Visual Accessibility of Websites

CSC 486 — Spring 2019

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Overview

We will explore different visual disabilities and how they each affect how a person interacts with a website. We would like to research how visual impairments can negatively affect a website viewing experience and what measures can be taken to offset those frustrations. For example, optimal color contrast and alternative text (alt text) can help accommodate visual disabilities. Through this exploration, we hope to prototype a tool that evaluates sites on visual accessibility, and shows a user a simulation of what someone with the selected visual ability might see when looking at that page.

Background and Related Work

A significant amount of background research will be needed for this project as we are dealing with a sensitive aspect of some people's lives. None of us have the experience of being visually impaired. Therefore, in order for us to effectively study these individuals and develop solutions for them, we must do our due diligence to learn about their backgrounds.

We researched common issues that users with visual impairments experience and have found the following to be the most pertinent:

1. Webpage Layout
2. Lack / Poor use of Headings
3. Inaccessible Flash and Javascript
4. Inadequate Alt Tags
5. Poor Color Contrast

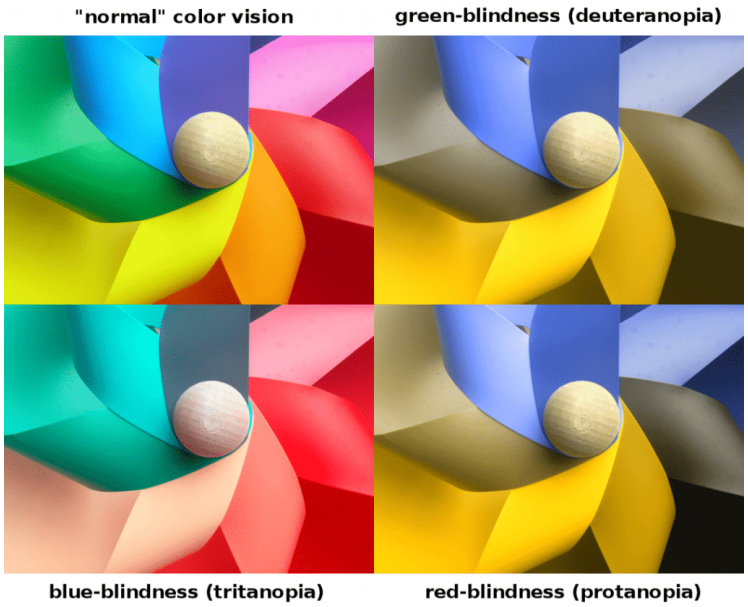
Our project aims to address these issues and hopefully lend itself as a tool that can make web pages accessible to all users with visual impairments.

Below are the visual impairments we have researched:

1. Color Blindness - These users will encounter issues with poor color schemes
    a. Red-Green: Protanomaly, Protanopia, Deuteranomaly, Deuteranopia
    b. Yellow-Blue: Tritanomaly, Tritanopia

   c. Total Color Blindness: Cone monochromacy, Rod monochromacy or achromatopsia
2. Low Vision - These users will potentially encounter issues with clarity, sharpness, and poor color schemes
3. Full blindness - These users will encounter issues when there is a lack of meaningful alt text and navigation for screen readers

We plan to use this research for our demonstration of viewing a webpage based on different levels of visual acuity and color blindness



An Image demonstrated through different color-blindness levels

An image demonstrating the contrast between average acuity (left) and low acuity (right)

Our Prototype

We made our interactive wireframe using Figma. This can be used and viewed at the following link:

https://www.figma.com/proto/YyehktB0NxdltIR5Bq7puYwD/Color-Companion?node-id=0%3A1&scaling=scale-down

Difficulty

The first challenge with this project will be finding individuals with disabilities to interview and test for our project. Not everyone advertises their disabilities and fewer will be comfortable having them researched and tested.

The next challenge will be determining metrics and tests that apply to the range of disabilities that are present. Some tests will be effective for color blindness but not for full blindness. It will be a challenge effectively test both of these test groups.

Lastly, it will be challenging but extremely important to be sensitive to our test participants. Every individual will vary in their comfort of being open with and tested on their disability, and we must remember to be respectful of and prioritize their boundaries.

