

Creating an App For Audio Journal's Print Disabled Listeners

A Major Qualifying Project
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ABSTRACT

As the world becomes more internet-oriented, it presents several unique challenges for people with blindness and visual impairments to access local news. Audio Journal is a radio reading service in Worcester, MA that broadcasts local news to blind and visually impaired people in Central Massachusetts. They wanted to improve access to their content by allowing their users to listen on demand without having to access their website. To achieve this goal, our project group created an iPhone app that was determined to be the best option towards improving accessibility for Audio Journal's current and future listeners. The app was developed and tested in phases over the course of 21 weeks, and is available on the App Store for download.

INTRODUCTION

In the information age of today, where almost everything and everyone is connected through the internet, the amount of online content available at one's fingertips is endless. From hit T.V. shows and popular music to the latest news, finding information on the internet is easier than ever before. However, there is one group that this may not be the case for: people with blindness and visual impairments. The internet is incredibly visual, and navigating it without vision requires the use of assistive technologies like screen readers or braille displays, and some websites are completely inaccessible to those without sight. The question therefore presents itself: as the world becomes more and more internet-oriented, how are these groups supposed to access important resources, such as the news?

It is this gap that organizations like Audio Journal aim to fill. Audio Journal's 130 volunteers read print materials like newspapers and magazines over the radio and archive them online. Based in Worcester, Massachusetts, Audio Journal is a non-profit radio reading service that broadcasts constantly, non-stop (Audio Journal, 2019). Their service is extremely important to their listeners, visually impaired or blind people (VIPs) who benefit from auditory information. Audio Journal provides a way for VIPs to get vital information; it can educate VIPs on the current events, new technologies, or legislative changes that they may be impacted by. Because of the necessity of their service, Audio Journal works very hard to make their content as accessible as possible; however, one thing they hoped to improve was VIPs' access to previous broadcasts.

While there are many ways for listeners to catch the live broadcast, the only way for listeners to hear previous broadcasts was through Audio Journal's website. Purely website-based content can be difficult for VIPs to navigate without accessibility features, especially if accessed on a mobile device, such as a smartphone. To remedy this issue, Audio Journal collaborated with a team of WPI students, aiming to improve the availability of their previous broadcasts. In March of 2020, three students, including two from our project group, ran a research study for an Interactive Qualifying Project to determine which platform was optimal to allow listeners to access previous broadcasts (Marion, Grigolia, & Doyle, 2020). The study determined that an iPhone application

would be the most accessible platform, leading the project team to create a visual prototype outlining the main features.

After the success of the study and prototype, the project was extended into a Major Qualifying Project, during which our team developed and released the iPhone app that was previously designed. However, creating an app for people with blindness and visual impairments provided some extra challenges in the development process. For the app to be accessible, it needed to be fully compatible with Apple's various accessibility settings. In addition, since Audio Journal's primary audience is people over the age of 65, the app needed to be intuitive and not overloaded with features. Further, it was important that the app was tested by people in the blind and visually impaired community, to ensure that the app was completely accessible to VIPs. We hope that the app will be a useful tool that helps Audio Journal to better serve the blind and visually impaired community in central Massachusetts.

BACKGROUND

VIP's Access to Print Materials

Whether on paper or digitally, information today is primarily spread through print media. News articles, novels, scientific journals, instruction manuals, recipes, medical advice--the majority of this content is documented in text. For most, this text is easily accessible and readable, but this is not the case for the 3% of Massachusetts residents who are visually impaired or blind (National Federation of the Blind [NFB], 2019).

Blindness and visual impairments come in many forms. Of course there is the natural degradation of the eye, which causes vision deterioration as one ages. Then,

there are maladies which directly impact the eyes, including glaucoma, diabetes, or traumatic injuries (CDC, 2020). Some may be born with some form of visual impairment, for example dyslexia, a condition which makes text difficult to read and process. Dyslexia affects between 5 and 15 percent of Americans (Society for Neuroscience, 2004). Some may develop diseases which affect their vision later in life, such as Parkinson's disease, where rigidity and tremors can make it difficult to focus on printed text (Downward & Pool, 2019). Other conditions, for instance dementia, affecting 50 million worldwide, can also make it difficult to focus and retain text information (WHO, 2019). In total, the World Health Organization estimates 285 million people in the world are blind or visually impaired (WHO, 2019).

In order to consume print media, these 285 million people must overcome their vision difficulties, through accessibility options or other means. Although there are tools which can help people with print disabilities or visual impairments, most require ownership of a computer, or expensive external devices such as braille displays. This makes consuming print media even more inaccessible, as a significant portion of blind or visually impaired people may not have the means to afford these devices. In 1994 and 1995, the Center for Disease Control and Prevention (CDC) surveyed people living with disabilities in the United States. Their survey concluded that most visually impaired people lived alone; 19% living in poverty, and 81% unemployed (Zuckerman, 2004). These numbers have changed in recent years; in 2019 the American Foundation for the Blind (AFB) reported only 56% of the blind population to be unemployed. However, the National Federation of the Blind (NFB) now estimates an increased 27% of visually impaired people in the United States to be below the poverty line (NFB, 2019).

Seeking to remedy these issues, Audio Journal offers an easily accessible solution for VIPs to access print media. Broadcasting live at all hours of the day, Audio Journal volunteers read out information over the radio. Through this service, visually impaired people can instead listen to all manner of print material. Audio Journal is considered a radio reading service--a program where newspapers, magazines, and other sources of information are read aloud over radio to an audience that is blind,

visually impaired or otherwise print disabled. However, there were very few ways to access previous broadcasts, with the main way being Audio Journal's website. To identify how to address this shortcoming, Audio Journal reached out to a team of WPI Students, aiming to develop a more accessible route to previously broadcasted materials (Marion et al., 2020).

Audio Journal's website does have previous broadcasts posted; however, this limits visually impaired people to the same methods as those which they would use to retrieve other digital print media. Navigation of the website would require a computer with which accessibility software or hardware is integrated.

