access to the information an image contains is achieved, without stating unnecessary details. Video content, on the other hand, has no other presentation like audio descriptions, transcripts or captions/subtitles included. Only controls are provided, which enables the user to pause stop, fast forward and rewind (slider), toggle the video in and out of a full-screen mode as well as mute and unmute the video. There is no direct control of volume possible. Thus, important components are missing to ensure videos is accessible and understandable for members of the audience who are deaf or hard of hearing or other ups such as non-native speakers. In addition, an audio description that describes important visual content for those who are unable to see the video would help to follow the narration, even if the video contents, as in this case, are mainly short movie trailers.

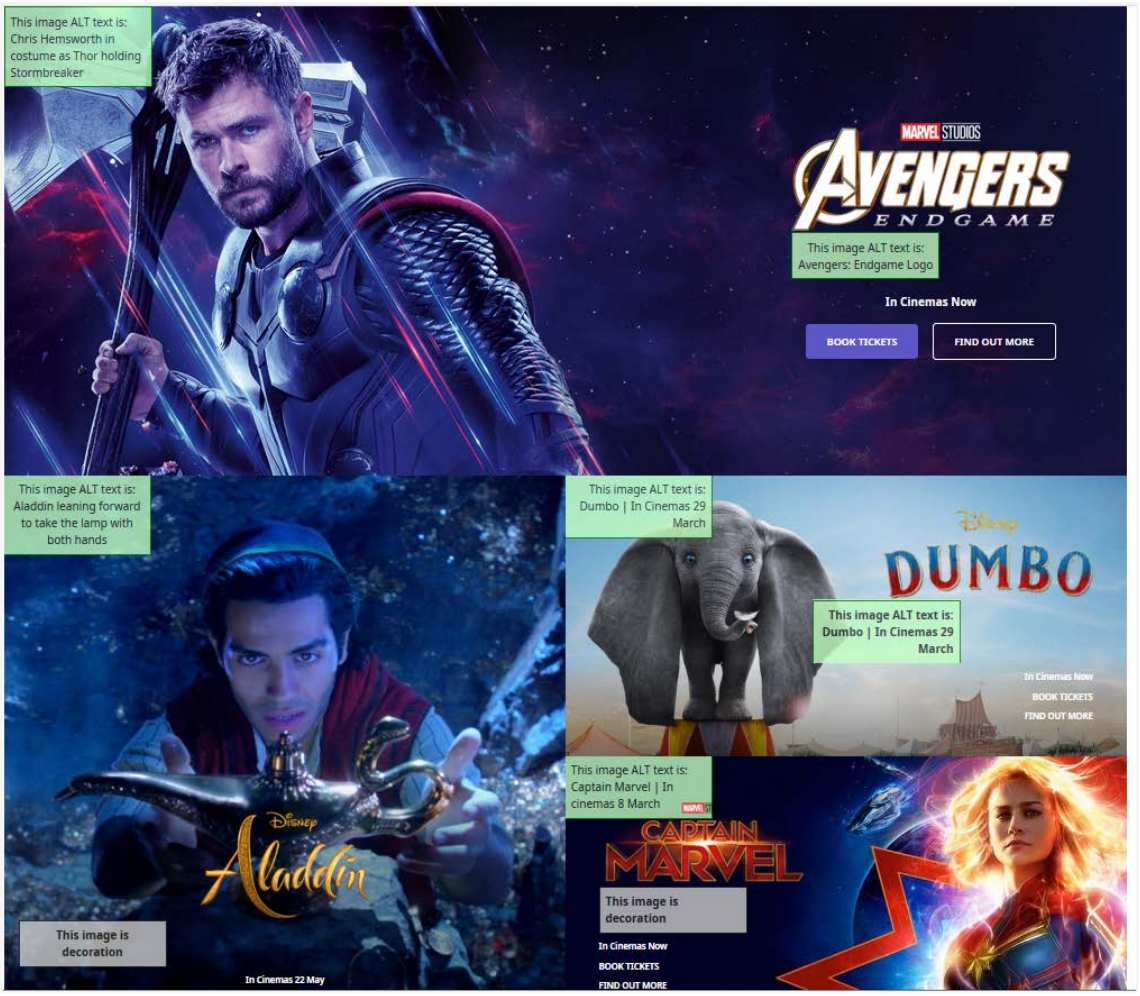

Figure 5 Sample alt-text for images

The only form of animating effects that can be recognized are the mouse over effects of images at some places of the website. A hover effect is present, which enlarges the images while staying in its boundaries, generating a zooming effect. Subjectively, this effect is so minor that it does not feel distracting, but instead serves the orientation by visually highlighting where the user is on the page. Furthermore, existing slideshows, which, for example, can be found on a movie detail page presenting merchandise articles to the site-visitor, can be controlled via arrows on the sides. This ensures that no unintentional movement takes place. Moreover, the website has automatically-updating content on the detail pages of the movies currently being shown in the cinema. This information is based on the geographical location of the user, which will receive information on how many nearby cinemas are currently showing the film. This statement is continuously changed, and the individual locations listed one after the other. This element cannot be hidden or paused directly on the web page. Which could be perceived as disturbing under certain circumstances.

