Accessible and Responsive Website Design
for Cal Poly DBS Marine Education Program

A Senior Project Report
presented to
the Faculty of California Polytechnic State University
San Luis Obispo

In Partial Fulfillment
of the Requirements for the Degree
Bachelor of Science in Computer Engineering

By
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Abstract

In this project, I demonstrate how accessible and responsive designs are followed in order to implement a modern, multipage website which both adapts to the size of the screen as well as has the logical, semantic structure needed for accessible technologies to accurately use the site. This website is designed for a marine education program, Dive Beneath the Surface, which hosts live streams of scientific divers as they interact in real time with students many miles away. Although this site will not be the streaming platform, it needs to host a repository of videos and lessons for those students and teachers to access.
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Introduction

Websites are a vital form of communication which provide access to information otherwise unavailable because of geographic, economic, or other mitigating factors. Dive Beneath the Surface (DBS) is an educational marine diving program partnered with faculty and students at Cal Poly SLO which provides a unique experience to K-12 institutions by streaming their dives live to students thereby engaging them in real time. Although Youtube provides a substantial framework for hosting these videos, DBS needs a website to host their own information including contact information and detailed lesson plans for use by the teachers. The primary focus of this project is to investigate different hosting services, modify the existing website design, create a simple website architecture in order to have a fully, functional site for DBS.

Client & Stakeholders

Professor Lynne Slivovsky of the CPE department is also an educational diver who works in conjunction with the DBS program at Cal Poly SLO. As the point of contact, she is coordinating the features and style of the website. However, the full team DBS consists of all those mentioned in the “About” section on the website [insert link]. In addition to the clients themselves, the program affects all those interested in the marine-based research, especially K-12 schools which don’t have immediate access to the coast.

Framed Insights & Opportunities

As the site is to be designed primarily for use by young students and teachers, the two most critical aspects of the site are that it is simple and mobile-friendly. Professor Slivovsky expressed that there will not be many resources with which to maintain the site, so it is critical that it is simple enough for programmers in the future to quickly understand to make changes. The second requisite is that it be mobile-friendly because it has been shown that the younger
generations are more likely to have and favor smartphone use over using tradition computers or laptops.

*Project Deliverables*

This project promises to deliver a fully functional and responsive website with which to host materials created by the rest of the DBS team. The website will be simply developed to be both accessible and conventional for users and programmers alike.

**Background**

The conventional state of website design requires three major considerations. The first is a navigation tool which links every page of the website together, commonly referred to as a “nav bar.” The second is that the website be responsive to the size of the device. Because devices come with different screen and view sizes, websites must be able to adapt to fit the user’s preferred method of browsing. The third major design consideration highlights being conscious of users with accessibility issues. This generally refers to some form of vision impairment. As such, good website design includes a semantic html structure by which those with impaired vision may be able to navigate screen readers with minimal difficulty as well as being conscious of color choices in order to increase background/foreground contrasts for text.

**Formal Project Definition**

After discussing the website with Professor Slivovsky, we concluded two overriding requirements were that the websites be simple and responsive. The majority of users on this site would be educators and young students, so we decided it was imperative that resources be easy to find and that it could all be access “on-the-go.”
**Value Propositions, Customer Requirements, & Engineering Requirements**

<table>
<thead>
<tr>
<th>Value Propositions</th>
</tr>
</thead>
<tbody>
<tr>
<td>People should be able to find what they want quickly.</td>
</tr>
<tr>
<td>The site will be very static. There won’t be many changes or moving parts.</td>
</tr>
<tr>
<td>As many people as possible should be able to use it.</td>
</tr>
<tr>
<td>Ideally, we can host for free.</td>
</tr>
</tbody>
</table>

**Table 1 – Value Propositions**

<table>
<thead>
<tr>
<th>Customer Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>The site should be easy to navigate.</td>
</tr>
<tr>
<td>The code should be simple to update.</td>
</tr>
<tr>
<td>The site should be as accessible as possible.</td>
</tr>
<tr>
<td>Minimize the cost for hosting services.</td>
</tr>
</tbody>
</table>