Platform Choice

This team of WPI students, Ryan Doyle, Irakli Grigolia, and Brandon Marion, enacted a two-term project to determine the best method by which VIPs could access previously broadcasted material. Through interviewing Audio Journal's listeners, as well as non-listeners, they determined that there was indeed interest for an Audio Journal app among the blind and visually impaired in Central Massachusetts. The majority of the interviewees owned smartphones from Apple, and some of them also used other Apple devices. Often mentioned as the reason behind their choices was Apple's excellent accessibility features. Seven out of 11 interviewees named *VoiceOver* as their primary method of navigating their phones. In addition to *VoiceOver*, Apple has many other accessibility features that visually impaired people can use such as *Bold Text*, *Larger Text*, *Text Increase*, *Zoom*, and *Magnifier*. For this reason, the project concluded that an iOS application, one which would be compatible on many of Apple's devices, would be the best choice regarding a way for VIPs to access Audio Journal's previously broadcasted materials.

App Features

During the previous project, the features that the app should have were also laid out by the project team, and separated into primary and secondary features. The primary features of the app include the ability to listen to Audio Journal's live radio broadcast and browse Audio Journal's archived broadcasts (Marion et al., 2020). The app also needs to be compatible with Apple's built-in accessibility features. The secondary features that are meant to enhance the experience are the ability to "favorite" a program that users want to access more easily, the ability to search for programs from Audio Journal's database using a search bar, an option to continue listening to an unfinished broadcast, an option to change the color palette of the app, and the ability to navigate the app using voice control (Marion et al., 2020). It's these features that our project group evaluated and implemented.

Assistive Technologies

Screen Readers:

The most prevalent assistive technology used by blind people to access computers and smartphones is screen readers. Screen readers are either software or hardware that will read aloud on-screen text for users who can't read the text themselves. Screen reading software for computers (such as JAWS, or "Job Access With Speech") lets users navigate by using commands on their keyboards. While most modern screen readers are software, some screen readers, like the Eye Pal Ace (Figure 1), are physical devices with the capability to scan print materials as well as computer screens (Freedom Scientific, 2015).



Figure 1: Eye Pal Ace Picture

One of the reasons that the iPhone was selected for the app was because of Apple's built-in screen reading software: *VoiceOver*. Instead of navigating using a keyboard, *VoiceOver* lets users navigate their phones using taps and swipes to input various commands. The basics of using *VoiceOver* involve swiping left or right to select various items, and then double-tapping the screen to interact with the item that is currently selected (Apple Support, 2019). In conjunction with these, there are a number of other commands that involve performing various combinations of multi-finger taps and swipes. For an app to be accessible to people for those who navigate without sight, it must be fully compatible with *VoiceOver*.

Another piece of assistive technology that can be used in conjunction with screen readers is a refreshable braille display. With refreshable braille displays, the output from the screen reader is displayed in braille on the device. These types of devices typically display between 40 to 80 characters at any time (AFB, 2019). However, they are very expensive. Refreshable braille displays cost anywhere between \$3,500 to \$15,000 depending on how many characters the device can display (AFB, 2019).

Screen Magnification:

For VIPs who still have some of their sight, there are a couple of options for navigating computers and phones. One tool that is especially useful for this population is screen magnifiers. Screen magnification hardware is a device that enlarges items placed beneath it, whereas screen magnification software is used to magnify certain sections of their phone or computer screens. Just like with *VoiceOver*, Apple has its own screen magnification software called *Zoom*. *Zoom* has two main magnification modes. With Full-Screen *Zoom*, the entire screen is magnified, and users are able to move around the screen by dragging three fingers around to control the view. With Windowed *Zoom*, a window appears on the screen, and only the contents of the window are magnified. When using *Zoom*, all gestures used for navigating menus will still work. To ensure *Zoom* compatibility, developers need to avoid using 3-finger taps or swipes, since those could interfere with *Zoom*'s controls.

Display and Text Size:

Another option for people with visual impairments is display and text size options. These types of options let users increase the size of on-screen text and let users customize other elements of the user interface, such as the color of the background. Most operating systems, web browsers, and smartphones have these types of options. In addition to being able to increase the text size, the iPhone's display and text size settings let users reduce the transparency on backgrounds, increase color contrast between the foreground and background, and invert the colors of the display. In order for an app to be compatible with these settings, developers need to ensure their text is compatible with dynamic types so the text will change along with the settings.

Apple's Accessibility Guidelines

Many people use Apple's accessibility features, such as *VoiceOver*, to interact with their devices in ways that are easier for them. Apple has its accessibility guidelines to help developers make apps that give everyone a good user experience, no matter their capabilities or how they use their devices. Apple's accessibility guidelines specifically request developers acknowledge the following three design "mantras": Design with Accessibility in Mind, Support Personalization, and Audit and Test App for Accessibility.

Design with Accessibility in Mind:

Simplicity and perceivability play main roles here. Simple and intuitive characteristics help ensure that the design is easy to understand and can be perceived whether people are using sight, hearing, or touch.

Support Personalization:

An app which properly supports personalization in terms of accessibility should ensure that the UI is compatible with Apple's built-in accessibility features. This requires extensive testing of the app to ensure that all functionality is maintained despite fully upsized or downsized text, changed visuals, zoom use, etc.

Audit and Test App for Accessibility:

As the name suggests, the “Audit and Test App for Accessibility” mantra encourages testing every element in the app extensively to check for bugs or other issues which would affect accessibility. *“Testing helps you ensure that all users can complete the most important tasks in your app, no matter how they interact with their devices.”* (Apple, 2020). It is important to test every user flow with accessibility features turned on to guarantee the app’s functionality for all users. It is vital to have an app without any errors in order to deliver a great user experience.

Gestures:

In general, simple, easy-to-understand gestures are the best option for mobile applications. Considering iOS devices have a variety of screen sizes, simple gestures can ensure ease of usability despite the restrictions of the device. Additionally, it can be challenging for new users to understand complex or long gestures. Apple explicitly forbids overriding its existing gestures, especially those regarding accessibility, because users expect system gestures to work regardless of the app they are using.