The Basic colour scheme is black and white. This classic light-dark contrast creates an ideal colour contrast in which the dark writing on a light background. It has a contrast ratio of 7:1 or more, meeting the Level AAA criteria for enhanced contrast (s. Figure 6**Figure 6**) and thus is optimally readable.

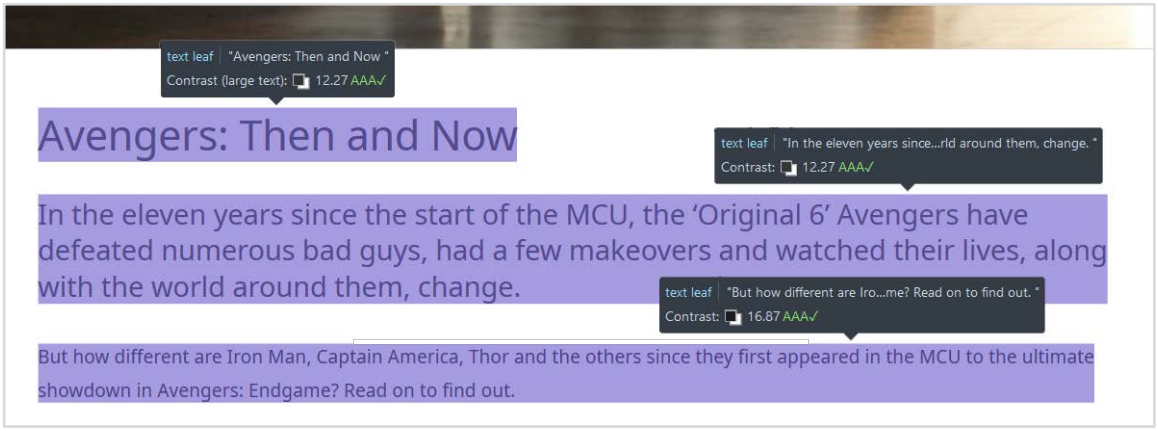

Figure 6 Sample colour contrast text

However, the main focus is on images and videos, which also function as the background for text. Here, it must be ensured that the colour contrast is satisfactory. In these cases, either black or white is used as the font colour for text elements on the Disney website, which may not always create enough contrasts for the test to be easy

to read. Figure 7 shows that for complex backgrounds such as gradients or, as in these cases, a range of colour contrast values can be determined. The colour contrast of one of the given examples ranges between the values 2.5 and 2.95 is potentially not high enough and fails to meet the acceptable ratio. If the page is viewed in grayscale mode, on a subjective basis, the text contents remain readable and image details recognizable, even if the previous random analysis showed that in some places the contrast ratio is not sufficient to fully meet the corresponding accessibility criterion.

