

Checking Web Accessibility

Ožbej Golob, Alexander Thien, Olli-Pekka Riikola, Robin Karlsson

706.041 Information Architecture and Web Usability 3VU WS 2021/2022
Graz University of Technology

10 Nov 2021

Abstract

The majority of the world uses the World Wide Web and millions of people deploy their web sites online. However, most of them overlook one important aspect of web: web accessibility. This research aims to highlight the importance of using good web accessibility practices to enable disabled people to browse the web properly. This survey gives an overview of most popular text-only browsers and screen readers, as well as most popular browser extensions and web tools for accessibility audit of web sites.

© Copyright 2021 by the author(s), except as otherwise noted.

This work is placed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Contents

Contents	ii
List of Figures	iii
List of Tables	v
1 Introduction	1
2 Text-Only Browsers	3
2.1 Text-Only Browsers in use	3
2.2 Common Problems	3
2.3 Known Text-Only Browsers	4
2.3.1 Lynx	4
2.3.2 WebbIE.	4
2.3.3 W3M	4
2.3.4 Links	4
2.3.5 Others	4
2.4 Showcase video	5
2.5 Text-Only Browsers Conclusion	6
3 Screen Readers	9
3.1 JAWS.	9
3.2 NVDA	9
3.3 VoiceOver	9
3.4 Narrator	11
3.5 TalkBack	11
3.6 Showcase videos.	11
3.7 Screen Readers Conclusion	11
4 Browser Extensions for Accessibility Audits	13
4.1 axe DevTools	13
4.2 Accessibility Insights for Web	13
4.3 Google Lighthouse	14
4.4 Siteimprove Accessibility Checker	15
4.5 WAVE Evaluation Tool	15
4.6 Showcase videos.	17
4.7 Browser Extensions Conclusion	17

5 Web Tools For Accessibility Audits 19

5.1 Accessi 19

5.2 WAVE 20

5.3 Page Speed Insights aka. Lighthouse 20

5.4 Showcase videos. 21

5.5 Web Tools For Accessibility Audits Conclusion 21

6 Build Tools for Accessibility Audits 23

Bibliography 25

List of Figures

1.1	www.gov.uk	2
1.2	www.mirror.co.uk	2
2.1	Browsh Graphical CLI Browser	5
2.2	Firefox Reader View	6
2.3	Lynx browser.	7
2.4	Lynx browser.	7
2.5	WebbIE browser	8
2.6	WebbIE browser	8
3.1	Primary screen reader	10
3.2	Historical trends for primary screen reader	10
4.1	axe DevTools.	14
4.2	Accessibility Insights for Web.	15
4.3	Google Lighthouse.	16
4.4	Siteimprove Accessibility Checker	16
4.5	WAVE Evaluation Tool	17
5.1	Accessi Overview	20
5.2	WAVE Overview	21
5.3	Page Speed Insights Overview	22

List of Tables

2.1	Text-Only Browser Information	5
3.1	Screen readers information	11
4.1	Browser Extensions Information	14

Chapter 1

Introduction

The great idea behind the World Wide Web is that it connects people all over the world, and almost everyone is able to access it. But it is only almost. Of course, there are places where the internet is not freely available and due to restrictions or poor connection it is not possible to access it at all but there are also different situations. Could be that there are no restrictions for accessing the internet or the internet connection is not poor but still, some users cannot access the web. Why is that?

Even though there now are great information infrastructures in the states and cities and there are those good-looking websites in there, also there is still a great drawback in the terms of web accessibility — a poor web design. For example, visually-impaired users cannot really see all the beautiful content or extremely diverse navigation bars, but rather they will struggle through the endless link lists, one by one, trying to figure out what is going on on the website. It is true that they have some assisting devices, like a device for the Braille reading or software for text to speech but there is one common factor with these all. It is necessary to read the screen somehow and there appear the problems.

The problems that blind users may face are empty element attributes or empty link lists in the site, dynamic content, or other elements which are difficult to read by screen readers. They might look like very tiny problems but in reality, they are remarkable accessibility issues when we are talking about visually-impaired users. Luckily, as mentioned above, there are tools for both visually-impaired users and web developers to escape these problems. Blind users can use a text browser in combination with a screen reader and the developer can use accessibility-checking tools to ensure that a website will be properly accessible at the end. And these tools are what this paper is about — checking web accessibility.

Throughout the whole paper, there will be two websites as examples of accessibility. The first one is www.gov.uk which represents a good example of an accessible website. Another one is www.mirror.co.uk which is a bad example of accessibility. Or rather it is a good example of bad web accessibility.

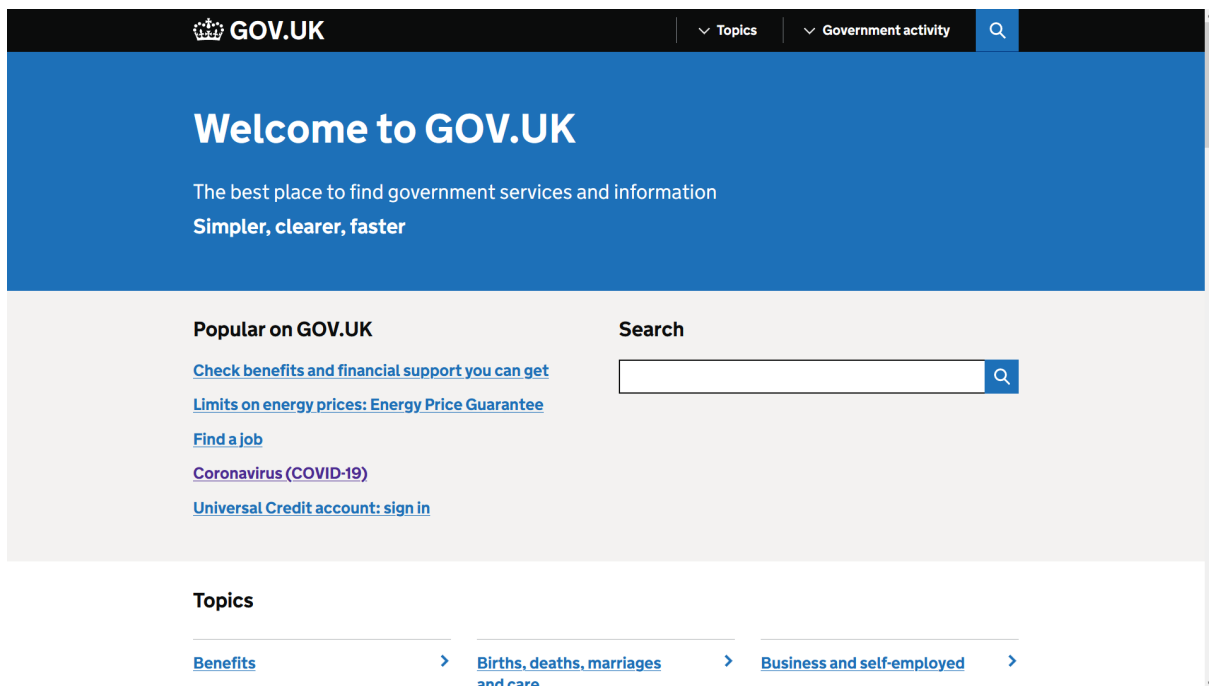


Figure 1.1: This website is a good example of an accessible website.

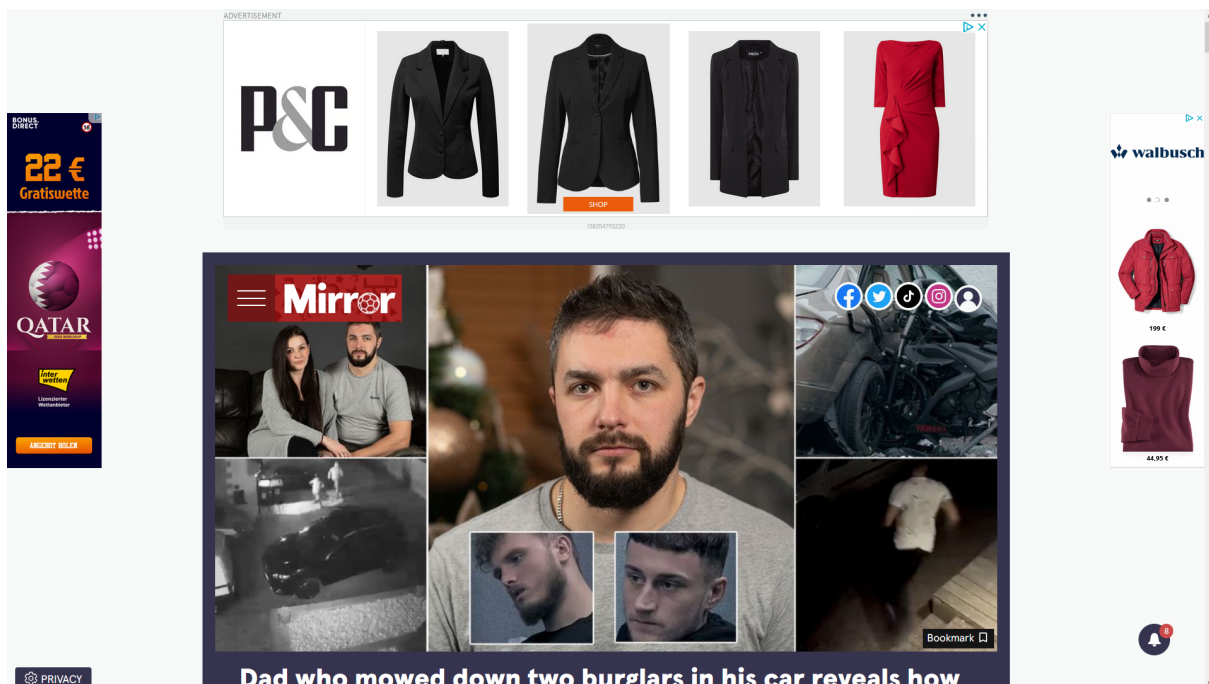


Figure 1.2: This website has quite a poor accessibility.