Relevance

This project is relevant to Human Computer Interaction since we will be delving deeper into the visual communication channel. Accessibility is unfortunately often an overlooked aspect of design. Due to this, many current technologies have become inaccessible for users with disabilities. This will only become a larger issue as we continue to migrate our information and interactions to the digital world. We believe that this project will help bring attention to and provide solutions for this issue.

Project Schedule

Week	Goal	Description
1	Team Creation, Topic Exploration	• Form Groups & Brainstorm Ideas for both project and research
2	Narrow scope of Project topic	• Focus goals for project & corresponding research
3	Project Overview, Research Proposal	• Write and submit Project Overview documentation • Complete Research Proposal for individual research activities
4	Features, Requirements, Evaluation Document	• Start preliminary interviews to find specific accessibility problems that need solutions • Hypothesize solutions to problems and outline in document
5	System Design: Mockups and Interaction Flow, Extended Outline	• Create mockup of website evaluation tool along with interaction diagram • Describe tool and its ability to solve the problem
6	Prototype 1, Mid-quarter project display	• Have interactive prototype of tool using Figma • Use research and survey findings to ensure prototype is functional and ready for testing
7	Implementation Document	• Describe process and application of prototype
8	User Feedback & Validation, Draft of Research	• Conduct follow-up interviews with our prototype to assess our success with addressing accessibility issues we chose to focus on
9	Design Revisions	• Update design of tool that reflects feedback from the follow-up interviews
10	Final research paper, project documentation and display	• Update display for final presentation • Ensure feedback on prototype is implemented

Features

- Be able to demonstrate what the page looks like to users with different impairments including
    - All types of color blindness
        - Red-Green: Protanomaly, Protanopia, Deuteranomaly, Deuteranopia
        - Yellow-Blue: Tritanomaly, Tritanopia
        - Total Color Blindness: Cone monochromacy, Rod monochromacy or achromatopsia
    - Low Vision
    - Full blindness (reduce page to alt text)
        - NOTE: This particular affliction wasn't represented in the final wireframe because calpoly.edu didn't have very much alt text
- Assess Alt Text
    - does every image / button have alt text?
- Assess Contrast
- Make suggestions for improvements
- Provide score on each category
- Our tool will try to accommodate everyone, but rank recommendations in order of impairment prevalence. For example, red-green color blindness is more common that yellow-blue color blindness, so a suggestion to improve accessibility for that disability would appear first.

Requirements

- Our tool should be able to assess the following aspects of desktop websites:
    - Check color contrast between text and background
    - Check color contrast between hyperlink text and paragraph text
    - check color contrast between titles and paragraph text
    - Check color contrast between buttons and background
    - Check color contrast between button text and button
    - Check if every button or image has alt text

    - Check if any alt text is repeated
- We hope to interview individuals with visual impairments
    - What are the greatest challenges they face when using websites
    - What makes a website experience good or bad for them
- We will conduct research
    - Find legislature that advocates for the visually impaired
        - what standards they set forth
        - how and how well these standards are enforced
    - Find organizations that advocate for the visually impaired
        - what standards they set forth
        - how they incentivize people to adhere to those standards
    - Research the visually impaired
        - how the visual impairments affect an individual's ability to navigate a website
        - what measures can be taken to alleviate strains
        - what measures can be taken to make the experience enjoyable, not just tolerable
- We need to interview a sample of individuals with visual impairments, speak to an expert, and/or conduct research