Buttons:

Buttons should be clearly presented and consistent in appearance. Consistency in the hierarchy of buttons helps users grasp the purpose of the buttons based on their appearance. In the app our team is developing, all of our major buttons have a rounded rectangle shape and a color fill in order to help them stand out. In accordance with Apple’s Human Interface Guidelines, all our

buttons or hit targets are not less than 44pt by 44pts; larger hit targets make the app more accessible for all users.

User Input:

Ideally, an application should have multiple input options for users to interact with. For example, having the option for people to dictate commands allows people who may have trouble interacting with the screen to instead use their voice to interact with the app.

Navigation:

The app should provide logical navigation that is consistent with Apple's standards. Users should be able to use their experience with other apps to help them learn how to navigate our app. *VoiceOver* is a screen reading tool that many people use in order to navigate through apps. In addition to screen reading capabilities, *VoiceOver* reads aloud each character when typing and can identify items shown in images. *VoiceOver* is a major built-in accessibility feature in Apple's iOS and we need to make sure our app is fully compatible with it.

Text Size and Weight:

Dynamic type allows users to choose a font size which works for them. In order to make an app dynamic-text compatible, it's important to avoid truncating text as the font size increases. In our app, rather than truncating text, we extend the scrollable space. This way, users can simply scroll to see the same amount

of text that is visible at the default font size. The app also needs to maintain a consistent hierarchy, regardless of the user's font size choice. Lastly, the app needs to behave correctly when users enable bold text. Our app is fully compatible with all of these features.

Color and Contrast

Optimally, an inclusive app would be designed with color blindness in mind. Making sure a color palette is accessible to VIPs and the colorblind is a complex process. There are three major types of color-blindness to consider. Deuteranopia results from a lack of cone cells which respond to the color green; this results in the inability to distinguish red from green. Protanopia results from a near-complete absence of long wavelength cones, resulting in the inability to see red and green. Lastly, tritanopia results from a lack of short wavelength cones; people with tritanopia cannot distinguish between blue and yellow.

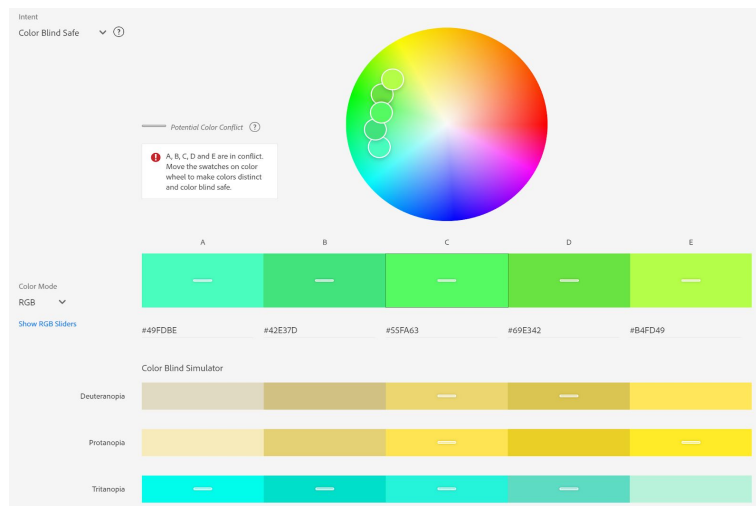


Figure 2: Adobe color

Tools like Adobe Color (Figure 2) take a given color palette and ensure that people with these three versions of colorblindness can still differentiate the colors.

Adobe Color passes the color palette through a filter which simulates what people with colorblindness would see. From this information, designers can alter the colors until they are clearly differentiable despite the filters. This is accomplished through varying the brightness of colors which a colorblind person may find similar; even if they cannot tell if a button is red or green, they should still be able to differentiate between the buttons based on their lightness or darkness.

A final thing that should be considered is compatibility with dark mode. This is a useful feature to have because many users prefer using a dark background.

METHODOLOGY

Development Procedure

The goal of the project was to develop an iOS application for Audio Journal. Development began in the summer of 2020. First, the team set up a private Github repository to establish version control. Then, a timeline was laid out in order to pace development of the application. Shortly afterwards, a Trello board was established to assign tasks to team members (Trello is an online project organization tool). The team designated several extended meeting times a week, one with the project sponsors and advisors, as well as daily check-ins to ensure constant effort from all team members. Although Agile's "scrum" and "sprint" methods were not formally employed, the team used incremental development, and brought a functioning product to the advisors each week.

Development took place in Apple's XCode environment using Apple's Swift language. The first stage of development involved implementing all the basic screens which had been created in the mockup by the previous project team. The development of these screens took place through "Storyboards", or app screens, which are linked

together with buttons. The team ensured that all screens have back buttons, and that the buttons match the aesthetic of the mockup.

The next stage of development involved linking portions of the website to the app. This was necessary in order to load Audio Journal streams into the application, as well as accurately depict the current categories of shows which Audio Journal is hosting. Through communication with Audio Journal's website developer, we established a method of interfacing the website with the app--endpoints. These endpoints are a series of URLs that contain text in JSON format. JavaScript Object Notation, or JSON, for short, is a text based format for organizing more complex data structures using key-value pairs as its basis. Included in the JSON files at the endpoints is the stream categories, names, and URLs to the actual stream playback.

We parsed in this information to determine the creation of the archived programs screen. Buttons are dynamically created based on the categories that are retrieved from the endpoints. In addition to dynamically creating the buttons, pressing the category buttons also dynamically creates additional buttons and descriptions of the content contained.

Using the URLs from the endpoints, the team was able to link up a media player in the app which can load and play Audio Journal streams. All archived programs are searchable through a search bar. Team also implemented some voice command features, and made the app compatible with *VoiceOver*, *Zoom*, *Dynamic Text*, and *Magnifier*.

User Interface

There was a lot to consider when developing the user interface for the app. Since our target audience was made of people with blindness and visual impairments, the user interface needed to be easy to navigate regardless of the user's navigation method. This was especially important because Audio Journal's listener base consists mostly of those who are 65 years or older (Frandsen, 2019). Based on this information, we came up with the following aspects that were needed for user interface.

