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Ways to improve user experience of visual impaired groups by accessible design in website-an example study on three educational websites

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Abstract. With the popularization of the concept of equality, people begin to think more about how to let the disabled keep pace with normal people. For example, they should have the same right and access to the same public resources. The Internet, as a useful tool, helping people get rich information, and becomes more and more widely applied. Therefore, the screen reader is designed to help the special groups to receive information on the websites. However, there are still lots of websites that the disabled can't get access to, feeling pain with it, mainly because the website designers do not take accessibility into account while building. In this study, by finding the habit which visually impaired people like to surf the internet, what the massive websites' layouts are like, where the parts are that lead to the confusion the visually impaired people have, then building up an example website, which is for visually impaired students to upload their assignments, to show what an accessible website should be like, finally determining the importance of accessibility for a good website design.

Keywords: Website, Design, Accessibility, Visual-Impaired, Education.

1. Introduction

1.1. Background

Due to the development of peaceful life, equal rights are getting more and more attention. For people with visual impairment, a new technology called a screen reader has come out. This technology can be downloaded inside the computers, read out the words displayed on the computer screen to the users in a specific order, and mainly focus on the layout. For the photos which lay on the pages, it required the website designers to do some specific introductory coding, so that the screen reader can introduce the content of the photo to the users, although just reading out the introduction letter. Not only that, but more and more methods and technologies have been developed to help these special people have a better experience when using the website [1]. People with visual impairments can also browse the website. People with visual impairment who have access to the Internet has increased a lot [2]. With the development, more functions of the website are designed. Some of them can be used for online shopping,

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some for important document storage, and some can even help an organization to be more efficient. It's easy to see that a good website is indispensable to a person's daily life. During COVID 19, the use of websites became more noticeable, and people increasingly relied on websites and the Internet to help them with their daily affairs. Since education is fast developing, the visually impaired people also get access to learn about how to do some coding through the Internet [3]. It is also connected with their future; thus, an accessible educational website is necessary. Recently, it has been found that the feedback of visually impaired users to some websites is disturbing [4], and a solution must be worked out to solve this problem.

1.2. Research

It is a concept first put forward by the World Wide Web Accessibility Consortium (W 3C) in 1997. Its purpose is to give all disabled people the same opportunity to use the website as normal people. In 2000, more rules were formulated over time to strengthen this idea. Through the process of development, a kind of tool within the website called navigation was made, helping the disabled to be more efficient while interacting with websites [3]. However, according to recent research on websites, most websites still fail to pass the evaluations [5]. Moreover, some websites do not take the pain points of the visually impaired into consideration, which makes those disabled people feel really frustrated [6,7]. This is mainly because designers pay more attention to the beauty of the web page, and some of them don't even know about the accessibility of web pages.

1.3. Overview

Through the researches of visually impaired people, lots of potential problems of websites are appeared, this paper analyses three major websites, explores their advantages and disadvantages, aiming at guiding the future website design to a better direction. The rest of this article will be as follows: In the second part, we will do some research into the shortcomings of some existing websites, especially focusing on how these shortcomings affect people with visual impairment. According to these points, the methods to solve these problems will be proposed. In the third section, three example websites would be used to find out the paint points while the special groups are using websites, user flow chart would be sketched to illustrate the ideas better. In section IV, the shortage of this study will be presented and the future concern will also be shown.

2. Method

In order to understand why current websites frustrate the special groups, a survey of the preference of the visually impaired people using internet and their suggestions for websites was built. Twenty patients were recruited to accomplish this research, mainly by doing the questionnaires to find out the answers.

The questions are as the follow:

- The number of times you use websites during a week.
- Have you been accustomed with screen reader?
- Will you always be frustrated while using?
- Had you met any problems while using?
- What’s your perspective of future websites?

These questions are designed to also help build the example website in the third section.

From their responds, the answer can be easy found that the number of *times* which visually impaired people surfing the internet is not less than normal people, it’s obviously that they have the same interest in dealing with websites, they also have to use it in their real life. Among the people who use internet, they can use screen reader in a moderate way. However, when turn to the third questions, the answers are seemed to be a tough one, most of them chose the second level frustrated. When looking at the fourth question’s answers, lots of drawbacks of websites are appeared. Some of them complained about the wordy homepages and navigation, which make them difficult to find out the link which they need to go with. Some complain about the complicated layout of the websites, which made them hard to remember the position of the button which they want to click, sometimes even clicked the wrong place, which led

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to a very terrible mood. And there is also some patients complained about some inferior websites, they even don't have accessibility, letting them disable to gain the information. For their perspectives, they mainly wanted websites makers to have a greater percentage of considering accessibility while designing, a navigation and search box will definitely be the helpful tools to help them.