**Table 2 – Customer Requirements**

<table>
<thead>
<tr>
<th>#</th>
<th>Parameter</th>
<th>Target</th>
<th>Tolerance</th>
<th>Risk</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HTML</td>
<td>Version 5</td>
<td>Min</td>
<td>L</td>
<td>I</td>
</tr>
<tr>
<td>2</td>
<td>CSS</td>
<td>Version 3</td>
<td>Min</td>
<td>L</td>
<td>I</td>
</tr>
<tr>
<td>3</td>
<td>Use of Javascript</td>
<td>None</td>
<td>Max</td>
<td>L</td>
<td>I</td>
</tr>
<tr>
<td>4</td>
<td>Web Hosting Service</td>
<td>$0</td>
<td>Max</td>
<td>M</td>
<td>A, I</td>
</tr>
</tbody>
</table>
According to the client, there were four major value propositions that stood out as seen in Table 1. These directly translated into the customer requirements seen in Table 2. Next, each customer requirement was broken down into one or multiple engineering requirements. The first customer requirement (CR) is broken down into #7, 8 engineering requirements (ER). That is, a site is easy to navigate if the user interface has a tool by which to go to every page from any page. So, a navigation bar which links to each page fulfills this CR. The second CR is broken down into the languages used to code the site (ER #1, 2, 3). HTML5 & CSS3 are the newest and most common languages by which to create a website. Although Javascript is popular, it adds an unneeded complexity for this project and was consciously avoided to make the code as simple as possible. The third CR is broken down into how users will view the site (ER #5, 6). In this, using html semantic tags, such as headers and links, properly allow screen readers to navigate the site. In addition, designing for mobile responsivity allows users with a wide array of devices navigate the site. The last CR translates to a single cost (ER #4) in which a price comparison is made between multiple webhosting services.

<table>
<thead>
<tr>
<th></th>
<th>Screen Reader Compatibility</th>
<th>Headers, Links</th>
<th>Min</th>
<th>M</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Mobile Responsivity</td>
<td>600px</td>
<td>Min</td>
<td>M</td>
<td>T, I</td>
</tr>
<tr>
<td>7</td>
<td>Intra-site Link Structure</td>
<td>Completely Connected</td>
<td>Min</td>
<td>L</td>
<td>I</td>
</tr>
<tr>
<td>8</td>
<td>Conventional Navigation Bar</td>
<td>1</td>
<td>Min</td>
<td>L</td>
<td>I</td>
</tr>
</tbody>
</table>

Table 3 – Engineering Requirements

*Engineering Requirements Process*

According to the client, there were four major value propositions that stood out as seen in Table 1. These directly translated into the customer requirements seen in Table 2. Next, each customer requirement was broken down into one or multiple engineering requirements. The first customer requirement (CR) is broken down into #7, 8 engineering requirements (ER). That is, a site is easy to navigate if the user interface has a tool by which to go to every page from any page. So, a navigation bar which links to each page fulfills this CR. The second CR is broken down into the languages used to code the site (ER #1, 2, 3). HTML5 & CSS3 are the newest and most common languages by which to create a website. Although Javascript is popular, it adds an unneeded complexity for this project and was consciously avoided to make the code as simple as possible. The third CR is broken down into how users will view the site (ER #5, 6). In this, using html semantic tags, such as headers and links, properly allow screen readers to navigate the site. In addition, designing for mobile responsivity allows users with a wide array of devices navigate the site. The last CR translates to a single cost (ER #4) in which a price comparison is made between multiple webhosting services.
User Stories

Anna is a biology teacher at Simi Valley High School. She hears about Cal Poly DBS from a colleague. To motivate her students’ interest in marine life, she visits the Cal Poly DBS website to learn more about the program. After watching some of the introductory video and reading about the different lessons for her class, she decides to contact Cal Poly DBS in order to let them know that her class will be tuning in to the next live video stream.