Chapter 2

Text-Only Browsers

Originally, text browsers were the only way to browse the web. Also, back in the days, internet connection speeds used to be much slower than today but similarly, websites were much simpler and it was possible to access them even with the narrow bandwidth. After that there are now several powerful graphical web browsers for web users, but the text browsers still have some important use cases even they are quite an old solution for web browsing [Memon 2019]. In addition, there are still a few promising text browser remaining and even receiving recent updates at least annually, and they are worth having a look.

2.1 Text-Only Browsers in use

The header above might seem to be a bit exaggerated, but it is possible and sensible to use text browsers on a daily basis. This is because text browsers are lightweight software and still efficient on poor internet connection and they could actually help users to reduce distraction while browsing the web and that is why they could be a good choice for a browser even nowadays. The text browsers are designed to logically organize the content of the website rather than just be ordinary web browsers that give access to the site to a user. More than that, persons with no sight or who are partially impaired can more efficiently access a website with a text browser in combination with a screen reader. And when talking about blind persons as web users it is important to consider, that they obviously can't see or otherwise access the actual graphical pieces of art, images, videos, or other similar media formats on the website [King 2008, Chapter 2]. So, text browsers reduce the content that screen readers cannot read and that way they will make web browsing more convenient for blind people.

2.2 Common Problems

Even though the layout of the site would be simple in a text browser, it still is not simple in practice. According to King [2008, Chapter 5] the reason is presentation. People with sight can have the advantage of a very versatile navigation link list, but for a blind user, it might be a struggle. It becomes a struggle at the point when the text browser tries to present the navigation bar as a list of links, and the screen reader starts to read it — link by link, one by one. Luckily, there is an option to skip this navigation bar and go straight to the content, but only if the element is designed properly on the website. Otherwise, the text browser does not realize that there is a navigation bar, but it just presents it like a list of links and the user needs to handle it.

Another issue is empty attributes of an element, like the ALT attribute in IMAGE element. And of course, this problem would quite easily be fixed by the programmer, especially with powerful accessibility checking tools, but sadly it is not always like that. So, since images are not relevant content for a person with no sight, it is very important that the ALT tag will tell, what is going on in that part of the website. Also, if an image is for hyperlink, then it should also tell with ALT tag, where it will bring the user [King 2008, Chapter 5].

Perhaps, the most difficult issue in the terms of text browsers is dynamic content. Since most text browsers do not support JavaScript, some functionality is not available for the user on the site. This essentially means that text browsers are not so convenient way to browse the web anymore. But still, as mentioned before, there are few interesting text browser software available on the internet.

2.3 Known Text-Only Browsers

There are several surprisingly well-working text browsers available in the internet. Even though there are those powerful and good looking graphical browsers too, text browsers have been kept up to date and they can be used for browsing today's websites. Of course, as mentioned in Section 2.2, if the design of a website is poor, it will not perform very well when accessed via the text browser. But what text browsers can be used then, the following sections will answer for that.

2.3.1 Lynx

Lynx is quite an old text browser and it appears to be probably the most well-known one. But as it is in the Lynx [2018] website, Lynx is a command line interface WWW client for Unix systems. An interesting side note could also be, that years ago Lynx has been a solution to build Campus Wide Information Systems.

2.3.2 WebbIE

WebbIE is one which is designed to help visually impaired persons to access the web. They are dedicated to work in combination with screenreaders, like JAWS, WindowEyes, Thunder, NVDA, and Narrator as mentioned in the King [2001] website. WebbIE runs on Windows, and it seems to be pretty much the only choice for Windows users.

2.3.3 W3M

W3M is also a very handy text browser and it works as a pager too, like 'more' or 'less' as it says in W3M [2022] website. It also works as a text formatting tool from HTML to plain text.

2.3.4 Links

Another interesting and very nicely working text browser is Links which is a school project from the days in 1999. But since then it has been kept up to date and many people are involved in the project and put effort to make Links more diverse [Links 2002]. It runs on Unix.

2.3.5 Others

There are also a few cases worth mentioning, perhaps even if they are not in the same class as those mentioned above. However, there is a project called Browsh, which is a graphical text browser running on Linux. It supports JavaScript, so all functionality in the site should be accessed but it is still a very early stage of development. But it might be useful on a poor internet connection.

Other ones are more like plugins, but it is good to know, that there is such available. Chrome offers a plugin, which makes a website like a text site, but it seems to be somehow outdated and poor. A more interesting and very well-working built-in function is Firefox Reader View. It just makes the website to be easier to read by removing distracting elements and making the content to be more clearly seen. This function can be activated just by pressing F9 in the Firefox browser and it works on several websites.

Additionally, in the paper there are images presenting how powerful text browsers actually could be. In the case of mirror.co.uk, even if there is plenty of images and advertisements, the text browsers are able to present the content somehow sensible as shown in the image `refig:lynx-mirror`. There are no

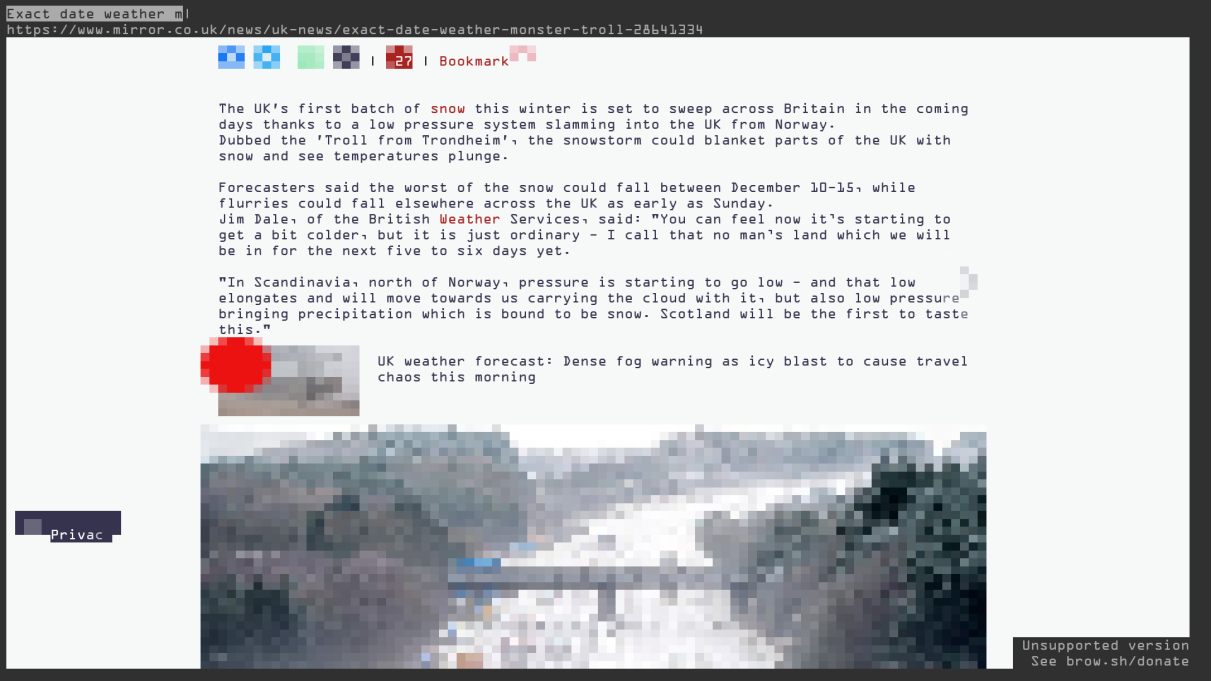


Figure 2.1: Browsing the web with Browsh in website gov.uk.

images presented from other text browsers, since most interesting examples are Lynx and WebbIE. Others are more or less similar than the Lynx — only thing to consider is, that only W3M and Links work responsively inside of CLI, Lynx does not.

Also, there is provided interesting data about these text browsers in the form of a simple table. Due to the simplicity of the text browsers, it is easy to get familiar with them by only watching a showcase video introduced in the Section 2.4 and comparing the screenshots mentioned earlier. But the Table 2.1 gives a good overview of the text browsers.

Browser	Last update	System	Licence
Lynx	2020, Feb, 27 (v2.9.0)	Linux	Free
WebbIE	2021, Dec, 23 (v5.1.0)	Windows	Free
W3M	2022, Sep, 17 (v2.28)	Linux	Free
Links	2022, Sep, 17 (v2.28)	Linux	Free

Table 2.1: Information of text browsers

2.4 Showcase video

There is a showcase video on YouTube, where is shown what it looks like when browsing the web with the Lynx text browser. In the video, it is shown two examples, gov.uk and mirror.co.uk, which represent examples of good and bad web accessibility. Both videos are quite similar in structure, just tabbing through the sites and entering the links, but that way it is easy to recognize the problems at the first glance on the mirror.co.uk website. Link to the showcase video is among the references and it is named as Riikola [2022].