3. Results

Research on accessing navigation and the contents of several educational websites that are focused on coding using screen reader has shown both advantages and disadvantages. Researchers compared 3 different websites that are used by coding learners in a different study environment.

In general, all three sample websites have a top navigation bar with some general links to outer web pages, a bar for user notifications and login information. In addition, a sidebar is used for accessing different categories of the contents. But researchers found that some of these sidebars are too long for a user using screen reader to read. Web developers separated the menu items and sub menu items using different styles by CSS stylesheets or designed it as fold/unfold categories. But the research with tab key and screen reader showed that although users can read through the navigation content clearly, they suffered from wasting a huge amount of time and with effort to memorize all the menu contents. In some of the conditions, researchers accidentally miss some of the contents, and they need to redo the whole navigation process. In another research on the sample website that is a university website [8] structured on www.moodle.org. Web developers of this website used fold/unfold links to separate menu classes. It is visually well-classified and visual users can access sub menus by unfolding first-class menu items. But a serious problem appeared for visual impaired users that using tab key with screen readers and clicking on the first-class menu items result in an action of folding/unfolding the sub menu. But there is not a way to have keyboard controls focus on the sub menu items. It is a missing part for visual impaired users and clicking with no response in screen readers will be confusing.

Table 1. Navigation time by using screen reader of 3 sample websites.

Website	**Time to read through navigation using Microsoft screen reader in speed of 13**	**If sub menu can be reached**
UIC Information Space https://ispace.uic.edu.hk/my/	*52 seconds*	no
The ED Site https://edstem.org/us/courses/23336/discussion/	*30 seconds*	no
W3 School https://www.w3schools.com/	*3minutes 13seconds*	yes

Since different sample websites have some differences between the user groups in coding education they are facing, researchers have research on them separately.

3.1. Website for universities

The first website UIC Information Space[7] which is a website for undergraduate students in university. Its main usage is for students to upload assignments and download course materials such as course slides or records. Researchers have research on the user journey of visually impaired groups with screen readers on assignment submission and materials download. The research shows that the side navigation

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bar is disabled from the screen reader users and the navigation for course stage is extremely difficult for them.

3.1.1. Advantages Instruction on top navigation is clear enough, it's easy to access the login form and can easily find login entry and login.

Users can directly find materials and the submission entry in course page.

3.1.2. Disadvantages. When click on the login button in the top navigation bar, it will take users to another login page, this may be confusing with two different login pages with duplicated functions.

User can only access course page by the recent accessed course bar in the dashboard page but cannot get to the side navigation bar's sub menu, using recent accessed course to navigate for courses is extremely difficult by screen reader because each page shows two courses in the bar and the switch page button is before the course selection which means you need to renavigate the whole page to get back to the place and change to another page of courses.

Course page is too free for customize, this may cause different teachers place materials in different methods and styles, some teachers add too much duplicated links within the text, which causes students confusing especially screen reader users.

steps	open site	login page navigation	login	navigate for course	course page	submission page
Emotion Experience	5	6	7	2	3	4
Describtion	neutral emotion start point	when click on the login button in the top navigation bar, it will take users to another login page, but the instruction is clear enough	it's easy to access the login form and can easily find login entry and login	user can only access course page by the recent accessed course in the dashborad page but cannot get to the side navigation bar's sub menu, using recent accessed course to navigate for courses is extremely difficult by screen reader because each page shows two courses and the swith page button is before the course selection which means you need to renavigate the whole page to get back to the place and change to another page of courses	users can directly find materials and submisston entry, but it is too free for costumize, this may cause differents teachers place materials in different methods	submission instructions are clear, easily access
User pain points		two different pages to login may be confused	the skipping content button may be confusing	navigation is not accessible	some teachers add too much duplicated links within the text, it may be confused	same as the previous costumize issue