One of the most important features for the user interface was scrollability. With dynamic type, users can make compatible text many times bigger if needed. As such, the user interface needed to be able to handle the increased text size. Moreover, because the amount of categories, programs, and podcasts for a particular program vary as new ones are added or removed, we couldn't ensure that all of the content would fit on the screen at once. To address these issues, every screen needed to have the ability to scroll. In addition, any items that contained text, such as buttons, also needed to be able to adjust their size to fit the text.

Another important feature for the user interface was consistency. Since *VoiceOver* users need to navigate item-by-item, it takes a lot longer to grasp the structure and layout of the screen. Consequently, if the app were to have several different layouts for various screens, it would be confusing for *VoiceOver* users and require much more effort to navigate than is necessary. As such, the user interfaces for the various screens aimed to follow the same layout so users only need to learn how to navigate one or two types of screens instead of several.

Another aspect the user interface needed to implement to improve navigability for *VoiceOver* users was content organization. Because *VoiceOver* reads from top-to-bottom and left-to-right, the items at the top of the screen are read out before items that are lower on the screen. To reduce the amount of time users need to navigate a screen, the most important items should be located at the top of the screen. This means *VoiceOver* users won't need to read through as many items before they get to the one they're looking for.

The last thing the user interface needed to be was uncluttered. Since the main goal of the app was accessibility, the user interface shouldn't have been compromised for the sake of aesthetics. Adding extra user interface elements such as tabs or dropdown menus would have added another step required to access certain elements. Keeping the user interface simple helped improve accessibility for everyone, especially Audio Journal's core listener base.

Color Palette

Accessible Color Palette Options

More rainbow-like palettes, similar the original Adobe XD button colors in vibrancy

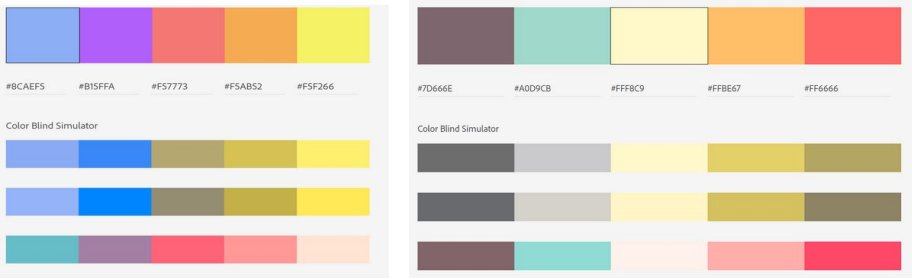


Figure 3: Accessible color palette options

The color palette feature was developed with those in mind who are color blind. The user is able to switch through a number of different palettes in order to have colors that make the app easiest for them to use. Based on results from Adobe Color, our team came up with a few different accessible and palette options (Figure 3). The first option is the default option with a gray background color. We chose this color because our app needed to be compatible with dark mode, and the default gray color accomplishes this goal (Figure 3). All other screen background and button colors were also chosen from the accessible color palette options (Figure 3).

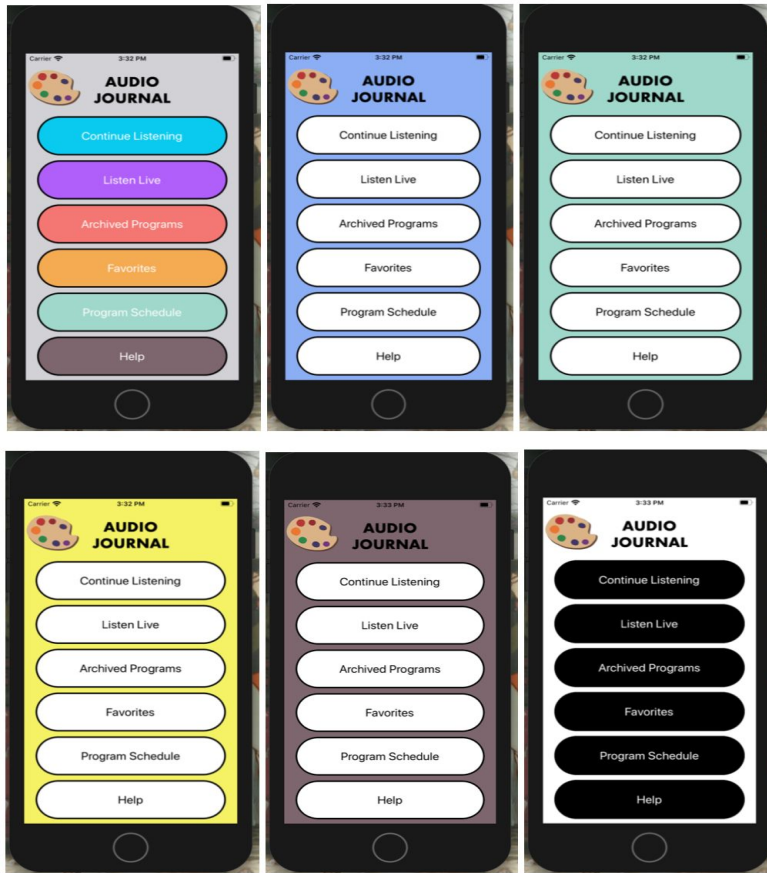


Figure 5: Color palette options

With the color palette feature, our team believes that every user can find an option that they are comfortable with, promoting a better user experience.

User Study

In order to ensure that all the elements of the app worked as intended, the app needed to be tested. Moreover, it needed to be tested in several different ways, including with *VoiceOver*, with *Zoom*, and without accessibility options to ensure that it could be used easily no matter what method is used to access the app. The best way to ensure that the app worked effectively was to test it with potential users.

Project Goals

The goal of our user study was to get feedback on the ease of use of the app, the functionality of the various features. In addition, we needed to collect general impressions of the app and any other improvements that could have been made. To do this, the team has reached out to Audio Journal to find some study participants who would be interested in testing the app and providing feedback on it. In order to deliver the app to the participants, each member of the team became a registered Apple developer and uploaded the app in a completed beta phase to the Apple store. The study participants were asked to download the application and follow a set of initial instructions to guide them through the app and its various features. After the initial testing, they were asked to continue using the app at their leisure over the course of a week before answering a second set of questions. In order to get a representative population of study participants, the team gathered information from three populations: those who navigate using *VoiceOver*, those who navigate with help from display and text settings, and those who navigate without accessibility features.