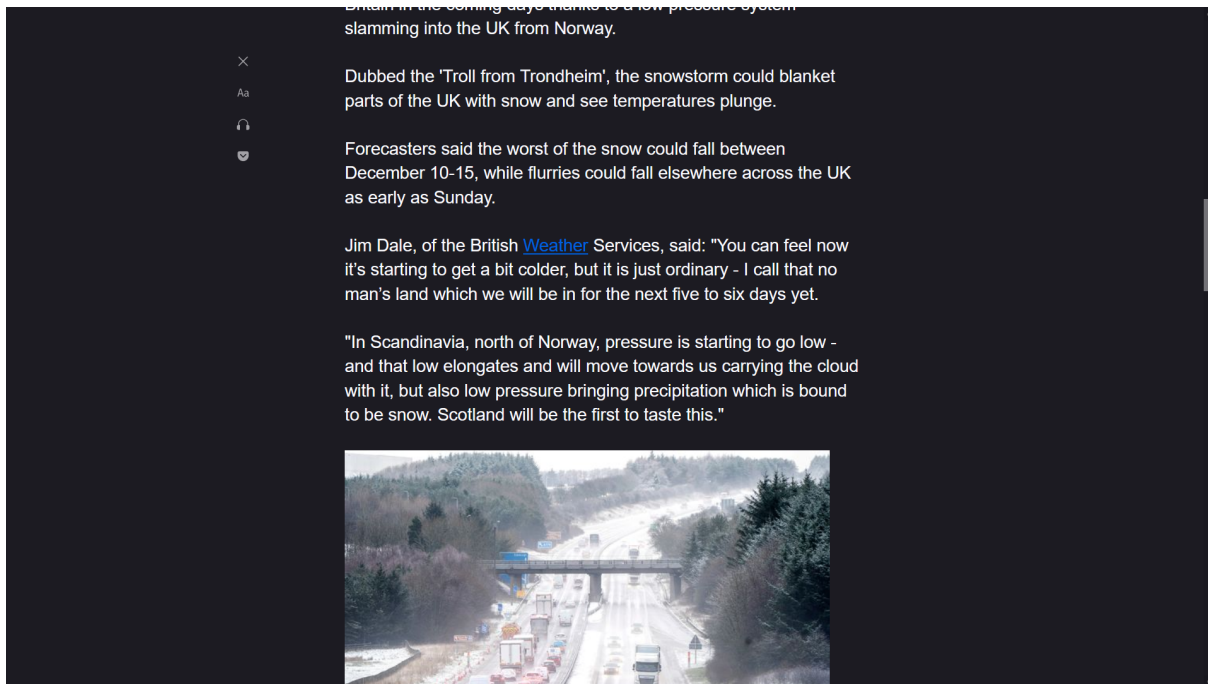


Figure 2.2: Firefox Reader View makes content easier to read.

2.5 Text-Only Browsers Conclusion

Text Browsers are a handy way to access the web with simple interface and they also help to check the web accessibility in the current website. Meanwhile the other text browsers just concentrate on providing lightweight and simple experiments of web browsing, WebbIE is more dedicated to blind users and it is very convenient to use in combination with a screen reader. Text browsers are not really in daily use nowadays and they are not very useful in today's dynamic web content, but still they are quite recently updated and they offer a non-distracting way to read content on the web. And even better, it is not really necessary to install a text browser at all, since Mozilla Firefox browser provides the its own built-in Reader View, which is a very convenient way to simplify the layout of the current website.

```

Welcome to GOV.UK

The best place to find government services and information

Simpler, clearer, faster

Popular on GOV.UK

* Check benefits and financial support you can get
* Limits on energy prices: Energy Price Guarantee
* Find a job
* Coronavirus (COVID-19)
* Universal Credit account: sign in

Search

(BUTTON) Search GOV.UK

Topics

*

Benefits
Includes eligibility, appeals, tax credits and Universal Credit
*

Births, deaths, marriages and care
Parenting, civil partnerships, divorce and Lasting Power of Attorney
*

Business and self-employed
Tools and guidance for businesses
*

```

Figure 2.3: Browsing the gov.uk website

```

#Default home feed Search mirror next                                     The Mirror: The Heart of Britain (p1 of 29)

IFRAME: https://www.googletagmanager.com/ns.html?id=GTM-M3TH25P

(BUTTON)
*
*
*

News (BUTTON)
UK NewsUS NewsWorld NewsWeird NewsReal LifeMore HopefulTeamDogsIn Your Area
PoliticsHealthCrimeRoyalsMoneyTechScience
Sport (BUTTON)
FootballBoxingUFCCricketRugby UnionRugby LeagueFl
RacingGolfTennisAthleticsDartsSnookerUS Sports
Travel (BUTTON)
NewsUK & IrelandEuropeUSA & CanadaCaribbeanAfrica
CruisesCheap FlightsAsia & Middle EastAustralia & New ZealandCentral & South America
Lifestyle (BUTTON)
FamilyFashion & BeautyMotoring
Sex & RelationshipsDietingGaming
Celebs (BUTTON)
TVFilms
US Celebrity News
Partners (BUTTON)
BingoCartoonsCompetitionsCrosswordsDating
Funeral NoticesHoroscopesOffersPartner StoriesNewsletter signup
Voucher codes (BUTTON)
AsosNikeArgosJohn LewisCurrys
BookingSHEINPrettylittlethingGrouponBoohoo
(NORMAL LINK) Use right-arrow or <return> to activate.
Arrow keys: Up and Down to move. Right to follow a link; Left to go back.
H)elp O)ptions P)rint G)o M)ain screen Q)uit /=search [delete]=history list