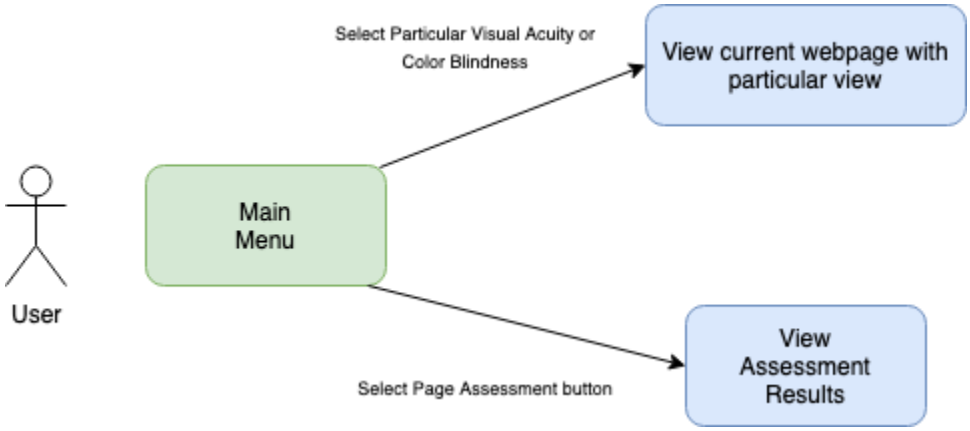
Evaluation Criteria

- Users with these visual impairments will be the best person to evaluate our tool. We will sample websites and see if they agree with our suggestions or are missing anything
- Rating Accessibility in terms of Alt Text (for people with full or partial blindness)
- The following will be scored on contrast and compared with standards such as WCAG AA & AAA:
    - Color contrast between text and background
    - Color contrast between hyperlink text and paragraph text
    - Color contrast between titles and paragraph text
    - Color contrast between buttons and background
    - Color contrast between button text and button
    - Does every button or image have alt text

    - Is any alt text is repeated
- Each area will be scored and suggestions will be made

Front End

The system is composed of a front-end and back-end. Since our tool will be a chrome extension, our front-end is designed to be very simple. The front end will allow users to select a full assessment option or view their webpage in the eyes of someone with a different level of visual acuity or color blindness. Once an option is selected, the backend will either perform the assessment on the current webpage and display the results to the user or view the current webpage according to the particular mode of vision that was selected.



Back End

Our product ultimately breaks down into two categories that are below. We decided to implement our product within Figma to simulate what want want our final project to look like. A very crucial consideration in our design was making sure it's of course accessible to those with visual impairments! If this was a functional prototype was created, the back-end would follow the below criteria:

Alt Text / Color Contrast Analysis

- Algorithmically traverse through the website and count the instances of alt text relative to text blocks, images, and figures

- Algorithmically traverse through the website asses the color contrast between neighboring alt text relative to text blocks, images, and figures

Color Blind Filters

- A button to toggle a series of visual filters
- Filters: normal, protanomaly, protanopia, deuteranomaly, deuteranopia, tritanomaly, tritanopia, cone monochromacy, rod monochromacy, achromatopsia, low acuity, full blindness

Implementation

We are using Figma to wireframe our Chrome Extension. While using Figma is fairly simple, there is some limitation to what can be done. For example, making a drop down menu functional is very tedious. We wanted to add a feature where the menu option is highlighted when the mouse hovers, and after much effort we were able to accomplish that.

During the implementation We found that making the home page of the Chrome Extensions contain too many buttons would unnecessarily overcomplicate the tool. For this reason, we have decided to make just one View button and one Assessment button. The assessment button will open a new Chrome tab with a findings report available for download.

Another implementation obstacle involves the View mode. It's hard to figure out exactly what something will look like to someone with a visual impairment, especially when they exist on a spectrum. As a result, I have considered making the View mode feature scalable, in which case the Color Blind view would blend with the normal view so that the user can see the range. Ultimately, given Figma's limitations and the quarter-long time constraint, this goal was outside the scope of this project.

Usability Testing

We interviewed individuals with visual impairments to narrow down the greatest obstacles they encounter on websites and how to fix them. While we have done a lot of research for this information, nothing beats talking to the people we ultimately hope to help. This way, our tool will successfully analyze and make recommendations for improving a website's accessibility.

These are the questions we asked:

1. How often do you encounter problems with accessibility?
2. How much do these problems hinder you? scale 1 (small hiccup that costs a few seconds) to 10 (I completely give up)
3. Examples of these problems.
4. Which is the biggest problem?
5. Do you know of or use any existing tools/methods for helping the situation?
6. If there was one thing you could change about websites to improve them, what would it be?
7. Any other improvements you can think of?

The accessibility technology specialist at Cal Poly's Disability Resource Center to connected us with individuals who felt comfortable being interviewed. The responses were fairly similar. All participants said that they frequently encounter problems with accessibility and that lack of color contrast and alt text tend to be the main source of their issues. They believed that addressing these problems would significantly improve their online experience.

Due to this feedback, we made sure to have the assessment of alt text and color contrast be the main features with our tool.

User Feedback

While the end goal of our system is to improve the lives of the visually impaired, our intended user community is website developers. Therefore, our interviews and testing will be split into two components.