Figure 1 – Anna’s User Diagram

Kenji is an 8th grade student at Monterey Middle School. His teacher is trying to pull up the live video stream on the classroom projector, but he is having technical difficulties. Kenji suggests that the students can tune into the stream on their own phones and asks his teacher for the website. The teacher puts the website URL on the board and tells the students to follow the calendar link to the current live stream.

Figure 2 – Kenji’s User Diagram

Alex is part of the Sea Life Stewards, an organization that raises awareness about the state of marine life. They travel to various high schools to give lectures and supplement learning material. Alex has heard of Cal Poly DBS and wants to use their curriculum in some of his own
lessons. They download the available lessons from the website and use them to prepare their next talk at Ramona High School.

**Design**

*Design Development Overview*

There were four major parts to the design development. These include:

1. Researching web hosting services.
2. Reviewing the previous DBS website design.
3. Iterating new accessible website designs.
4. Integrating externally created content into the website.

*Web Hosting*

The primary web hosting services investigated were Microsoft’s Azure, Amazon’s AWS, and InfinityFree. All of the services offer a freemium version by which websites can be hosted with certain limitations. After considering the different limits, Amazon’s AWS was chosen for being the most flexible and reliable service offered. Within the AWS framework, an EC2 server has been made accessible via an SSH connection.

*DBS Website Review*

While researching web hosting services, I also reviewed the previous design of the DBS website provided by a previous student. After discussing some of the design choices with Professor Slivovsky, we decided to keep most of the architecture the same. We decided there were two major resources (“lessons” and “videos”) and that there should be a page for each. The “home”, “about”, and “contact” pages are conventional, information pages which constitute the rest of the site. As shown in the site architecture diagram (Figure 3), the previous design was a completely connected graph with six distinct pages, whereas the new design only has five pages having simplified the “events” and “videos” page into a “calendar” page.
Figure 3 – Site Architecture Diagram.

**Accessible Iterations**

Another improvement from the original design involved the sites semantic and mobile structure. In the HTML, there are now descriptive tags such as, `<header>`, `<nav>`, `<article>`, `<section>`, `<footer>`, and header levels that were previously missing. These descriptive tags allow screen readers such as NVDA and Microsoft’s JAWS to parse through the content of the site and better inform users with vision impairment. In addition, the site uniformly uses flexbox as the CSS way to organize the content. While before there was a combination of tables, flexbox, and relative positioning for the display styles, having a singular style to adhere to is simpler for future designers.
Content Integration

The content integration as of this report is unfinished. It will be handed off to the next person or group who will update and maintain the site.

Conclusion and Future Work

Although much of the site is finished, website design is very much a living process as content and styles change over time. I have used the latest version of HTML and CSS in an effort to insulate the site from any necessary immediate updates. In addition, the Bibliography and Appendixes contain online resources and written procedures to facilitate any updates to the site.
Bibliography

HTML & CSS Design

CSS Reference

https://www.w3schools.com/cssref/default.asp

HTML Accessibility Reference

https://www.w3schools.com/html/html_accessibility.asp

Hosting Help

https://www.brianshim.com/webtricks/host-multiple-sites-amazon-ec2/comment-page-2/

Contact Backend


CSS Organization

Navbar Guide

https://medialoot.com/blog/how-to-create-a-responsive-navigation-menu-using-only-css/

Flexbox Guide

https://css-tricks.com/snippets/css/a-guide-to-flexbox/
Appendix A - Procedures

Setting up new credentials for EC2 Server

1. Go to https://aws.amazon.com/
2. Select “My Account” -> “AWS Management Console”
3. Input username & password.
4. Select “Services” -> “EC2” -> “Security Groups”.
5. In the list of groups, find and select “dbs-security”.
6. In a panel below, select the tab “Inbound”.
7. Select “Edit” -> “Add rule”.
8. Input the fields, Type: “SSH”, Port: “22”, Source: “My IP”.
9. Now, you have allowed yourself to SSH/FTP from your current IP address location.
10. If you find yourself on a different IP network, you may not be able to SSH into the EC2 until you have followed these steps.
11. Be sure to log out when finished making changes.