```

Figure 2.4: Browsing the mirror.co.uk website

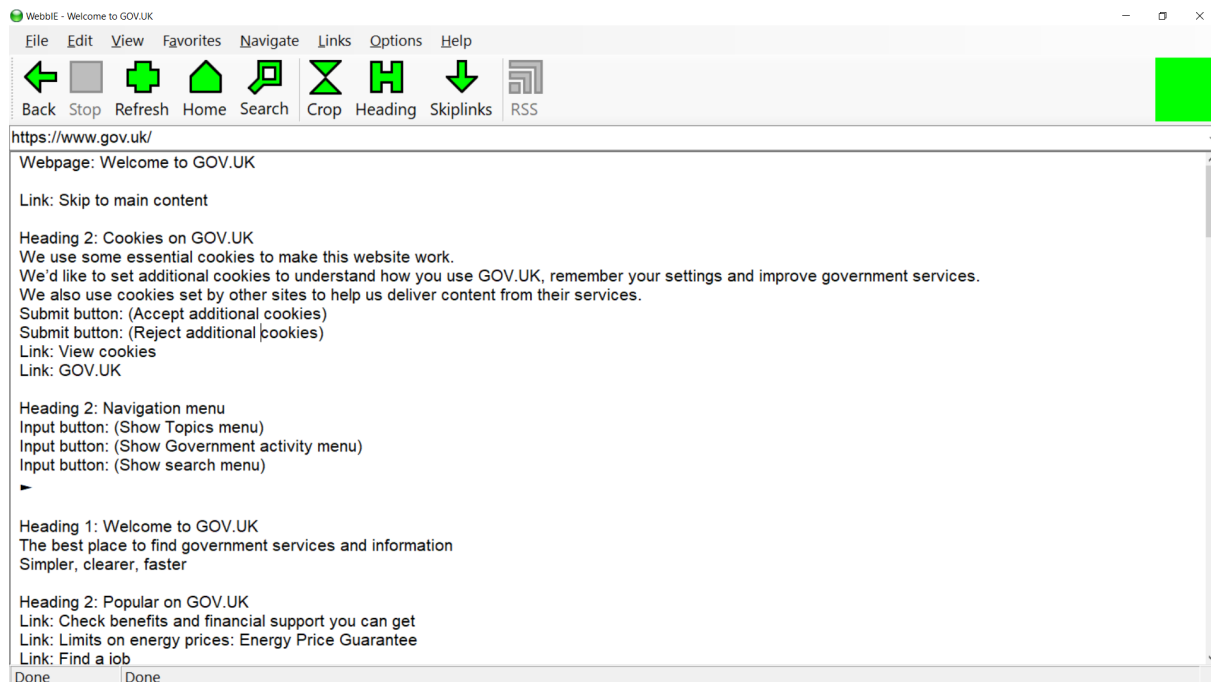


Figure 2.5: Browsing the gov.uk website

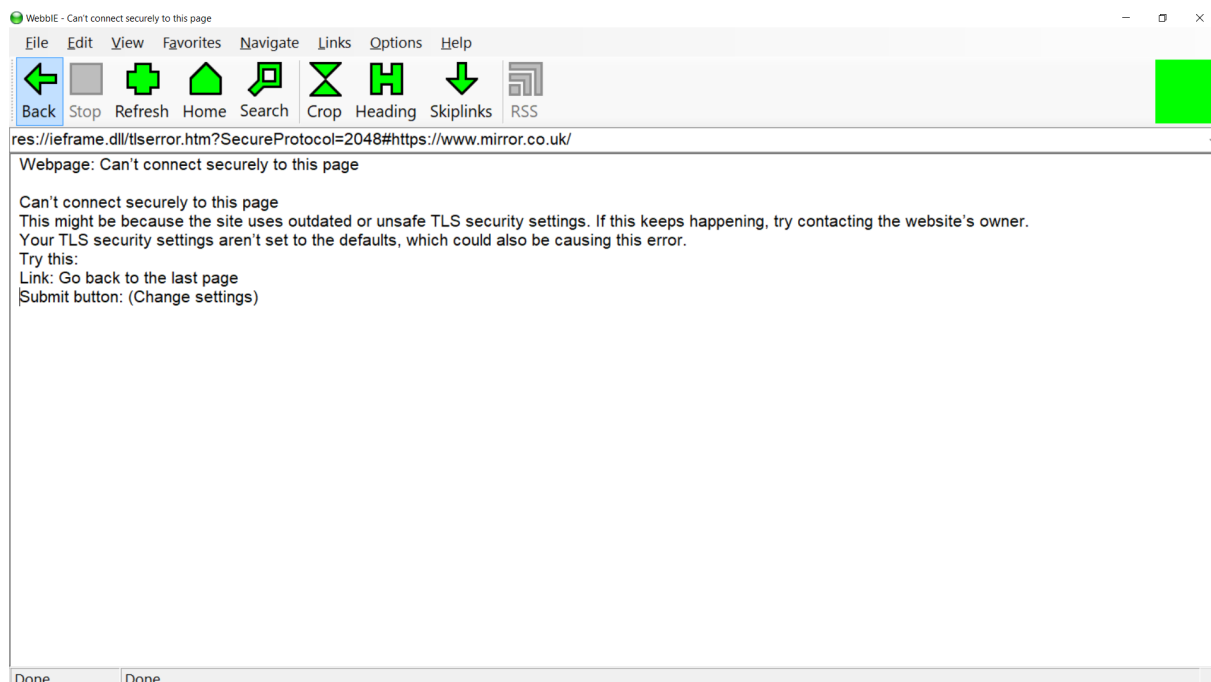


Figure 2.6: Browsing the mirror.co.uk website

Chapter 3

Screen Readers

Screen readers are software applications, primarily used by visually impaired people. Screen readers convert web content (text, buttons, images, and other elements) into speech or braille output. Screen readers attempt to convey what visually non-impaired people see on a display via non-visual means like text-to-speech, sound icons, or a braille device.

In May - June 2021, WebAIM surveyed the preferences of screen reader users. They received 1568 valid responses. Figure 3.1 shows the primary screen readers preferences. The majority of users use JAWS and NVDA screen readers as their primary screen readers. Figure 3.2 shows historical trends for primary screen reader usage. After a decade of decreases in primary usage, JAWS is once again the most used screen reader, with NVDA and VoiceOver both decreasing in primary usage over the last two years.

In this paper, we focus on JAWS, NVDA, VoiceOver, Narrator, and TalkBack screen readers. They are further described in the sections below.

3.1 JAWS

JAWS is the most popular screen reader for Windows computers, however, it has a learning curve. JAWS has a lot of shortcuts and hotkeys that a user has to get used to in order to operate JAWS efficiently. JAWS has the most configurable options among the reviewed screen readers. JAWS is only available as paid software, either as an enterprise or single-use package (90 EUR a year or approximately 900 EUR as a one-time purchase). JAWS demands a lot of the computer's RAM and can occasionally slow the computer down. JAWS supports 10 languages.

3.2 NVDA

NVDA is the second most popular screen reader for Windows computers. NVDA is available as free and open-source software. NVDA is a good free alternative to JAWS, however, it is not as configurable as JAWS. NVDA has a lot of shortcuts and hotkeys that a user has to get used to in order to operate NDVA efficiently. NVDA supports 63 languages.

3.3 VoiceOver

VoiceOver is free and comes included with all Apple products. VoiceOver requires no installation or setup. VoiceOver is user-friendly and configurable. The learning curve takes some effort since VoiceOver is not operated the same way as typical mobile phone users are used to. Voice is operated by multiple special gestures (for example double finger drag, triple finger drag). VoiceOver supports 64 languages.

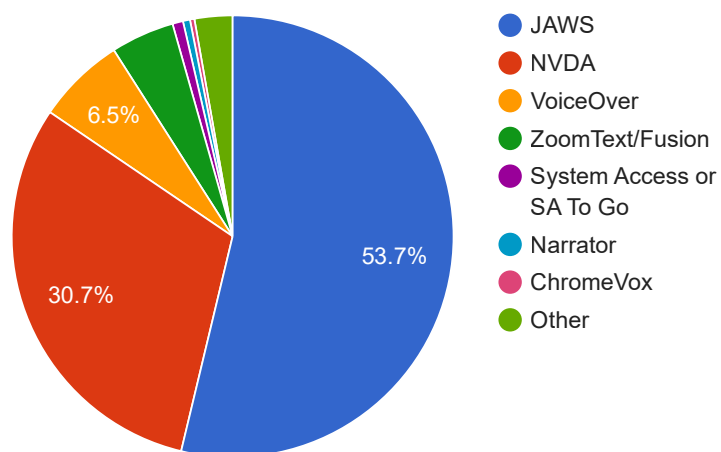


Figure 3.1: Primary screen reader. [Image extracted from WebAIM. ©2022 WebAIM.]

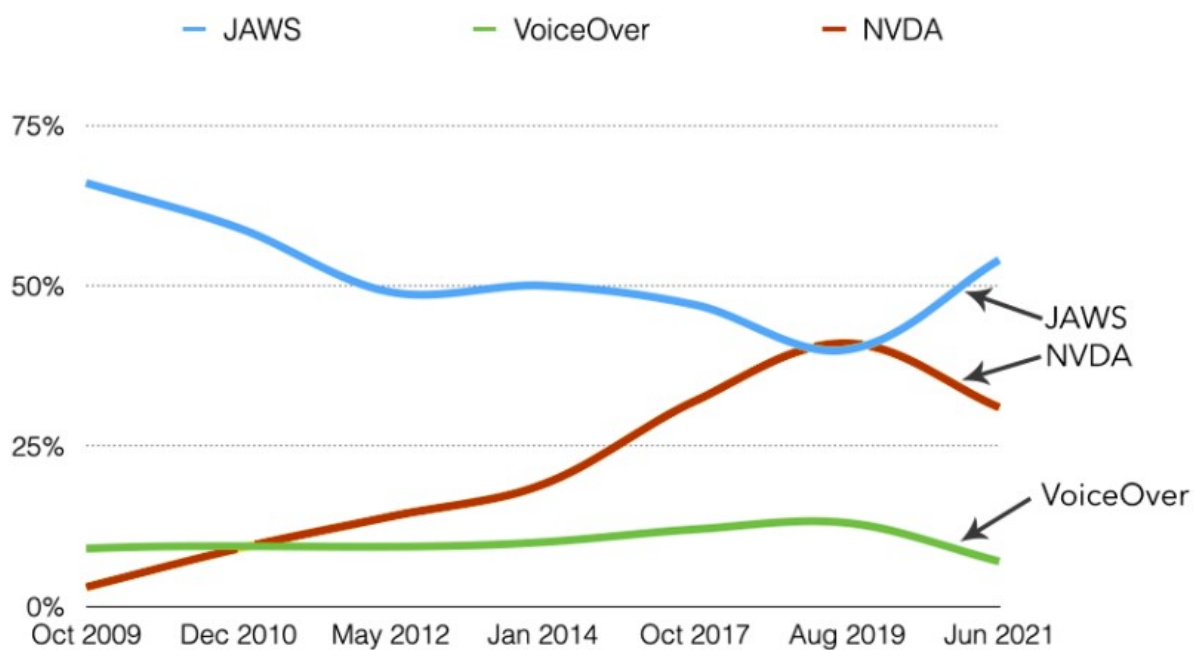


Figure 3.2: Historical trends for the primary screen reader. [Image extracted from WebAIM. ©2022 WebAIM.]

Screen reader	Last update	System	Licence	No. of lang.
JAWS	25. 10. 2022	Windows	Commercial	10
NVDA	1. 3. 2022	Windows	Free and open-source	63
VoiceOver	24. 10. 2022	iOS, macOS	Free	64
Narrator	2020	Windows	Free	49
TalkBack	27. 10. 2022	Android	Free and open-source	63

Table 3.1: Screen readers information

3.4 Narrator

Narrator is free and comes included with the Windows operating system. Narrator requires no installation or setup. Narrator has some shortcuts and hotkeys, but not as many as JAWS and NVDA. Narrator offers limited functionality with web browsers and web apps, especially with navigation and deeper levels of the Windows operating system. Narrator supports 49 languages.

3.5 TalkBack

TalkBack is free and open-source. TalkBack comes included with the Android operating system. TalkBack requires no installation or setup. TalkBack is user-friendly, however, the learning curve takes some effort, since TalkBack is not operated the same way as typical mobile phone users are used to. TalkBack is operated by multiple special gestures (for example swipe left then right). TalkBack supports 63 languages.