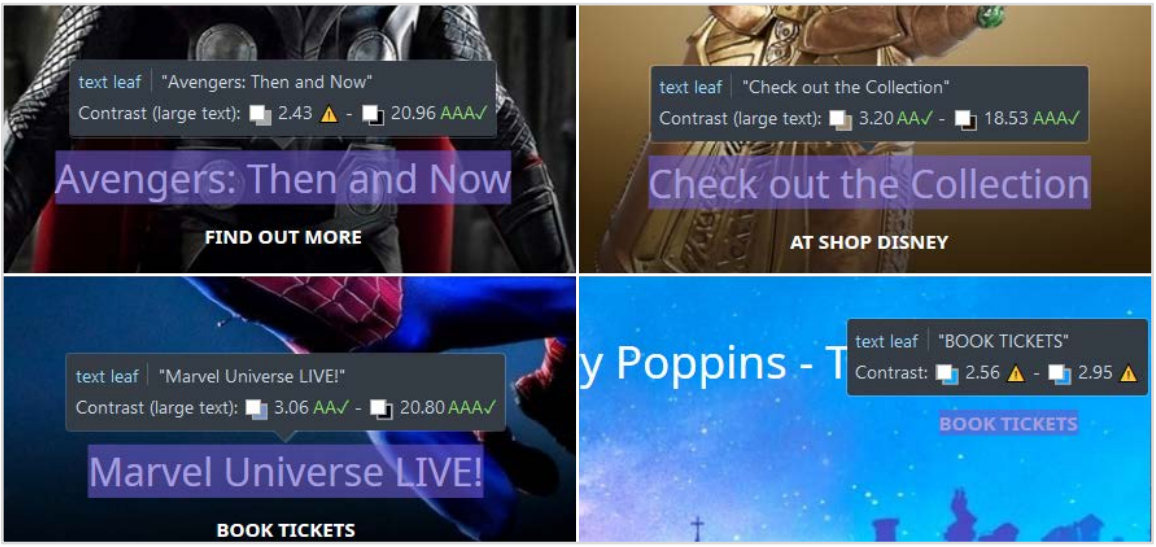

Figure 7 Sample colour contrast complex background

Another important point is that an existing input support for forms on the page is given both via colour and textual. While the colour indicates that something is wrong visually, the associated message provides accurate context, so that the error can be corrected more easily and user groups which cannot rely on colour to perceive the necessary information[6] (e.g. colour-blindness). However, the forms are not standardized, but this may be due to the fact that they are located on different sub-sites[7].

The analysis shows that the website has some accessible features included. On the one hand, it limits itself to a manageable amount of content on a page, which makes it overall easier to understand and navigate. Mobility impaired users are able to use keyboard as an alternative input device without keyboard traps, clear text-alternative representations are given for images and colour is not used as the only means to convey

[6] Websites were viewed in grayscale mode

[7] Cf. *https://disneylife.com/ie/join* and *https://disney.co.uk/why-join* [accessed 01.05.2019]

information (Level A). Besides that, the colour contrast can be considered acceptable (Level AA or AAA) in most cases. Nevertheless, the site is not completely user-friendly for all audience groups. Videos, that have indeed a central role on the pages, have no alternative representation in order to achieve Level A compliance. Neither captions nor audio descriptions are included which are essential for hearing and visually impaired people. Regarding the videos, it should also be noted that although the controls are available, they couldn't be operated via keyboard navigation in the test.

4.3 Case Study: Nomensa

The UX design agency Nomensa[8] has a website, which, according to their accessibility statement, was developed taking the Level AA criteria of the WCAG 2.1 into account (Nomensa, 2019). This claim was confirmed by a random analysis of different page elements. For this reason, the following will focus on examples of accessible features of the site, before referring to their characteristics for a responsive website.

First, the page has a functional keyboard navigation with a clear visual keyboard focus, which allows access to the existing elements in a logical order. Embedded controls of interactive elements such as videos and slideshows are accessible via the tab-navigation and like the Disney website, the site has a skip navigation button, which directs the user directly to the page content. Since the site contains a blog, this section has a directed search function included (search bar) through which users are able to filter the numerous block entries for specific information and thus find the desired content within the page faster and easier, which has a positive impact on the user experience.

Furthermore, the semantic structure, as well as the existence of alternative descriptions of non-text elements, were examined using a screen reader simulator[9]. It was noted that the text content of the individual elements and if available its role like for example link, button or heading where accurately reproduced. This also applies to alternative texts of images, provided they convey meaning. By contrast, images that have a pure decorative function were not captured and skipped by the screen reader. Integrated videos are not recognized as such and omitted. A closer look into the textual

[8] *https://www.nomensa.com/* [accessed: 01.05.2019]

[9] Chrome extension "Silktide - Screen Reader Simulator" was used

content of the page in which they are embedded, it can be said that the viewed videos provide no additional information. They merely represent an alternative form of presentation of the page's content. In case the video doesn't serves this purpose like the Agency's image video an equivalent transcript is provided below. Another reason is that all videos inspected on the website can be viewed as video-only content, as the information is only disclosed in the form of video and picture material as well as text elements, the included audio track is merely background music. In this way, also user groups that have a hearing impairments are included.

Both the content and the semantic structure appear clear and logical, so that is possible, e.g. to navigate the content via headers. If the stylesheet is disabled, it is noticeable that text elements contained in the code get hidden while CSS is applied. However, these are short additional indications helping to establish contextual correlations that sighted people can do visually without any additional help. Thus no essential content gets hidden, but the user experience improves if, e.g. a screen reader is used (s. Figure 8).