SSHing into EC2 Server

1. Open an SSH/FTP program such as Bitvise SSH Client.
2. Input host name. Host: ec2-[ip address].us-east.2.compute.amazonaws.com
3. Input username. Username: ec2-user

Transferring Files from Local Drive to EC2 Server

1. Log in using an FTP/SSH program such as Bitvise SSH Client.
2. Copy the desired files from local drive to the remote drive using the FTP program.
3. Be sure to log out when finished.

Moving files from user directory to root, host directory

1. Log in using an FTP/SSH program such as Bitvise SSH Client.
2. Enter the following command: `sudo cp ~/www/calpolydbs/* -r /var/www/html/calpolydbs`

3. Verify the files have been moved.

**Appendix B – Bill of Materials**

<table>
<thead>
<tr>
<th>BOM #</th>
<th>Part Description</th>
<th>Qty</th>
<th>Part Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Amazon EC2 Server</td>
<td>1</td>
<td>$0</td>
</tr>
<tr>
<td>2</td>
<td>Domain Name</td>
<td></td>
<td>$14.98</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$14.98</strong></td>
</tr>
</tbody>
</table>
Analysis of Senior Project Design

Please provide the following information regarding your Senior Project and submit to your advisor along with your final report. Attach additional sheets for your responses to the questions below.

**Project Title:** Accessible and Responsive Website Design for Cal Poly OBS

Marine Education Program

Quarter / Year Submitted: Spring 2019

Student: (Print Name) Charles Alexander (Sign) ____________ 

Advisor: (Print Name) ____________________ (Initial) ________ Date: __________

- **Summary of Functional Requirements**
  Describe the overall capabilities of functions of your project or design. Describe what your project does. (Do not describe how you designed it.)

- **Primary Constraints**
  Describe significant challenges or difficulties associated with your project or implementation. For example, what were limiting factors or other issues that impacted your approach? What made your project difficult? What parameters or specifications limited your options or directed your approach?

- **Economic**
  - Original estimated cost of component parts (as of the start of your project)
  - Actual final cost of component parts (at the end of your project)
  - Attach a final bill of materials for all components
  - Additional equipment costs (any equipment needed for development?)
  - Original estimated development time (as of the start of your project)
  - Actual development time (at the end of your project)

- **If manufactured on a commercial basis:**
  - Estimated number of devices to be sold per year
  - Estimated manufacturing cost for each device
  - Estimated purchase price for each device
  - Estimated profit per year
  - Estimated cost for user to operate device, per unit time (specify time interval)

- **Environmental**
  Describe any environmental impact associated with manufacturing or use.

- **Manufacturability**
  Describe any issues or challenges associated with manufacturing.

- **Sustainability**
  - Describe any issues or challenges associated with maintaining the completed device or system.
  - Describe how the project impacts the sustainable use of resources.
  - Describe any upgrades that would improve the design of the project.
  - Describe any issues or challenges associated with upgrading the design.

- **Ethical**
  Describe ethical implications relating to the design, manufacture, use or misuse of the project.

- **Health and Safety**
  Describe any health and safety concerns associated with design, manufacture or use.

- **Social and Political**
  Describe any social and political concerns associated with design, manufacture or use.

- **Development**
  Describe any new tools or techniques used for either development or analysis that you learned independently during the course of your project.
Analysis of Senior Project Design

Summary of Functional Requirements

This project serves as an informational repository for a marine research education program. It is a website which is coded strictly in HTML5 and CSS3 designed with accessibility and mobility in mind.

Primary Constraints

The primary constraints of this project included not using Javascript in any capacity for the website. It required that the website cost as little as possible. The biggest challenge though is making the website responsive for any screen size while also being aesthetically pleasing.

Economic

- Original estimated cost: $10
- Actual cost: $15
- BOM included in Appendix B
- Original estimated development time: 10 weeks
- Actual development time: > 10 weeks

Social & Political

I think this project has great potential for positive impact by spreading information and awareness about the oceans and state of marine wildlife. By giving DBS a platform to communicate with students, this project fosters learning and exploration into new experiences and a healthier state of mind towards the environment.