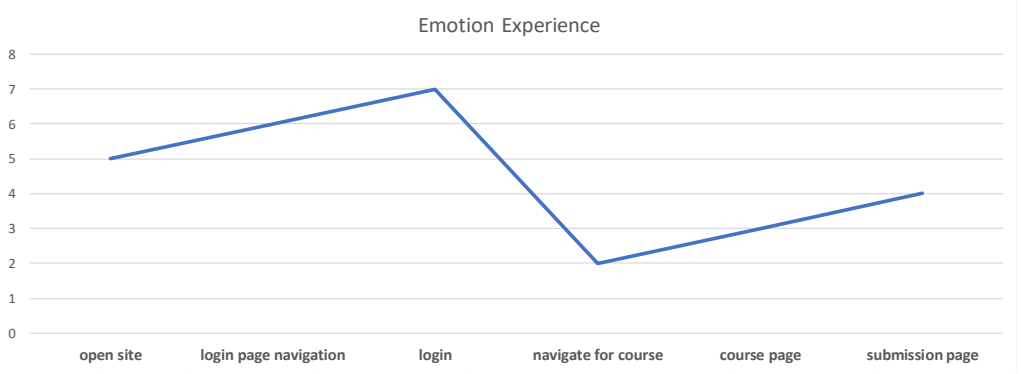

Figure 1. User experience of the UIC Information Space.

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3.2. Website for online courses off campus

The second website the ED site [9] which is a website for online teaching by an online education organization. Its main usage is for students to have questions discussion online, assignment submission and access to course records. Researchers try to have research on the user journey of visually impaired groups with screen readers on assignment submission, question posting and view course records but failed. Because the site blocked users with screen readers from accessing the main content by missing the highlight of selecting thread but instead focusing on some confusing elements. It is a serious problem for visual impaired groups if they are attending courses based on this site.

3.2.1. Advantages. The home page, login page and course selection page are compact and can easily find the link to login at the top navigation and it's easy to access the login form which can easily find login entry and login. In course selection page users can easily find course link with screen readers.

Users can directly find materials and the submission entry in course page.

3.2.2. Disadvantages. Users can access part of the sub menu but the highlight skipped the selection of threads so there's not a way to access the main content, but the highlight will focus on the split line which is confusing. This means that there is no access to the main content by screen readers, so it is not an accessible website.

Some of the links are missing description when using screen readers to focus on it.

steps	open site	home page	login	navigate for course	course page
Emotion Experience	5	6	7	8	1
Describtion	neutral emotion start point	the home page is compact and can easily find the link to login at the top navigation	the login page is compact and it's easy to access the login form and can easily find login entry and login	the course selection page is compact and can easily find course link	users can access part of the sub menu but the highlight skipped the selection of threads so there's not a way to access the main content, but the highlight will focus on the split line which is confusing
User pain points					no access to main content by screen readers

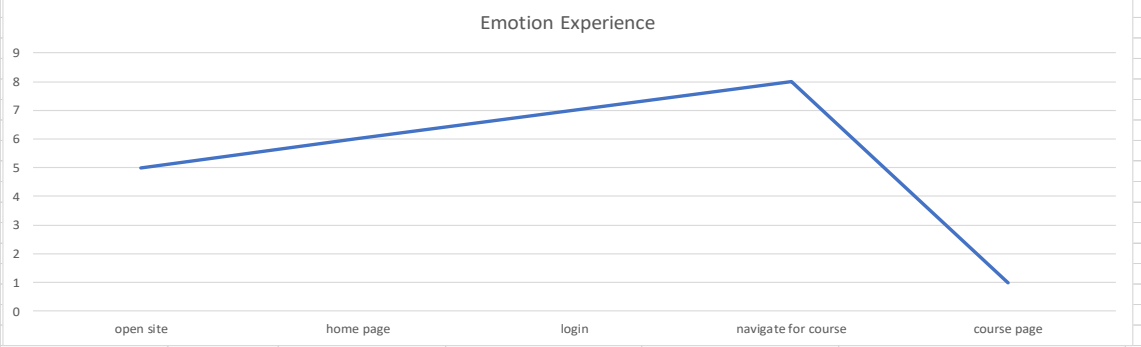

Figure 2. User experience of the Ed Site.

3.3. Website for self-learners

The third site is a site for coding self-learning or a reference for coding courses called W3 School [10] which is famous among coding learners. Its advantage is that it has a detailed navigation and it is accessible. But when showing all the contents in a same navigation seem to be too long for screen reader users to navigate.