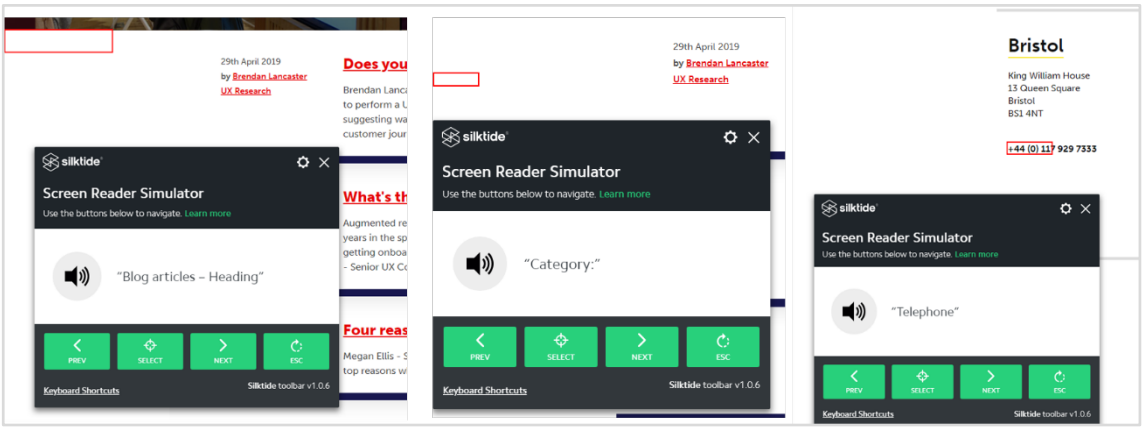

Figure 8 Sample Screen Reader output

Just like Disney, Nomensa relies on a clear visual design with a basic colour scheme based on the black-and-white contrast (body-text) but uses additional colour to emphasize elements visually. This includes a dark blue-magenta shade (#18174f) used for the navigation and the footer-area or a pink-red (#e80004) shade to emphasize links. In addition to the colour highlighting, they are underlined so that they are clearly visible even in grayscale. In this context, it was also found that the contrast ratio of the text elements between the foreground and background colour meets the requirements for Level AA or AAA compliance in most cases, even when the background is complex (image). A San-

serif font was used, which preserves legibility across all devices. This is also helped by the fact that relative values were used for properties like the font-size (rem, em, and percent).

On the well-structured website, the length of the texts is kept moderate and it is written in a clear and understandable language. Furthermore, the site can be intuitively navigated since links and button labels have unambiguous identifiers. If the website is now viewed on different devices, it becomes apparent that it also has responsive characteristics. The layout adapts to the individual devices while the content stays consistent. Images and videos adapt to the screen size and the order of the block elements stays the same when stacked on top of each other (follows “mostly fluid”).

Since the nature of the interaction in the mobile environment changes completely and control of the website usually mostly happens via touch displays, it is important that clickable areas for the size of the acting fingers are optimized to ensure trouble-free operation. Recommendations based on the average size of finger-tips 8-10mm and -pads (19-14mm) suggest that a clickable area has an average minimum width and height of around 7-10mm with a minimum distance of 1-2mm (Wroblewski, 2011 p. 69; cf.Wroblewski, 2010). This criterion is fulfilled as far as possible, controls and buttons stay in a touch-friendly size[10]. However, the distance between two clickable elements isn’t always in the recommended range as shown in **Figure 9**. In addition, common touch gestures[11] are supported.

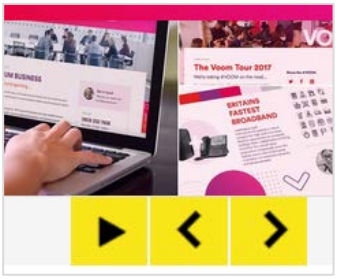

Figure 9 Controls of slideshow

The navigation changes on smaller viewports (<752px) from a top-navigation bar to a hint-and-reveal navigation and thus also follows the content over navigation principle. This is a side navigation, which slides in and pushes the page content to the left. Also, the telephone number of the individual locations is indicated in

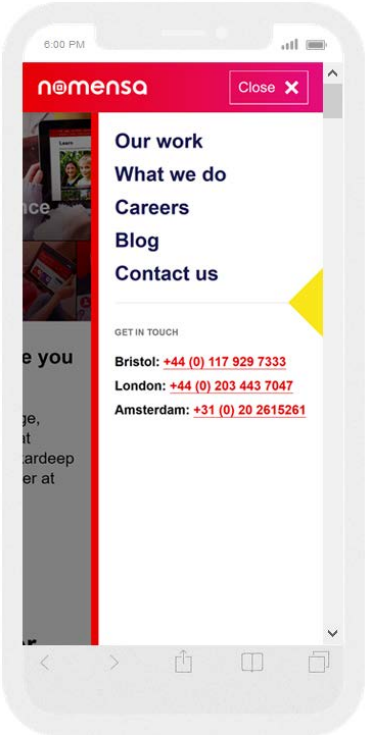

Figure 10 Mobile Navigation

[10] determined values: height around 7-9mm and width 7mm+

[11] scrolling, scaling up and down, swiping were tested

this bar. Thus, a possibility of contacting the agency in addition to the footer is added to the navigation area and this way always accessible to the user without scrolling to the end of the page (s. Figure 10).