The first component is ensuring that our tool successfully addresses the needs of the visually impaired. We are asking our interviewees the following questions about their interactions with websites:

- How often do you encounter problems with accessibility on websites?
- How much do these problems hinder you?
    - scale of 1 - 10
    - 1: small hiccup that costs a few seconds

    - 10: I completely give up
- Can you give any examples of problems you've experienced?
- Which problem would you say is either the worst or the most common?
- Do you know of or use any existing tools/methods for helping the situation?
- What would you change about websites if you could?
- Any other thoughts, suggestions, or comments? We will gladly take any input you can give us :)

The second component is verifying that our tool is functional and useful and would help a web developer make their website more accessible. We will have our tool judged on the following:

- User is able to change the site appearance to match the view from a visually impaired person from the following list of impairments:
    - All types of color blindness
        - Red-Green: Protanomaly, Protanopia, Deuteranomaly, Deuteranopia
        - Yellow-Blue: Tritanomaly, Tritanopia
        - Total Color Blindness: Cone monochromacy, Rod monochromacy or achromatopsia
    - Low Vision
    - Full blindness (reduce page to alt text)
- User is able to assess their website on the following characteristics:
    - Color contrast
        - Between text and background
        - Between hyperlink text and paragraph text
        - Between titles and paragraph text
        - Between buttons and background
        - Between button text and button
    - Alt text
        - Every button
        - Every image
        - Alt text should not be repeated
- User is able to perform the above tasks without strain
- User feels that this tool is helpful

Validation and Evaluation

- We hope to interview individuals with visual impairments
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- Users with these visual impairments will be the best person to evaluate our tool. We will sample websites and see if they agree with our suggestions or are missing anything
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- The following will be scored on contrast and compared with standards such as WCAG AA & AAA:
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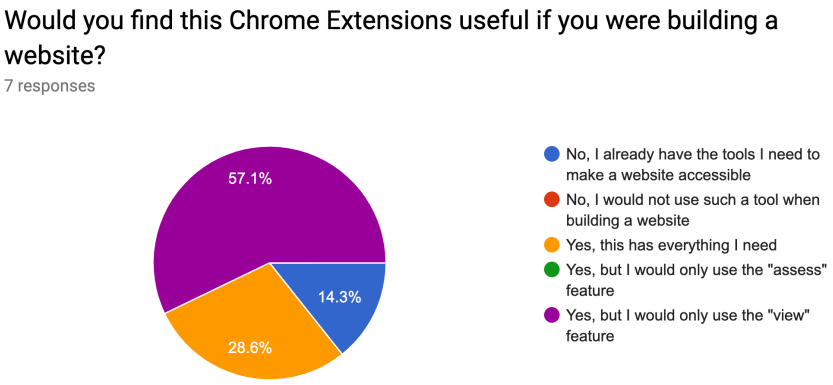
    - Color contrast between hyperlink text and paragraph text
    - Color contrast between titles and paragraph text
    - Color contrast between buttons and background
    - Color contrast between button text and button

    - Does every button or image have alt text
    - Is any alt text is repeated
- Each area will be scored and suggestions will be made

Responses

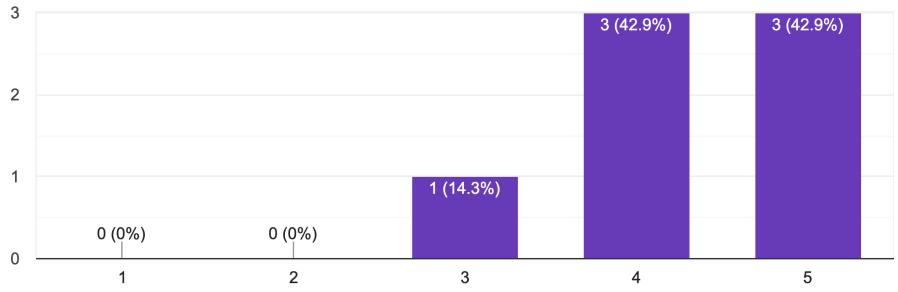
The metrics for our tool's analysis of accessibility center around color contrast on a website and assessing if alt text is present. We decided upon these two metrics as through our research and interviews they proved to be the simplest and most reasonable to analyze. So far through limited demonstrations, our product is succeeding! Individuals who have disabilities approve and developers appreciated a refined product to give them not only metrics but insight on the struggles people with disabilities have to face.