3.6 Showcase videos

We recorded showcase videos for each screen reader. We used the screen readers on the UK government site [GOV.UK 2022], which is a good example of web accessibility site, and on the Mirror newspaper site [The Mirror 2022], which is a bad example of web accessibility site. Showcase videos for JAWS ([Golob 2022a], [Golob 2022b]), NVDA ([Golob 2022e], [Golob 2022f]), VoiceOver ([Golob 2022i], [Golob 2022j]), Narrator ([Golob 2022c], [Golob 2022d]), and TalkBack ([Golob 2022g], [Golob 2022h]) are available online.

3.7 Screen Readers Conclusion

A comparison of information can be seen in Table 3.1. All screen readers in question, except Narrator, are maintained regularly. JAWS, NVDA, and Narrator are available on Windows, VoiceOver is available on iOS and macOS, and TalkBack is available on Android. JAWS supports 10 languages while other screen readers support between 49 and 64 languages. JAWS is the only screen reader available as paid software while other screen readers are available as free software (NVDA and TalkBack are also open-source). Windows users have 3 options: JAWS, NVDA, and Narrator. The most popular paid option for Windows is JAWS, and the most popular free option for Windows is NVDA. iOS and macOS users can use VoiceOver, and Android users can use TalkBack.

Chapter 4

Browser Extensions for Accessibility Audits

Using browser extensions is one way to audit the accessibility of websites. This paper evaluates five different extensions for accessibility auditing: axe DevTools, Accessibility Insights for Web, Google Lighthouse, Siteimprove and WAVE. Three of the tools we have selected for this paper use the *axe-core* library [Deque 2022b], which is an open-source accessibility engine for automated web UI testing. As a result, many of the tools will give similar results and the main difference between the extensions is how the list of accessibility issues is presented and what additional features are offered. The library allows accessibility auditing to Web Content Accessibility Guidelines (WCAG) 2.0 and 2.1 on the levels A and AA.

Most of the browser extensions evaluated in this paper are completely free. Only axe DevTools offers a paid version of the extension with additional features.

4.1 axe DevTools

Axe DevTools [Deque 2022a] is a tool for auditing accessibility developed by Deque Systems Inc. The browser extension, as seen in Figure 4.1, is based on the *axe-core* underlying library for auditing the accessibility, but also offers some additional stricter audit rules compared to the base *axe-core* library, allowing validation according to WCAG 2.1 AAA. The extension is available for Chrome and Edge. The Deque website contains a link to the axe DevTools extension for Firefox, but at the time of writing this paper it does not seem to work.

There are three different plans available, Free, Pro and Enterprise. The free version has a limited set of features and mostly consists of only the automated testing of accessibility. The Pro version costs \$40 per month and offers additional features, such as guided manual tests, partial accessibility testing and exporting of accessibility issues. Lastly, the Enterprise version of axe DevTools offers even more features, for example CI/CD integration and custom rules.

The descriptions of the accessibility issues are great, but short. However, links are provided to the Deque accessibility rule documentation for learning more about the accessibility issues and how to fix them. The element highlighting in the extension is excellent and works better than the highlighting in the rest of the extensions evaluated in this survey.

4.2 Accessibility Insights for Web

Accessibility Insights for Web [Microsoft 2022] is a browser extension for accessibility auditing using Chrome or Edge. The extension offers two different audit methods, automated checking, known as FastPass, and manual assessment. The FastPass automated check provides accessibility auditing using the *axe-core* library. The accessibility issues are then visible in a list and can be exported as an HTML report or directly to GitHub Issues or Azure Boards for easy integration in the development process. The

Extension	Browser	Licence	Downloads ¹
axe DevTools	Chrome, Edge	Free, commercial	210000
Accessibility Insights for Web	Chrome, Edge	Free, open-source	120000
Google Lighthouse	Chrome (built-in)	Free, open-source	900000 ²
Siteimprove Accessibility Checker	Chrome, Firefox, Edge, Opera	Free	30000
WAVE Evaluation Tool	Chrome, Firefox, Edge	Free	520000

Table 4.1: Browser extensions information

¹Data collected from Chrome Web Store, Opera Addons, Firefox Add-ons and Microsoft Edge Add-ons.

²Google Lighthouse is built-in into Google Chrome, so the actual number of users may be significantly higher.

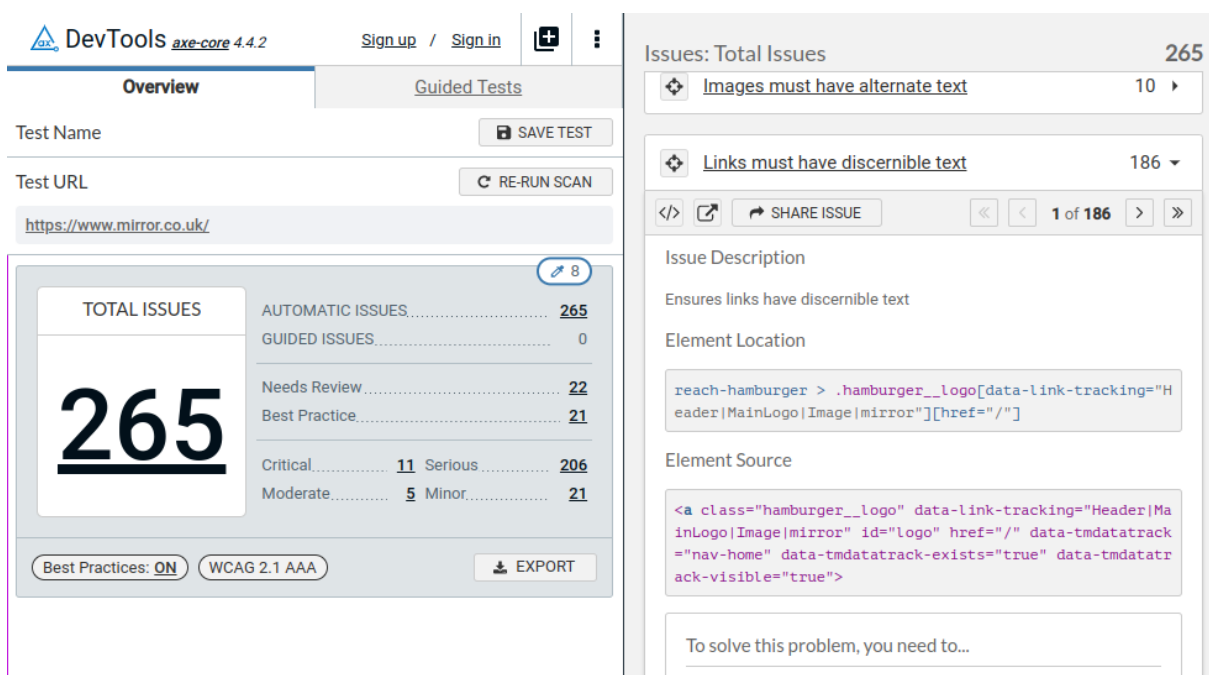


Figure 4.1: The accessibility of The Mirror [The Mirror 2022] audited using axe DevTools.

manual assessment in the browser extension consists of extensive step-by-step instructions for auditing the accessibility manually. Of the browser extensions evaluated in this paper, Accessibility Insights for Web is the only free tool to offer support for manual testing.

Another feature available in the extension is the visualization of accessibility issues directly on the web page, similar to how WAVE evaluation tool works. This allows scrolling the web page to see where accessibility issues occur. The visualization, or highlighting, of the elements on the web page works nicely and the descriptions of the accessibility issues are good too. The extension can be seen in Figure 4.2.

4.3 Google Lighthouse

Google Lighthouse [Google 2022a] is the most popular tool for auditing accessibility, which is included in Google Chrome. Lighthouse, like the previous browser extensions, is also based on the *axe-core* library. For auditing accessibility, Lighthouse offers a relatively basic set of features, and relies heavily on integration with Chrome DevTools and external references for accessibility issue descriptions. Accessibility issues are presented as a list of what accessibility checks have passed and which ones have

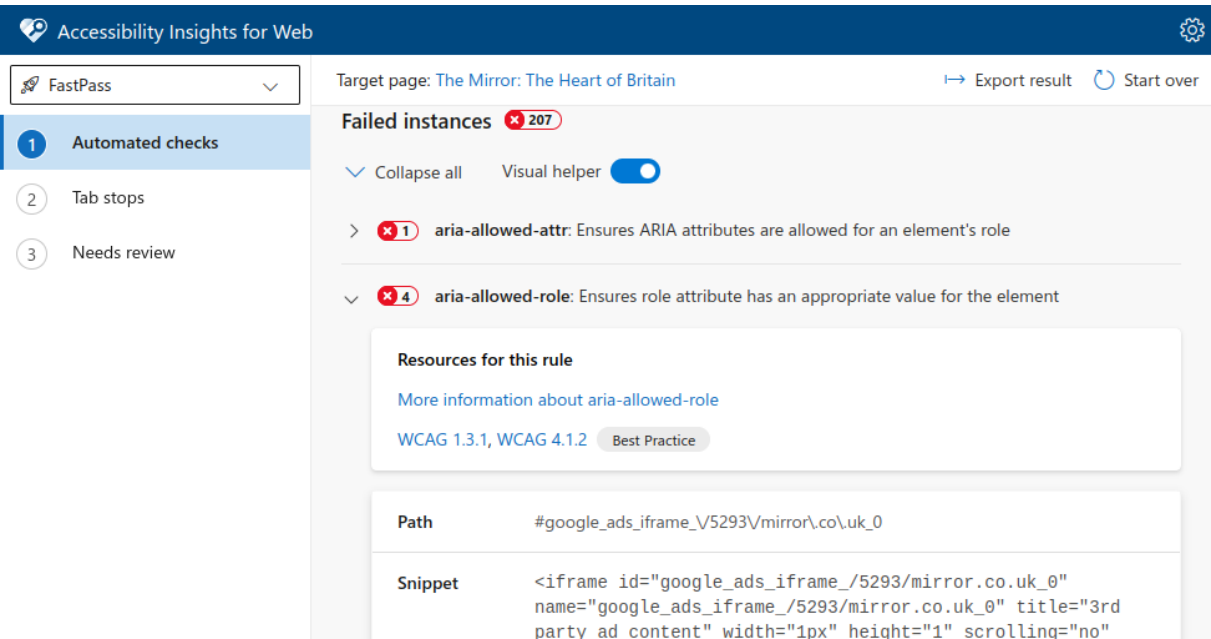


Figure 4.2: The accessibility of The Mirror [The Mirror 2022] audited using Accessibility Insights for Web.

failed.

