

Enhancing the Computer Science Curriculum with Web Accessibility in Web Development

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Abstract

Web accessibility is a growing need as the internet becomes more ingrained within society. The University of Virginia's (UVA) electives have provided a good foundation for basic web development through its core computer science curriculum and electives available to students. However, the issue of web accessibility is a peripheral topic in such courses. Concepts presented in the classes CS3205 Human Computer Interaction (HCI) in Software Development and CS4640 Programming Languages for Web Applications like usability and the fundamentals of HyperText Markup Language (HTML) are evaluated in how they prepare students with an understanding and awareness of web accessibility. These concepts are expanded upon to build a stronger foundational understanding about web accessibility. Novel concepts that strengthen understanding about web accessibility, like how screen readers work, are discussed in how they may enhance the existing curriculum. The intended impacts and benefits of a strengthened understanding about web accessibility in the academic setting are discussed.

1 Introduction

"How *do* blind people use the internet?"

When I told people the topic of my capstone project, namely that I was looking at web accessibility on the internet, most people's first response was confusion. These people are not strangers to the internet. They are fellow computer science undergraduates. Unless they have a disability or are close to someone with a disability, most people are not consciously aware about how disabilities impact how individuals use and interact with the internet. This

ignorance is not on purpose; it is something that people are blind to because it is something that they never had to think about. I fell into the same mentality of overlooking web accessibility before undertaking this capstone project.

The lack of awareness by web developers leads to tangible consequences. In a study performed by Erikson et al. [2013] examining the accessibility of community college websites, a majority of the websites used in the study posed barriers to use for the participants, a majority of whom had some sort of disability. This is not exclusive to community college websites either. In fact, the lack of accessibility is a problem in a majority of websites. This is also a problem that has not improved with time. A study commissioned by the United Nations (UN) in 2006 found that only 3% of the websites evaluated followed the Web Content Accessibility Guidelines (WCAG) [3]. An annual analysis of the top million homepages by WebAIM [2021] found that over 97% of web-sites had WCAG violations.

This is a failure on the part of computer scientists who, as professionals, have an ethical responsibility to create accessible products. It is failing people with disabilities who, as the internet becomes more and more integrated with society, will be barred from critical and non-critical online services. This problem will not improve unless something is done about it.

2 Related Works

The examination of the million most popular websites by WebAIM [2021] was eye-opening. While the raw percentage of websites with WCAG failures decreased from the year prior, the number is still significant with 97.4% of websites having some

detected failure. The report details the finding that 96.7% of all errors fell into one of six categories: low contrast text, missing alternative text for images, missing form input labels, empty links, missing document language, and empty buttons [5]. Fixing these six things—some of which do not have complicated remedies—would make the web significantly more accessible [5].

Another motivator for this project was a literature in which Ellcessor [2014] examined 40 works published on the topic of web accessibility. Ellcessor identified myths about web accessibility: accessible websites have compromised aesthetics, fixes are costly or difficult to implement, and it serves an insignificant number of people [1]. Ellcessor argued that these myths have shaped opinions about web accessibility as additional and something that can be tacked onto regular web development [1]. Another consequence of these myths is that accessibility is “a skill that is often acquired as-needed by web designers and developers” [1]. As a result, there is a lack of formal training which is something this project seeks to remedy by dispelling myths and making future web developers familiar with accessible design early in their education.

The WCAG, developed by the World Wide Web Consortium (W3C), are the most widely consulted and most detailed guidelines about web accessibility. They seek to outline best practices in web development and how to implement accessibility with the overall goal of making the web more accessible to all people [6]. These guidelines are developed through the collaboration of organizations and individuals globally [6]. Due to its international origins, these guidelines also minimize cultural bias and promote more universally accessible design [6]. The WCAG tends to be the guidelines against which accessibility of a website is judged. It is also a good resource to be aware of for guidance when implementing accessible design.

3 Project Design

The core curriculum for a student pursuing a Bachelor of Science in computer science at UVA does not include a design class. The only class with any focus on user interface (UI) design is CS3240 Advanced Software Development Techniques which is a realistic look at software development. However, the topics important to software development, like UI design or cybersecurity, were given a high-level overview of the basics. Electives, not including special

topics classes, offered during my time at UVA, from fall 2019 to spring 2022, that mentioned accessible design were CS3205 HCI in Software Development and CS4640 Programming Languages for Web Applications.

3.1 Content from CS3205

HCI is exactly what the name implies: it is how humans interact with computers or any other technology. A primary concept in HCI is usability. Usability is not the same as functionality. Functionality is ensuring that a designed product is able to perform the tasks it was intended to perform. Usability is ensuring that the design does not inhibit functionality. Figure 1 displays a teapot designed to be unusable. While it is functional, the placement of the handle makes use inconvenient.



Figure 1: The “coffeepot for masochists” is a coffeepot that is functional but has poor usability, designed by artist Jacques Carelman [4].

Another important concept in HCI is understanding users. As the name suggests, understanding users is trying to understand the needs of the users in order to make the best product. It is a way to contextualize design to be targeted to those that will use the technology rather than being designed for the designer. Personas are specific instances of users and the primary persona is the ultimate user. Designing for the primary persona is meant to alleviate the broadness of designing for all users and having a specific point of reference when making design decisions. However, personas tend to be able-bodied users. Designing for disability only occurs if the primary user base is those with a specific disability.