3.3.1. Advantages. The home page is compact in main content. The color contrast is suitable and it is comfortable for readers to read through. The structure is also clear for visual users as they highlighted the different categories by a striking color.

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3.3.2. Disadvantages. The content and the top navigation in home page is duplicated with similar links, the top navigation is too long for screen reader users to read through, because it mixed up the top menu and the sub menus. In the main content page web developers added a side navigation for more detailed categories, but this makes screen reader users spend even more time to navigate. This causes users with screen readers find it hard to remember all the navigation items and it is confusing. A waste of time, not efficient.

steps	open site	home page	main content
Emotion Experience	5	5	4
Describtion	neutral emotion start point	the home page is compact in main content but the content and the top navigation is duplicated with similar links, the top navigation is too long for screen reader users to read through, because it mixed up the top menu and the sub menus	except for the top navigation, web developers added a side navigation for more detailed catogories, but this makes screen reader users spend even more time to navigate.
User pain points		too long to read, hard to remember contents, duplicated links may be confusing	too long to read, hard to remember contents

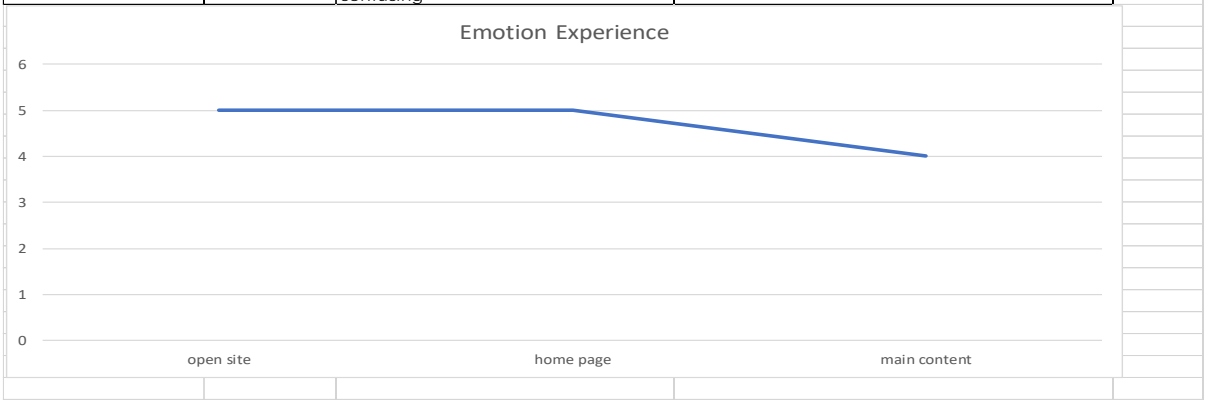

Figure 3. User experience of the W3 School.

4. Conclusion

Through the research of using screen reader to navigate and use three sample websites for coding education in different use scenarios, researchers found that the general problems that three websites have in accessibility is the navigation system. They all seemed well organized visually and can be accessed by mouse clicking easily by visual users. But the code structure behind the designed user interface can hardly read by screen readers, which causes accessibility problems with visual impaired groups who needs to use screen readers to access the website.

Research found that some voices argued that there is specific education website in specific education system for visual impaired groups who needs screen readers to go online. But the aim of this article is to reduce the difference between the visual healthy people and visual impaired groups. Websites that are designed in an assessable way can enable visual impaired groups navigate the website just like a healthy people.

In order to achieve this goal, researchers agreed on some suggestions that web developers can follow to create websites that are more accessible and promote the user experience of visual impaired groups who uses screen readers.

- All content should have a way to access by screen reader users, all links should have a way to focus by keyboards and all links should have a description. Avoid focusing on meaningless contents.
- Avoid duplicated contents (especially links), which will confuse screen reader users.
- Avoid putting all content in a single navigation bar in a single page, which is too long to read by screen readers. If the content is long, separate it with menus and sub menus. While doing

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this, ensure all menus and sub menus are accessible and with proper hierarchical relationship (for example, navigate through all top menus first then when users click on it then shows only the sub menus under this category, instead of mixing it up) that enable screen reader users to navigate to their target page easily. It is necessary to create a subpage for navigation if the content is extremely long.

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