The descriptions of the issues are decent, and links to the Deque documentation are provided to gain a better understanding of what the issues are and how to fix them. Highlighting of elements with accessibility issues in Lighthouse is not as good as in the other tools. In many cases the either the link to the code for the element, or the scrolling to the element do not work. The accessibility audit report can be exported as JSON. Overall, the extension provides a decent set of features, and is very convenient to use as it is built-in into Chrome. However, many of the other extension provide nicer presentation of the accessibility issues. An example of how the extension looks can be seen in Figure 4.3.

4.4 Siteimprove Accessibility Checker

Siteimprove Accessibility Checker [Siteimprove 2022] is the least used accessibility audit browser extension out of the extensions in this survey. The extension presents the accessibility issues as a list, where you can expand each issue to read the description of it and highlight the element on the web page. Some features that the extension offers, that the other extensions do not offer is simulation of color blindness and excellent filtering of accessibility issues. The list of issues can also be filtered by difficulty, role, WCAG level and HTML element type.

Descriptions of the accessibility issues found by the extension are quite short, but links to additional descriptions are provided. The extension also provides code examples for examples on how to fix the accessibility issues, but the usefulness of these examples is limited as the example code can not always be applied in real world scenarios. Overall, the extension provides a good set of features for auditing the accessibility. However, one feature that is not offered, which is offered by other tools, is the possibility of exporting the audit report. The extension can be seen in Figure 4.4.

4.5 WAVE Evaluation Tool

The WAVE evaluation tool [WebAIM 2022a] is another extension for auditing accessibility, supporting Chrome, Firefox and Edge. The extension functions somewhat differently than the other extensions, as

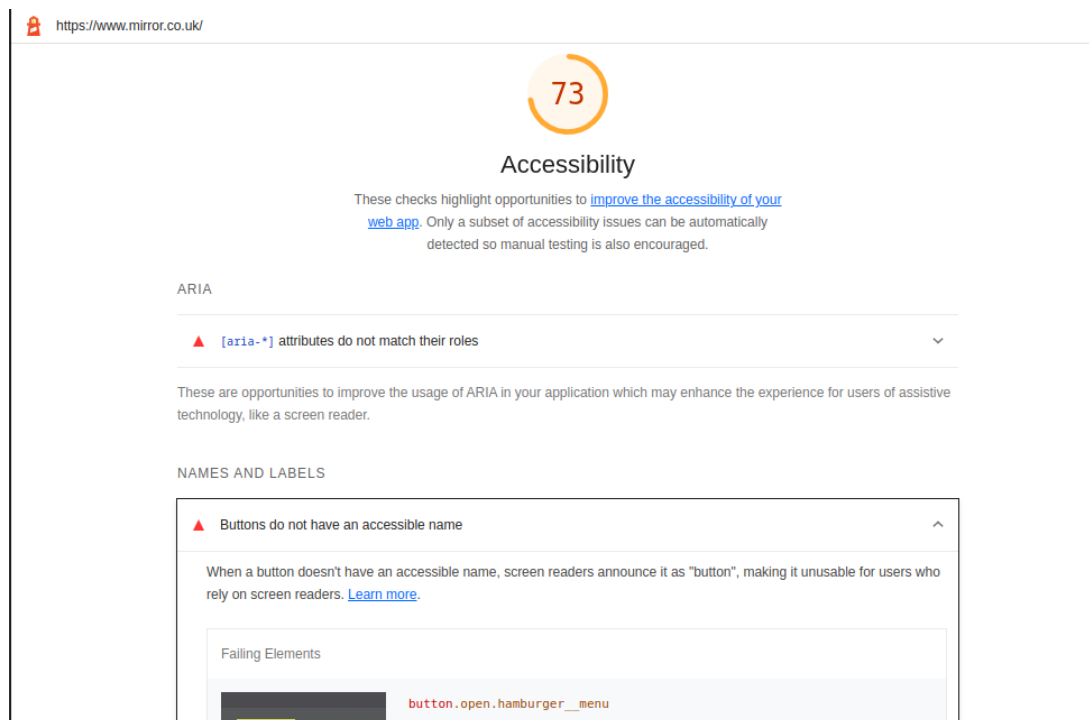


Figure 4.3: The accessibility of The Mirror [The Mirror 2022] audited using Google Lighthouse.

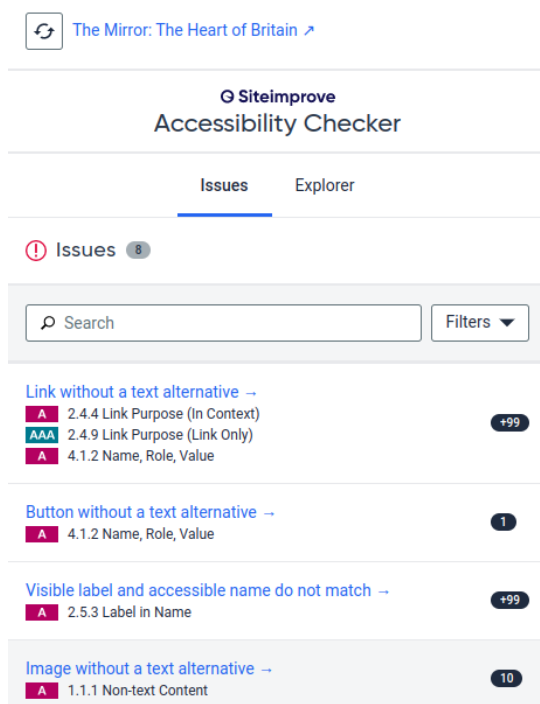


Figure 4.4: The accessibility of The Mirror [The Mirror 2022] audited using Siteimprove Accessibility Checker.

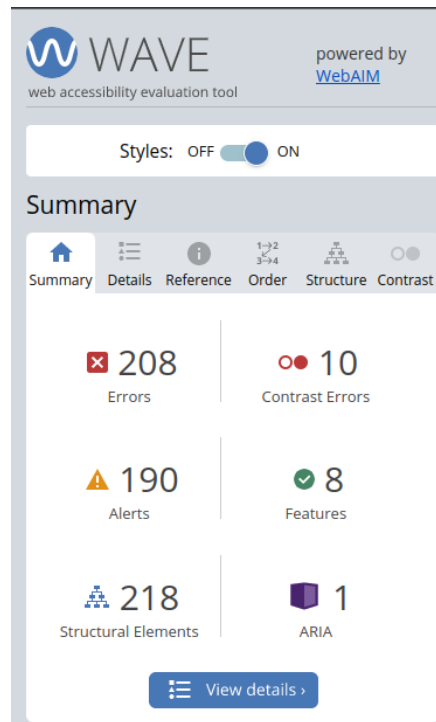


Figure 4.5: The accessibility of The Mirror [The Mirror 2022] audited using WAVE Evaluation Tool.

the tool is embedded directly on the web page. It then inserts icons for elements that fail or succeed in the accessibility checks. The user can then scroll the web page and click the icons to learn more about the accessibility issue. Descriptions of the accessibility issues in the built-in reference are decent and links are provided for further information. As the tool is very interactive, the element highlighting is a fundamental part of the extension, which also works well.

Some special features that WAVE offers are the evaluation of page structure and a tool for contrast checking. The extension does not offer exporting of the audit report, which is acceptable considering that the tool relies on scrolling the web page to find the accessibility issues. Elements with accessibility issues are somewhat difficult to find in the code in the extension, as the extension uses its own code browser, which can not be resized at all. An example of the extension can be seen in Figure 4.5.

4.6 Showcase videos

For each of the browser extension, we have recorded videos to showcase the extension and their features. Using each extension, we performed an accessibility audit of the UK government site [GOV.UK 2022] and The Mirror [The Mirror 2022]. The showcase videos for axe DevTools [Karlsson 2022a], Accessibility Insights for Web [Karlsson 2022b], Google Lighthouse [Karlsson 2022c], Siteimprove Accessibility Checker [Karlsson 2022d], WAVE Evaluation tool are available online [Karlsson 2022e].

4.7 Browser Extensions Conclusion

There are many good browser extensions for auditing accessibility of web pages, and all of the extensions evaluated in this survey would be good options for auditing accessibility. Which extension is the most suitable one depends on what features are needed, what accessibility issues are the most important ones to audit on the web page, what WCAG level is required, and the budget. For overall accessibility auditing with good descriptions and element highlighting that works well, axe DevTools, Accessibility Insights

for Web and Siteimprove are excellent choices. If a WCAG level of AAA is required, the only suitable extensions are axe DevTools and Siteimprove as the rest of the extensions do not audit as strictly.