Target Populations

The target population for the app consisted of listeners of Audio Journal who are also owners of iOS devices. Based on the team's research in previous terms, iOS mobile devices were preferred by listeners of Audio Journal for Apple's built-in accessibility features. In order to ascertain the usability and successful interfacing of the app, the team needed to gather feedback from diverse Audio Journal listeners. Visual impairments can vary from person to person, so the team strived to make sure the app was comfortable to use for people with all types of visual impairments.

The most relevant population that the team planned to interview were listeners who utilize accessibility features to navigate the app. These users were likely to have a visual impairment and may rely on these accessibility features to navigate applications. Our team planned to subdivide this population further into users who use audio-verbal

related accessibility features, and those who use visual accessibility features such as font-size changes. Feedback from those who use audio-verbal related accessibility features pertained to the app's ability to respond to voice commands, to read out the contents of pages, and to be easily understood through listening alone. Feedback from those who use visual accessibility features involved the app's scalability, zoomability, and adaptation to various text sizes and color palettes.

The other population the team planned to interview are Audio Journal listeners who do not use Apple's accessibility features. From this population, the team wanted to garner more general feedback about the layout and responsiveness of the app. Although this group was not the target population for an app specifically designed for the visually impaired, their feedback could still be useful to determine the overall polish of the application.

Procedure

The project and its details were to be submitted to the IRB for approval. Upon approval, and prior to working with a participant, each participant was sent or read an IRB consent form which they must have either digitally or verbally signed in order to participate in the study.

With help from Audio Journal's Executive Director, Mary Frandsen, the team reached out to a group of Audio Journal listeners who indicated that they would be interested in testing the Audio Journal application. Due to the ongoing pandemic, the team interacted with these participants completely remotely, using email as the primary form of communication.

Once the participants have signed the consent form, they were sent a set of instructions via email that guided them through the initial testing process. Afterwards, they answered a set of questions about their initial experience. Once the participants have answered the initial questions, they were asked to continue using the app for a week. After they have used the app for a week, they were asked to answer a second set of questions about their experience using the app over a longer period of time. The instructions and questions were sent to the participants through email. The answers to

the questions were sent to the research team as a reply to the email that sent participants the instructions, or through a phone call with the participant.

Each participants' feedback was documented by the team, and feedback from all participants was gathered together for comparison and analysis. The feedback was analyzed in three sections regarding the participants utilization of accessibility features, as expressed above. The team took note of common complaints or comments made by the participants, and put this feedback at the highest priority for making app modifications. Complaints or comments that were expressed several times, or by several participants, indicated a common user experience with the application that needed to be looked into by the team.

During the final project term, we conducted a second round of testing. For this second round of testing, the testing instructions were structured to tell the user less about the app and its functions. This was done to get opinions on the usefulness of the help menus and to test the app's ability to communicate the use of its features on its own. The methods used to gather and analyze feedback were identical to the first round of testing, with the differences being the updated application and revamped instructions/questions. Due to time limitations, feedback from this round of testing was analysed but changes were not made to the app as a result. All the recommendations and necessary changes we feel should be made based on these results can be found in the Future Work section of this report.

IMPLEMENTATION

To help make tracking our implementation progress easier, our group created a table that we used as both a schedule and record of our progress. This schedule was not set in stone, and changed a lot throughout the course of the project when certain features took longer than expected to implement or were prioritized over others.

KEY			A Term							B Term							C Term						
-	Working	Week:	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
•	Completed																						
App Implementation																							
Designing UI			-	•																			
Browsing Functionality						-	•																
Color Palette			-	-	•																		
Search Bar							-	•															
Voice Control										-	-	•											
Favoriting Programs							-	•															

Figure 6: Original Implementation Schedule

KEY			A Term							B Term							C Term						
-	Working	Week:	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
•	Completed																						
App Implementation																							
Color Palette			-	-	•																		
Browsing Functionality						-	-	•															
Favoriting Programs								•															
Search Bar										-	-	•											
Continue Listening										-	-	•											
Program Schedule													-	•									
Voice Control													-	-	-		-	•					
Bug Fixes/Minor Improvements										-	-	-	-	-	-		-	-	-	-	-	-	•
Code Refactoring																	-	-	-	-	-	-	•
User Feedback and Fixes																							
Initial Testing										-	-	-	-	-	•								
Feedback										-	-	-	-	-	•								
Evaluation										-	-	-	-	•		-	-	-	•				
Secondary Testing															-		-	-	-	•			
Report Writing																							
Introduction			-	•				•															•
Background/Lit Review					-	-	-	•															•
Methodology							-	•															•
Analysis													-	-	-		-	-	-	-	•		
Conclusions																				-	-	•	
Video Presentation Script																	-	•					

Figure 7: Final Implementation Schedule

Our first goal was to make sure all of the core features were implemented by the end of our first project term so that we would have enough time to consider the feedback of testers and implement some of the suggested features and improvements. To ensure we were able to get the core functionality working in time for the first round of testing, our team started working prior to our project officially starting in the fall. Before our project officially began, we had already created the user interface and ensured compatibility with Apple's accessibility features, including dynamic type and dark mode.

There were three features that we determined were most important to have in the first iteration of the app. The first was the browsing functionality, since this was the main purpose of creating the app. The second was the color palette changer, since it's an accessibility feature, and the app needs to be accessible and usable by people with blindness and visual impairments. The last feature we deemed necessary for the first iteration was the favorites function, which is important for helping to reduce the amount of time users spend searching for programs. This version of the app was the one that was used in the first round of testing.

During our second project term, we worked on implementing secondary features, including the *Search* feature, *Resume Last Broadcast (RLB)* feature, the *Program Schedule* feature, and the *Voice Control* feature (see Figure 8). Two of these features (the *RLB* and *Program Schedule*) were not part of the original app design. The *RLB* is important not only because it helps make the experience easier for users, but also because the length of Audio Journal's broadcasts range from 1 to 2 hours long. As such it's reasonable to expect that users might not be able to listen to an entire broadcast in one sitting. The *Program Schedule* is also important so users can know when different shows air.