The analysis shows that a website adheres to both the principles of web accessibility and responsive web design. Functionality and a visually appealing appearance are given equally. The functionality can be operated by a very large audience because people experiencing some type of impairment or disability get included. The use of a fluid grid-based layout, flexible media elements and media queries ensures that the website can be displayed flexibly on various devices. For all screen sizes, the basic layout is automatically applied and changes stringently for each breakpoint. This confirms that a web page can be quite functional without compromising on design.

5 Conclusion

In order to create user-friendly website aspects from functionality and appearance to navigation and the semantic structure has to be considered. However, the design process begins with the understanding of the website's purpose by specifying its main objectives and prioritize the content accordingly because the function and design of a website are ultimately specified by its content, which comprises a variety of media. By defining which content elements are essential to meet the user's expectations and needs, constraints are offered which set the design in a substantive framework. The less element, the better the layout adapts to small and wide viewport equally as well as has a benefitting effect on the user's orientation due to the reduced visual load. For most visitors, the primary focus is not on the appearance of the website because they visit the site to accomplish a goal, either to carry out a particular action or gather the information provide (UXPin, 2015 pp. 25,50). Adding unnecessary design or inessential content, in other words, elements that do not fulfill any function makes it harder for users to reach their initial goal. Therefore Content-Fist thinking, which is, for example, followed by the development concepts Mobile First and Progressive Enhancement, benefits both Responsive Web Design and Web Accessibility. Besides that, it forms the fundamental basis for all further essential design decisions which encompasses layout, navigation, functionality, imagery, and typography.

A responsive design adapts itself automatically to different screen sizes, which optimizes the layout for being viewed on mobile devices or in zooming conditions. This characteristic benefits, for example, people with low vision who need to magnify the content. But implementing responsiveness doesn't guarantee accessibility at the same time. First of all, the range of disabilities (hearing, vision, mobility, cognition), which could affect how a person can interact with the website, must be considered. Responsive Web Design alone is not able to include all audience and can rather be seen as an additional tool applicable to solve some accessibility issues. The conducted case studies show that a website's usability depends on a variety of factors. The chosen language and the organization of the content affect both readability and understanding. Choosing the right colours and legible font variants enhance the site's accessibility. The legibility of a text depends besides the typeface, mainly on contrast and font-size, but line-height and the

whitespace between text para-graphs play a role as well to ensure that visually impaired people can still read the text easily. A markup with distinct sections, descriptive headings, and lists to communicate hierarchy in a way screen reader and other assistive technologies can convey the information accurately. To ensure that all users are able to understand the meaning of the content, it is essential that visual media have an alternative form of representation.

The usability of a web page also depends on how well it can be interacted with. Since the navigation serves the orientation, it should be kept simple and clear. Regardless of the number of navigation points, inline-links or buttons, it has to be considered, that the nature of the interaction in a mobile environment or by using the keyboard navigation changes completely. When controlling the website via touch screens, it is essential to optimize clickable areas for the size of the fingers in order to ensure easy operation. If the page is controlled without a mouse and through keyboard commands, it should be noted that the access to each content block and link is sequential and not directly. In addition, a keyboard-friendly website needs to avoid keyboard traps and provide a visual indicator for the keyboard-focus to determine the current position on the page.

Accessibility may come with a few design limitations, such as the choice of font or colour palette and many other factors must be considered when designing for inclusion, but that shouldn’t be the reason to not implement Accessibility at all. The case studies have once again confirmed that both Responsive Web Design and Web Accessibility principles must be integrated into the whole design process.

Otherwise, the different needs of the users cannot be optimally addressed in order to obtain as end-result a website that can include both a flexible layout and the possibility for people with disabilities to interact (Chpt. 4.3). Thus, the responsive design principles can be seen as a starting point for accessibility, since a responsive site is flexible and accessible to different devices and thus improves the user experience and usability. However, to achieve the goal of a universally accessible web, to create a web page, the specified Web Accessibility Guidelines must be taken into account, so that at the end a web presence has an appealing design and is user-friendly.

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