Chapter 5

Web Tools For Accessibility Audits

Web tools for accessibility audits provide core auditing functionality to anyone interested. The amount of tools in this category is large, and most of these tools come to the same conclusions for an audited web page regardless of the level of detail. This is attributed to several factors, one being that many of these web tools are using the same core library to assess the accessibility of a given website. In the case of this survey, the used library is called axe-core, which is provided by the Deque company.

In this survey, the tools that are inspected closely are but a fraction of the tools that are currently available on the web. The chosen tools were selected in a way, which enables a closer look at tools that run with the axe core library and without. Additionally, the selection also tries to show the different qualities of each choice and what can be expected when someone tries to use these tools online.

In this survey, our selection of web tools for accessibility audits consists of the following: Accessi, WAVE, and Page Speed Insights which is the web tool equivalent to the Lighthouse browser extension. All of the mentioned web tools will be discussed in further detail in the following sections. For each of these three tools, there were also videos created, which demonstrates the features and the functionality of each of the tools. The videos also give a quick overview of the metrics that were used to determine the accessibility of the tested websites.

5.1 Accessi

Accessi [Accessi 2022] is one of the websites that were used to assess the accessibility of the two test pages. Accessi is a website that offers a free accessibility test to its users. It works according to the Web Content Accessibility Guidelines (WCAG) standard. This can be further refined while using the tool by a choice of the 2.0 version of this standard or its 2018 renewed 2.1 version. The website will analyze the target test website and give a basic rating between 0-100% telling the user the state of compliance of the test site. Through an automated test, further metrics are detected, one example being a statistical analysis of the found issues on the web page. Accessi ranks these issues in three categories: High impact, medium impact, and low impact. The high-impact issues are the most obvious and intrusive ones, descending in severity, followed by medium and low. All the issues that are detected by the automated test run will additionally be listed, described, and enhanced with examples. The feature that makes Accessi stand out from its competitors is the ability to export all of the aforementioned findings in PDF or CSV format, giving the user a form of a To-Do list or a fixed statement that they could work on if they would be looking towards improving the accessibility of their web site. An example of the graphical interface of Accessi can be seen in Figure 5.1.

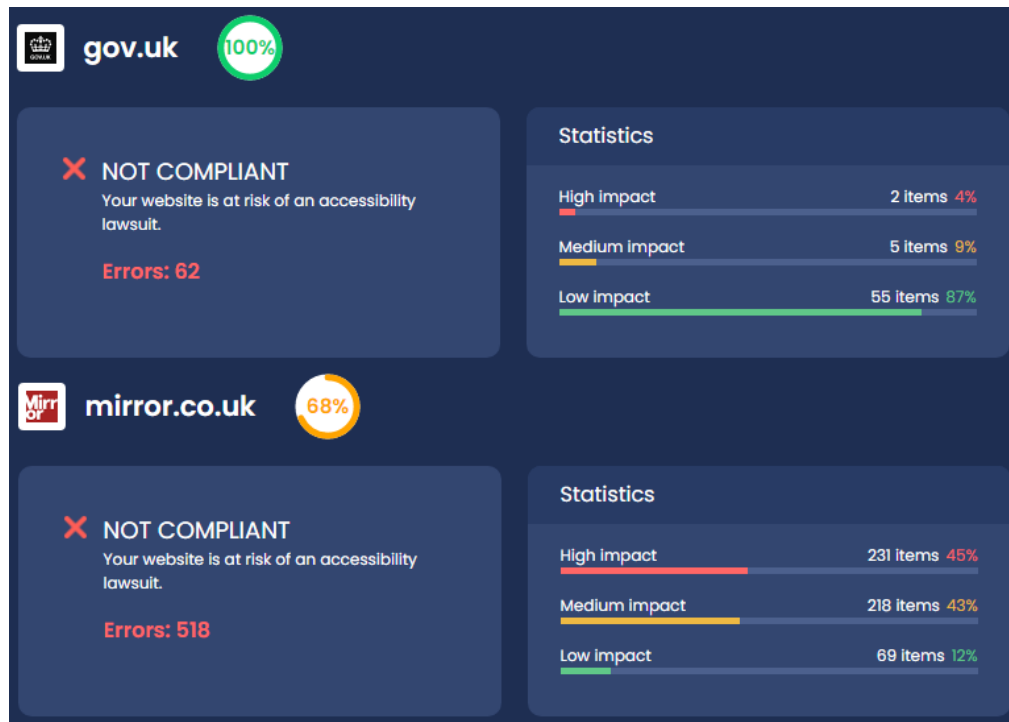


Figure 5.1: Accessi web tool header showing an overview for each test site.

5.2 WAVE

WAVE [WebAIM 2022b] is a tool provided by the company WebAIM. As the tools described in this survey its purpose is to assess the accessibility of a website. WAVE offers a different take on the user interaction with a website which is subject to an accessibility test. The user is offered an interactive web tool, which embeds itself in the test website which is being surveyed. This embedded interface gives the user the ability to interactively inspect all the errors and warnings that are produced for a given website. The user is given the ability to click on icons which are attached to elements of the test site, clearly outlining which element is considered non-compliant with accessibility guidelines. This interactivity is a special feature of the WAVE tool as through the course of research in our survey it is still the only tool providing these options. The interactive nature of the tool really provides the user with an indepth look into each error and where on the website it is located. In addition to this feature, WAVE also gives a summary over all the different kinds of errors or issues find on a given website. This detailed summary is linked to the icons that are embedded in the website that si being surveyed and will outline and focus the element from the list on the website if clicked on.

As can be seen in the Figure 5.2 this web tool does not necessarily work with every website, as due to some scripting errors the tool might fail to integrate itself properly into some websites.

5.3 Page Speed Insights aka. Lighthouse

Page Speed Insights [Google 2022b] is a web tool based on the popular Lighthouse browser extension. Using the axe-core library as mentioned in Chapter 4.1 this tool provides the same functionality as its browser extension counterpart. The tool can evaluate not only in consideration to accessibility but other metrics relevant to website quality. The web tool offers insight into basic performance, best practices, and Search Engine Optimization (SEO), in addition to assessing the accessibility of the tested website. After the accessibility audit is done the user may interact with the tool for further information on the found issues. These issues are represented in a list format, explaining what the current error is, as well as suggestions on how to fix said errors and examples of what they might look like. This list view can be

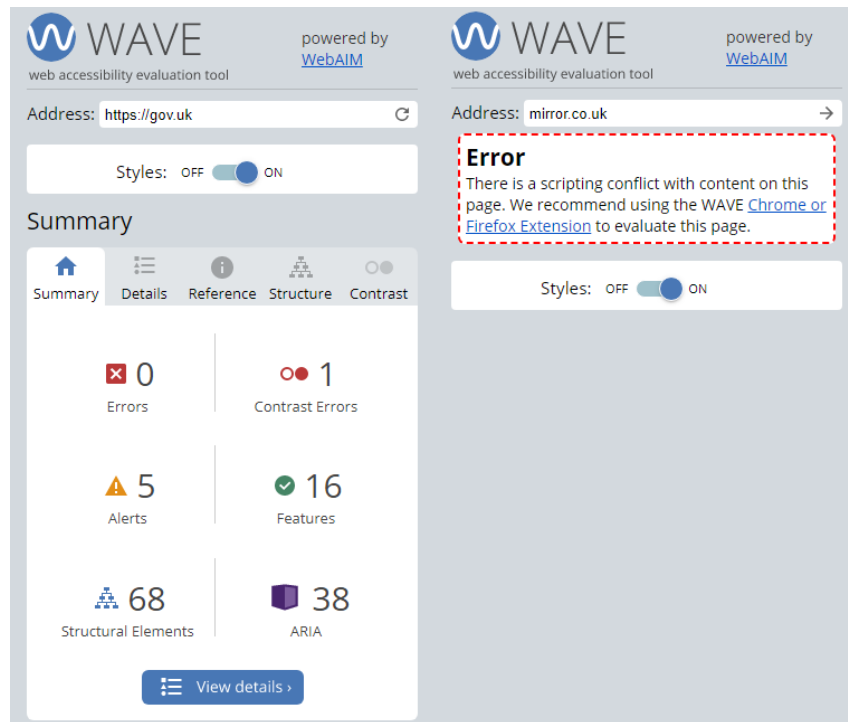


Figure 5.2: WAVE web tool header showing an overview for each test site.

seen in the given example in Figure 5.3. Each of the elements in the list can be clicked on to view a more detailed version of the aforementioned errors and issues.

5.4 Showcase videos

In this survey, two websites were targeted for evaluation by the aforementioned tools. For a good example concerning web accessibility, the <https://www.gov.uk/> website was chosen whereas for the negative example <https://www.mirror.co.uk/> was the choice. The videos that were produced each showcase the interaction between the user, the tools, and the website that is being evaluated respectively. A video of this format was produced for Accessi [Thien 2022a], WAVE [Thien 2022c] and Page Speed Insights (Lighthouse) [Thien 2022b]. All of these videos showcase the features of the tool that is being covered as well as highlight a few extras the tool of each video might have over other tools that might have a different focus. The outcome of all of the videos is yet the same, as they all evaluate the positive example as being very well rated and rating the negative example as being non-compliant with the usual standards of accessibility for websites.