Figure 8: From left to right: Search Functionality, Resume Last Broadcast (RLB) Screen, Weekly Program Schedule Screen, and Daily Program Schedule Screen.

In addition to these new features, we also worked on making bug fixes and other improvements. In our first iteration of the app, the app only loaded programs from the website when users needed to access them. This created some difficulties when we were working on implementing the *Search* feature since we didn't have a single list of programs to pull from. For our second iteration, we made it so the category and program data were loaded during the launch screen. This means the users do not have to wait on every screen for the data to load from the website. We chose not to load the program listings at the start of the app, because it would have resulted in users waiting too long on the launch screen for data that they may or may not need to access.

By the end of our second project term, we had the fundamentals in place to facilitate the Voice Control feature but it was still not fully implemented. As such, our group decided to work on the app in the winter break between our second and third project terms. During the break, we continued working on the Voice Control feature, and

worked on fixing bugs that came to light as a result of our testing thus far. These bugs included a fix for dynamic type compatibility and a bug that caused the app's audio to be nearly silent. We also finished the Voice Control feature with the exception of one minor bug that we worked out in the first week of our third term.

Our final implementation of the Voice Control feature was smaller in scale while still providing the main functionality we were hoping for when proposing the feature. The main purpose of the Voice Control feature is to make navigating the app quicker and easier. In the original concept design, we had a button for voice control on nearly every screen (Marion et al., 2020). We decided that having a button on every screen wasn't necessary and would just add another item users would need to scroll past when using VoiceOver. As such, we included a single voice control button on the main menu. We also cut down the number of voice commands from 4 commands to 1. These commands were primarily cut due to time constraints.

The goals for our final project term were to get the app ready for launch and to set the stage for the future development and maintenance of the app. As such, our implementation priorities for our final project term were fixing bugs and refactoring our code.

ANALYSIS

Regarding the feedback we received about the app itself, there were several common threads established between testers. Almost every tester rated themselves highly in their skills as an iPhone user, all users answering either a 4 or 5 on a 1 to 5 scale from "not at all proficient" to "very proficient" where 5 is most proficient. Most users seemed generally pleased with the app, with a few points of feedback each; though some encountered issues that they found important to address.

Positive feedback included that the app was easy to navigate and that the interface was simple and intuitive to use. Users commonly reported that past broadcasts were easy to find and that features generally worked as intended. It was exceedingly

rare to get feedback less than a 4 on questions regarding the usability and layout of the app (where a 5 represents strong satisfaction with the functionality of the app). This would imply that in general, users were satisfied with the layout and usability of the app. This told us that the app did not require any major overhauls in the user interface or app structure, but instead smaller tweaks and fixes. In addition, all VIPs who tested the app said that they would continue using it in the future, which let us know that the app resonated with our target audience.

Ease of Use of the Audio Journal App

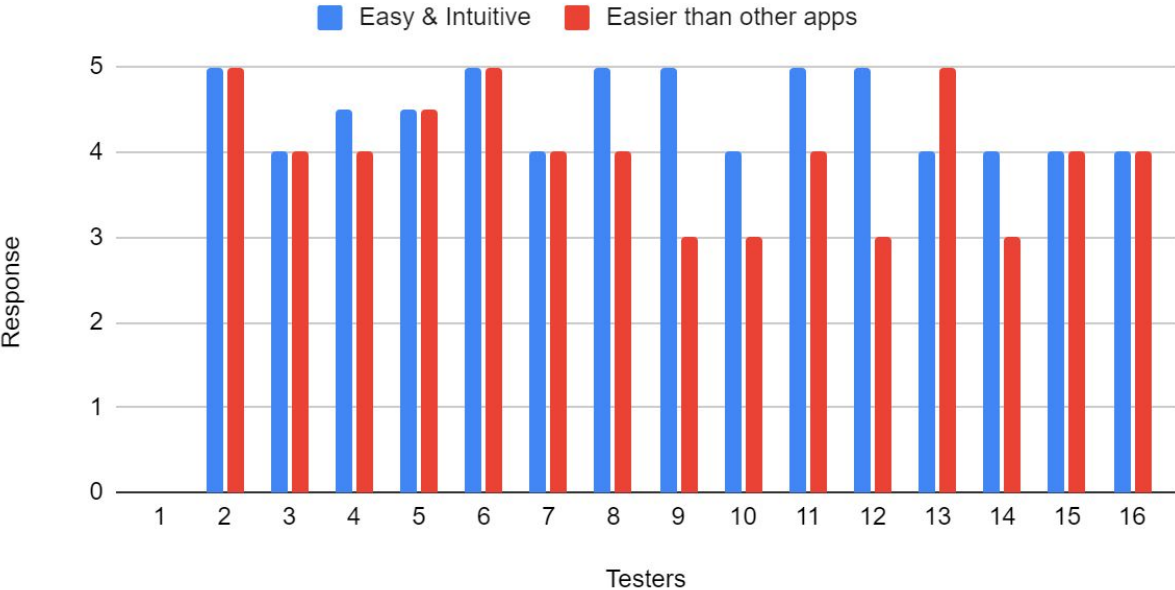


Figure 9: Feedback regarding the “easy and intuitive” and “easier than other apps” testing questions. Here, 1 represents strongly disagreeing, and 5 represents strongly agreeing. Participants largely indicated that the app was easy to use. Note that Participant 1 failed to answer these questions.

From this data, we can deduce that participants generally felt that the app was indeed easy and intuitive, but may not have felt as strongly that it was easier than other apps.