Below are our survey results for our prototype. From these responses we believe that our prototype is sufficient to meet the needs of developers that are looking to evaluate the accessibility of their websites. Obviously, it is still just a prototype but the proof of concept seems to identify the main components of accessibility that is desired. There are several tools that already exist but they are either not as user-friendly or do not consolidate all the features that we have in one application. We believe that this is a success!



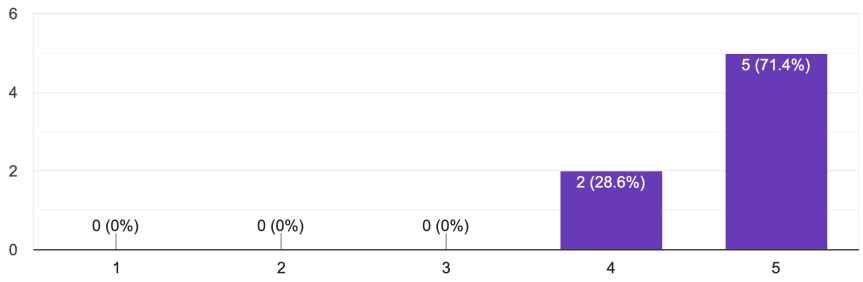
Rate the design of the of the Chrome Extension

7 responses



Rate the User Interface of the of the Chrome Extension

7 responses



Conclusion

We designed a mock Chrome Extension to better analyze the accommodations web designers are making for individuals with visual disabilities. We chose to do this through two main avenues: website visual filters and a report detailing the quality of a website's color contrast and alt text inclusion.

The filter aspect of the tool would overlay an image simulating the following vision:

- Protanomaly
- Protanopia
- Deuteranomaly
- Deuteranopia
- Cone monochromacy
- Rod monochromacy
- Achromatopsia
- Normal vision
- Low acuity
- Full blindness

Ultimately, we were able to simulate all of these impairments in the wireframe, with two exceptions of note. Firstly, we weren't able to find much definitive information regarding the differences between cone monochromacy and achromatopsia, so their images look essentially the same. As for full blindness, we originally intended to overlay just the alt text of the page, but the portion of the Cal Poly page we used didn't have much alt text, so we decided that we wouldn't be able to do it justice.

The assess button brings up a pop-up window with an option to download a PDF of the report. It also has drop down menus where the user can see different aspects of the report, such as which images are missing alt text and where there is insufficient color contrast.

We felt compelled to make this, because the visually impaired are a large minority that often aren't taken into account when programmers and designers are creating their websites. This lack of recognition sadly leaves these people with severe or debilitating limitations in their access of websites.

While the direct beneficiary of this tool would be individuals with visual impairments, the actual target audience of the tool would be website developers. We found through limited demonstrations that our product really excelled in putting people directly in the shoes of disabled individuals. We were pleasantly surprised by the lack of responses indicating that a user felt as though enhancing accessibility wasn't their responsibility. Pushing that responsibility

to others is how accessibility falls by the wayside. But one of the greatest goals of the product is to foster empathy for people with visual afflictions. By putting users in their shoes, web developers are more likely to keep visually disabled people in mind when designing a system!

Ultimately, we learned that despite how much we tried to narrow the scope of this project from the start, there is still so much research, designing, and testing involved in truly seeing the development of a tool like this through.

Furthermore, this project has been an incredibly humbling experience. Talking with everyone has shown us what a privilege it is to be able to use technology as is, given what an integral part of our daily lives it has become.

Future Work

In the future, it would be interesting to see this tool actually be developed. The whole project would be composed of the following components, which could be treated as smaller projects:

- **AI for Assessment of Alt Text**
    - Assessing if the alt text of images (or other items) is helpful, and possibly even making suggestions for improved alt text.
- **AI for Assessing Layout of a Page**
    - Assessing how coherent the layout of a page is based on the code. Logical ordering is considered a standard of the WCAG.
- **Overlaying a website with color filter**
    - Making a menu with scalable filters (to control the strength of a filter to mimic different severity levels of an afflictions symptoms) as well as doing the research and testing necessary to maximize accuracy
- **Color Suggestions based on given colors**
    - Calculating the color contrast of colors using the formula, and then making suggestions from other color families for colors that meet color contrast standards
- **Wireframing and user testing**
    - Iterating on the design and getting more web developers to test it.
- **Actual Implementation of all the aforementioned features**