The last major point of note is usability testing. In one project group, we designed a mobile application and then had to perform usability testing. In usability testing, designers outline tasks that users are expected to perform then monitor participants’ ability to perform

the specified tasks. It is meant to simulate how real users engage with the application and highlight points of struggle. Since students were conducting usability testing, participants were individuals that the students knew and were most often able-bodied college-aged students. The applications were more or less designed and tested on able-bodied users which limited exposure to how accessibility plays a role in the way users with a disability might interact with the application.

3.2 Content from CS4640

Programming Languages for Web Applications teaches what its name implies. While not a programming language, CS4640 teaches the basic building block of the web: HTML. HTML defines the structure and content of a website. Simply put, a web browser looks at the HTML for a webpage, interprets it, and displays the content on the monitor. HTML is unique in that it can be written improperly but still be displayed correctly. In an aside by the professor, he stressed the importance of having properly structured HTML. The page may display properly; however, when viewed through a screen reader, the page is illegible or otherwise hard to navigate.

Being a class focused around web applications, this class was my first exposure to the WCAG. The class discussed the history of the WCAG, W3C, and its founder Tim Berners-Lee. Additionally, the class was made aware of Section 508 of the Rehabilitation Act, the legislation that relates to accessibility in technology in the United States. However, while some guidelines of the WCAG were encouraged, like alternative text for displayed images, grading for the created projects often did not have focus on accessibility features.

Related to both the previous topics, the last topic of note is HTML validators. These are tools that examine the underlying HTML and judge certain criteria like structure or color contrast between text and background. One homework assignment for the class and a checkpoint for the class project required using ANDI, an HTML validation tool, to verify accessibility of the HTML written for the project. However, after the related assignments, no further mentions of HTML verification was brought up. While a point can only be made so many times before the class needs to move on to other topics, getting into a habit of using and making sure good code is being written is also important. The one time mentioned in class and two times required for

the homework and project checkpoint were not sufficient for building habits.

3.3 Novel Content

I believe that the most valuable piece of information is awareness of how disabilities impact user interaction. Most people do not think about how individuals with disabilities engage with the web. People overlook what they do not think about. Making people aware of how disabilities impact user interaction can make them more conscious of their design decisions and spark motivation to want to foster accessibility.

Related to making people aware of the impact of their design decisions, another important point would be to dispel the myths about web accessibility Elcessor derived. It is particularly important to dispel the second myth that accessibility is difficult or costly to implement. As referenced in the WebAIM study, the six most common errors were: low contrast text, missing alternative text for images, missing form input labels, empty links, missing document language, and empty buttons. Most of these can be fixed by as little as one line of code. Oftentimes, these problems exist because people get into the habit of writing sloppy code. Missing alternative text for one image is an easy fix. When the website has pages with multiple images without alternative text, then fixing it becomes tedious.

Finally, the last topic of value that would expand students' understanding of accessibility would be to look into assistive technologies like screen readers. Related to HCI's principle of understanding users, knowing what to design for is important. By understanding how assistive technology works, sites can be better designed for compatibility, rather than being adjusted to accommodate after creation.

4 Anticipated Outcomes

The anticipated outcome of this project is a changed view about accessibility. Rather than viewing accessibility as a separate project that must be tacked onto one's existing project, it would be viewed as a necessary component. Through making people more aware of the need for and impact of accessibility, web developers would make a more conscious effort to make sites that are accessible. From this, the myths surrounding web accessibility would be seen as harmful untruths that stymie progress. Accessibility would be viewed as something just as important as

security, an uncompromisable component of any competent website.

From a more conscious effort for accessibility, changes would be seen in the web. The web would become the global hub that it was envisioned to become. Websites would be more accessible, tearing down the barriers of use that some users have faced in the past. Statistics would change for the better; a majority of websites would be accessible rather than the other way around. As the internet becomes more ingrained into society, the impact of not ostracizing a percentage of the population due to poorly designed websites would be monumental.

5 Conclusion

This project sought to find a way to improve the internet accessibility by stressing the importance of understanding and fostering web accessibility. By looking at UVA's existing computer science curriculum, the extent to which students were exposed to accessible design and the impacts of their design decisions was evaluated. CS3205 HCI in Software Development provided students with strong foundations in design; however, it did not address accessible design. CS4640 Programming Languages for Web Applications teaches the basics of programming for the web. The course stresses the importance of writing good code, but it does not address the impacts of poorly written code in depth. Though these courses sow the seeds of curiosity to spark further interest into the topic, what is discussed in the classes is not comprehensive. The gap in the curriculum is the understanding of what web accessibility is and its impacts. By having a strong foundational understanding about web accessibility and its importance, students may impact web development for the better.

6 Future Work

I am inexperienced when it comes to creating a course. The novel ideas proposed in this project are broad. They provide a good overview of what a class could cover should it be put into practice. However, there is more to explore surrounding the topic of web accessibility beyond the topics mentioned in this report.

Furthermore, the information needs to be structured to better organize ideas and more effective implementation in a classroom setting. Computer

science courses have a blend of lecture content and assignments to apply concepts. This report proposes primarily lecture content. In order to have a course, assignments could be hands-on experience with the technology and ideas presented in lecture like designing a web page then viewing it through a screen reader to see how HTML is interpreted and the impacts of poorly written HTML.

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