5.5 Web Tools For Accessibility Audits Conclusion

Concluding this chapter of the survey, it is fair to say that the selection of web tools for accessibility audits is plentiful. There are many tools which base themselves on the axe-core library and many others which use their own libraries to assess the accessibility of a website. As there is a standard in place which sets the boundaries for accessibility, usually all the tools come to the same general conclusion for a given website, evaluating a good website as compliant to accessibility and bad ones as being non-compliant. Through the big selection of available tools, it is advisable to choose the one which suits the needs of the auditor the most. An example would be when maintaining a website on their own, the auditor might choose to use either WAVE or Accessi, depending on if they prefer a list type of view or the more interactive way. When looking for a more general overview including other metrics like performance, it is probably safe

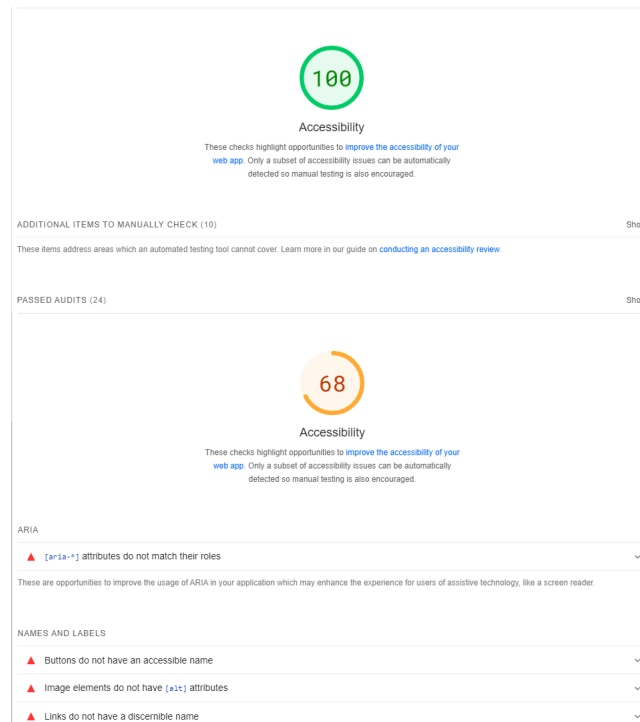


Figure 5.3: Page Speed Insights (Lighthouse) web tool showing an overview for each test site.

to assume that Page Speed Insights will be more useful, as it always includes a performance report as well as many other metrics additionally to the accessibility assessment. The overall recommendation is to first find a tool that is applicable to the situation for each individual auditor. From this decision on the tools commonly provide the same answer to a given test, where they focus on different details depending on which tool was chosen.

Chapter 6

Build Tools for Accessibility Audits

Accessibility can also be audited using tools that are integrated in the build process. Many of the browser extensions and web tools surveyed in this paper also offer versions of the tools that can be used in the build process. One benefit with these tools is that they offer instant feedback during development without even opening the website, reducing the amount of work required for accessibility auditing. However, build tools for accessibility audits were not considered in this survey.

Bibliography

- Accessi [2022]. *Accessi*. 30 Nov 2022. <https://www.accessi.org/> (cited on page 19).
- Deque [2022a]. *axe DevTools | Developer Tools for Accessibility Testing*. 04 Dec 2022. <https://deque.com/axe/devtools/> (cited on page 13).
- Deque [2022b]. *Projects that use axe-core*. 04 Dec 2022. <https://github.com/dequelabs/axe-core/blob/9e1e31b253398cc2a3e840c7cb9c5527f4e4ba66/doc/projects.md> (cited on page 13).
- Golob, Ožbej [2022a]. *Using JAWS on gov.uk site*. 30 Nov 2022. https://youtu.be/aX_vK0JpYZE (cited on page 11).
- Golob, Ožbej [2022b]. *Using JAWS on mirror.co.uk site*. 30 Nov 2022. https://youtu.be/4zxA2TmmN_A (cited on page 11).
- Golob, Ožbej [2022c]. *Using Narrator on gov.uk site*. 30 Nov 2022. https://youtu.be/ZVT012_vw1s (cited on page 11).
- Golob, Ožbej [2022d]. *Using Narrator on mirror.co.uk site*. 30 Nov 2022. <https://youtu.be/LktZKcB7xNo> (cited on page 11).
- Golob, Ožbej [2022e]. *Using NVDA on gov.uk site*. 30 Nov 2022. <https://youtu.be/oTBNTaBVXM0> (cited on page 11).
- Golob, Ožbej [2022f]. *Using NVDA on mirror.co.uk site*. 30 Nov 2022. <https://youtu.be/SY2njevCTuI> (cited on page 11).
- Golob, Ožbej [2022g]. *Using TalkBack on gov.uk site*. 30 Nov 2022. https://youtu.be/Hx_pI2bz930 (cited on page 11).
- Golob, Ožbej [2022h]. *Using TalkBack on mirror.co.uk site*. 30 Nov 2022. <https://youtu.be/EyYMB9Kn8Xw> (cited on page 11).
- Golob, Ožbej [2022i]. *Using VoiceOver on gov.uk site*. 30 Nov 2022. <https://youtu.be/UBPnCozggK4> (cited on page 11).
- Golob, Ožbej [2022j]. *Using VoiceOver on mirror.co.uk site*. 30 Nov 2022. https://youtu.be/_4sDqR2oT0c (cited on page 11).
- Google [2022a]. *Overview - Chrome Developers*. 04 Dec 2022. <https://developer.chrome.com/docs/ligthouse/overview/> (cited on page 14).
- Google [2022b]. *Page Speed Insights*. 30 Nov 2022. <https://pagespeed.web.dev/> (cited on page 20).
- GOV.UK [2022]. *Welcome to GOV.UK*. 30 Nov 2022. <https://gov.uk/> (cited on pages 11, 17).
- Karlsson, Robin [2022a]. *Using axe web browser extension for accessibility audit*. 03 Dec 2022. <https://youtu.be/hMzs7v-xsDA> (cited on page 17).
- Karlsson, Robin [2022b]. *Using Insights web browser extension for accessibility audit*. 03 Dec 2022. <https://youtu.be/4kIIb09bnhA> (cited on page 17).

- Karlsson, Robin [2022c]. *Using Lighthouse web browser extension for accessibility audit*. 03 Dec 2022. https://youtu.be/ZuJOI8LN_6s (cited on page 17).
- Karlsson, Robin [2022d]. *Using SiteImprove web browser extension for accessibility audit*. 03 Dec 2022. <https://youtu.be/tGB5CJ3qU4U> (cited on page 17).
- Karlsson, Robin [2022e]. *Using WAVE web browser extension for accessibility audit*. 03 Dec 2022. <https://youtu.be/vhMk3B3gPFE> (cited on page 17).
- King, Alasdair [2001]. *Webbie*. 2001. <https://webbie.org.uk/index.htm> (cited on page 4).
- King, Alasdair [2008]. *Blind People and World Wide Web*. Jun 2008. <https://webbie.org.uk/webbie.htm> (cited on page 3).
- Links [2002]. *Links*. 2002. <http://links.twibright.com/about.php> (cited on page 4).
- Lynx [2018]. *Lynx*. 08 Jul 2018. https://lynx.invisible-island.net/release/lynx_help/Lynx_users_guide.html (cited on page 4).
- Memon, Zeeman [2019]. *Best Linux Text-Based Browsers*. 2019. https://linuxhint.com/best_linux_text_based_browsers/ (cited on page 3).
- Microsoft [2022]. *Accessibility Insights for Web*. 04 Dec 2022. <https://accessibilityinsights.io/docs/web/overview/> (cited on page 13).
- Riikola, Olli-Pekka [2022]. *Showcase video - the Lynx browser*. 20 Nov 2022. <https://youtu.be/fSYBxFXR4Q0> (cited on page 5).
- Siteimprove [2022]. *Siteimprove Accessibility Checker*. 04 Dec 2022. <https://help.siteimprove.com/support/solutions/articles/80000448491-siteimprove-accessibility-checker-browser-extension> (cited on page 15).
- The Mirror [2022]. *The Mirror: The Heart of Britain*. 30 Nov 2022. <https://mirror.co.uk/> (cited on pages 11, 14–17).
- Thien, Alexander [2022a]. *Using Accessi for web accessibility*. 30 Nov 2022. <https://youtu.be/FqZQIkF1gYM> (cited on page 21).
- Thien, Alexander [2022b]. *Using Page Speed Insights (Lighthouse) for web accessibility*. 30 Nov 2022. <https://youtu.be/oTBNtaBVXM0> (cited on page 21).
- Thien, Alexander [2022c]. *Using WAVE for web accessibility*. 30 Nov 2022. <https://youtu.be/-URDq3PK8zs> (cited on page 21).
- W3M [2022]. *W3M*. <https://w3m.sourceforge.net/> (cited on page 4).
- WebAIM [2022a]. *WAVE Chrome, Firefox and Edge Extensions*. 04 Dec 2022. <https://wave.webaim.org/extension/> (cited on page 15).
- WebAIM [2022b]. *WAVE Web Accessibility Evaluation Tool*. 30 Nov 2022. <https://wave.webaim.org/> (cited on page 20).