Yes and No Question Responses

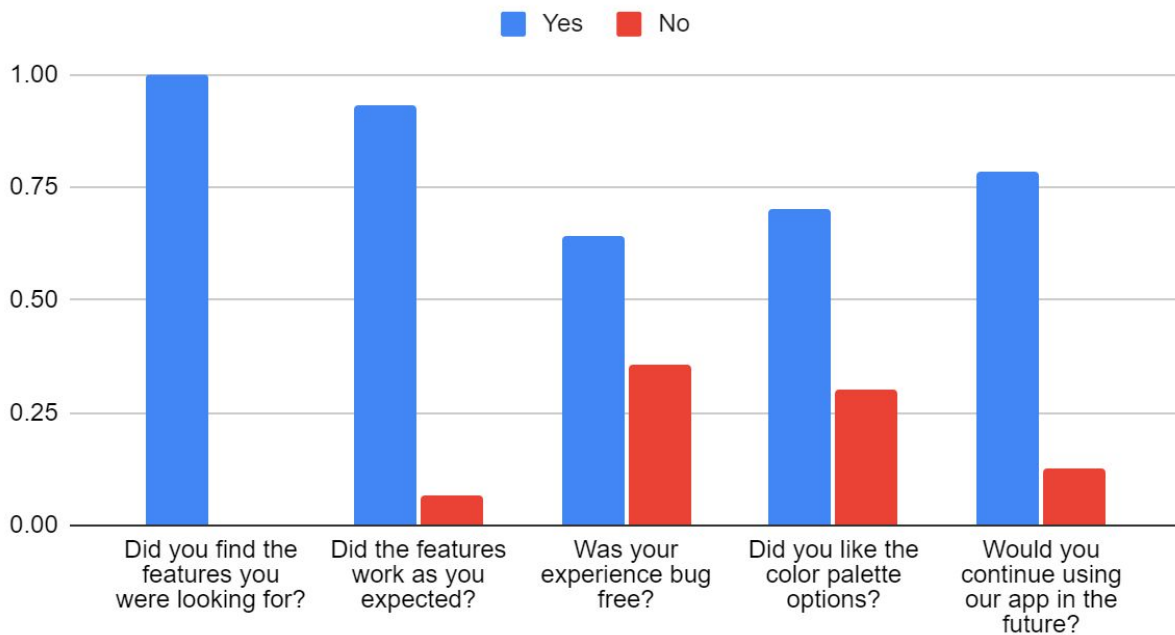


Figure 11: User responses to five of the “Yes or No” feedback questions, compared based on the percentage of “yes” and “no” responses.

Here, the answers to many of the “Yes or No” questions asked of participants are compared. Participants unanimously agreed that they found the features they were looking for. Very few participants had issues with the features working as expected. Contradictorily, a shocking number of participants, about one third of all users, reported finding “bugs”, or glitches, in this program. This would suggest that the features were not working as expected, in contradiction to the previous question. It could be assumed that although users experienced some unintended behavior, they for the most part experienced expected behavior, and therefore answered the second question differently from the first. We found that asking clarifying questions such as “Was your experience bug-free?” helped us gather much more accurate information as opposed to more generalizing questions, such as “Did the features work as you expected?”.

App Criticisms by Number of Times Mentioned

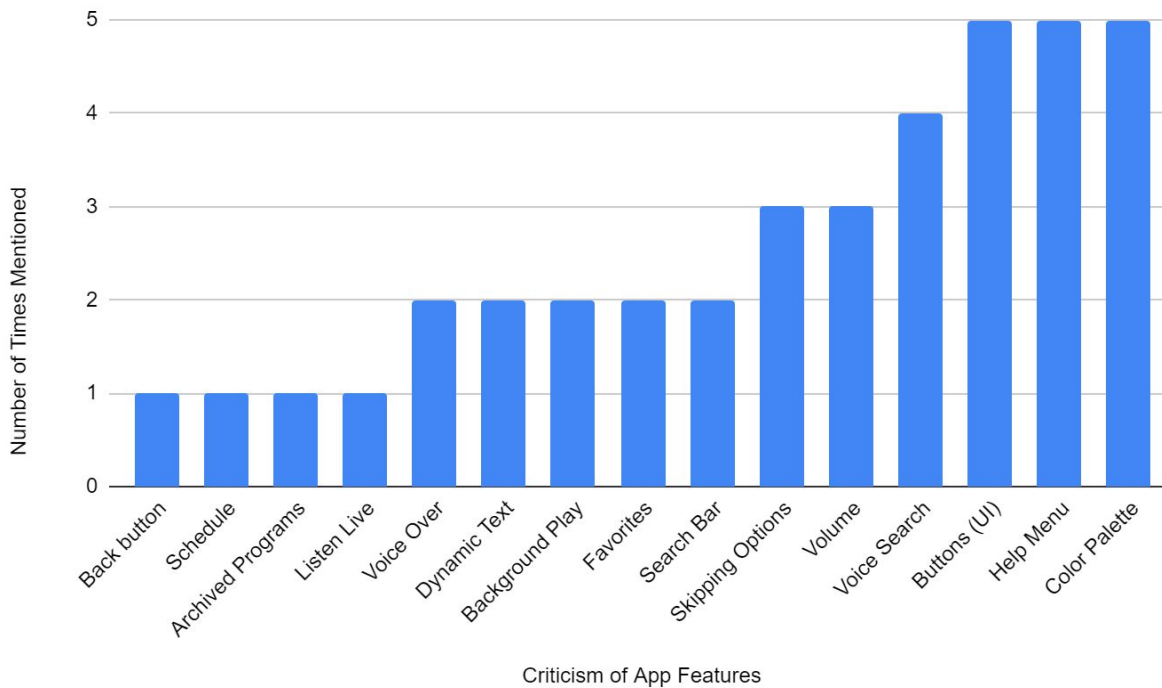


Figure 12: Criticisms of various aspects of the app, ranked by how many users mentioned that aspect of the app in their critical feedback.

The most critical feedback was present in the “opinion-based qualitative questions”. Some feedback pertained to the visual aspects of the app, such as the fonts and color choices. For example, One user requested that the font used for buttons be more bold and distinctive. Another noted that the default color palette should have more contrast. Several users mentioned the color palette option: most testers were pleased with its simplicity and the option for customization, but a couple of testers believed that it was not necessary - “Apple did it better.”. We did not end up making any significant changes to the color palette, since the vast majority of testers enjoyed the current color palette options, and none of the testers said that it harmed their experience with the app.

Many users mentioned that the headings or descriptions should be revised to be simpler. For example, there were issues with the title “Archived Programs”, with one tester believing it to be confusing, and another wishing that it matched a later label,

“Program Categories”. A few users also requested that some of the instructions under the “Help” page be rewritten to be more precise. There were several changes made to the labels as a result of this feedback. In addition to changing labels like the “Archived Programs” label, we made several changes to the VoiceOver labeling based on the feedback, including changing the VoiceOver label on the “Favorites” button to say “On” or “Off” instead of “Enabled” and “Disabled”. Several help menus were also added over the course of the project to address the feedback given by testers.

Issues with layout and formatting were also addressed in feedback. Two users believed that the button positions should be changed. It was suggested that the “Back” button be moved to the upper left and that the “Help” button be listed after the “Color Palette” button in *VoiceOver*. One *VoiceOver* user suggested that while listening to a broadcast, that the buttons for skipping forwards or backwards be easier to access. One user with very limited sight who used *VoiceOver* to navigate was confused by the “Dimmed” status on some headings. According to him/her, “Headings do not have to read as dimmed or disabled, and buttons should not read as disabled especially if they are a toggle which is meant to be turned on or off”. Our group took some of these suggestions into account when making user interface revisions. We removed the “dimmed” status on the headings and moved the back button to the upper left of the screen on all screens. While we did make changes to the location of the color palette button throughout the course of development, we feel that its final position in the bottom left of the main menu is the best location. This is because it’s an optional customization feature. Moreover, it’s not something that users need to access frequently. Since it will likely be the least used option on the main menu, it should be the last item listed.

Testers also addressed many issues which had already been identified by our development team, which were in the process of being fixed for the second version of the app. For example, one tester recognized that text on the buttons on the main page could “spill out” of the buttons if Apple’s Dynamic text size was changed to be too large. Several others recognized that the app was currently unable to play broadcasts in the background while the user used their phone for other things. As one of the testers reported “ When I click on Live Broadcast, I hear the ad and then Audio Journal. But after a very short period of time, it turns off. If I try to do something else on my phone

while it is still on, it turns off. To keep it going, I have to keep tapping the screen”. Finally, one user had an issue loading certain programs, instead of being redirected to other programs. This was a bug which we had also encountered and were fixing at the time.

Testers were also able to find some bugs that our development team did not find on our own. One major bug that was identified by testers was the app and *VoiceOver* audio becoming nearly inaudible when not using headphones. This bug, if it wasn't caught, could have seriously harmed the experience for a large number of users if it weren't brought to our attention. Moreover, the cause of the bug was difficult for our development team to track down, making it even more important that it was caught with enough time for us to fix it before launch.

Some of the most critical feedback we received involved the Voice Control feature. 4 of the 7 testers in the second round of testing reported issues with using Voice Control. One tester assumed that the feature needed to be used in conjunction with Apple's built-in Voice Control feature because of the name. As a result of this feedback, we renamed the feature to “Search by Voice” to better reflect the current functionality and avoid confusion with Apple's Voice Control. Other testers reported that the feature was inconsistent in recognizing their voice. As one tester explained, “It did not recognize multiple words when I spoke only the first one. So when I searched for “Community News – Gardner” I got all of the Community News programs, but when I searched for just “Gardner” that specific program showed up”.

Several testers also gave feedback on the testing process itself. These testers suggested that the app installation process should have been easier, as TestFlight installation can be daunting for people who are visually impaired. A deadline was requested, to ensure testers responded in a timely fashion. According to one tester “TestFlight actually took [them] more time to get through that process than it did to review the AJ app”. Because of this, the tester delayed their review. “When you have a busy schedule, not having a deadline makes it too easy to place a task on the back burner”. Several users were not impressed with the testing questions, firstly with how inaccessible they were, and secondly with how long and seemingly repetitive they were.

Suggested Features

Several other features were proposed during feedback; these were not necessarily issues with already-implemented features, but instead mechanisms that users would like to be added. Several users, especially those with little to no vision, suggested that they should have the option to skip more than 15 seconds in audio playback (15 seconds being the default skip duration). One tester requested that a toolbar be added which would allow them to enter a day and time, in order to access the broadcast which aired at that time. Another tester requested that contact information and a link to Audio Journal's website be present somewhere within the app. Finally, one tester suggested that the app should let you continue listening to a broadcast while browsing the app.

Setbacks

While our group received a lot of positive feedback from testing, the process for gathering feedback itself did not progress as smoothly as our team had hoped. Many testers were completely unaware of the presence of questions, given that they were “hidden” in an email beyond the installation and usage instructions for the app. Our team discovered this oversight when, despite many consent forms being signed, little to no feedback was received. Audio Journal’s director reached out to many of the individuals who had not yet responded, and collected their feedback over the phone, drafting it up on the tester’s behalf. This method was necessary to collect feedback from three of the nine testers in the first round of testing.

Our group also had difficulty locating testers for the second round of testing. There were several attempts by our group to locate more VIPs that were willing to test the app that were largely unsuccessful. In the end, we were only able to find 7 new testers for the second round of testing, none of whom were VIPs.

FUTURE WORK

While we were able to fully develop the app that was conceived in the previous project, there is still a lot of app development work that could be done for the benefit of Audio Journal and other radio reading services. In particular, there were four new features suggested by testers that we feel should be a priority to implement when future work is done on the app.

The feature we feel is most important to implement is to add the air time for a program to its listing screen. This is important because it would fix the biggest limitation of the app in its current form. The current implementation of the program schedule is helpful when you're searching for a program based on the time, but not if you're searching for a time based on the program. If you enjoyed a show, and wanted to listen to it live, you'd need to read through the entire program schedule searching for a time slot when that program airs, which can be very time consuming. Adding the air time of a program to its listing screen would fix this problem. It would also be the easiest of the three features to implement because the schedule data is already stored in the model class.

The second feature we feel should be implemented is the ability to adjust the playback speed. This would be a useful feature to have, because experienced users may be used to listening to audio at faster playback speeds, since one of the options for VoiceOver is the ability to adjust the playback speed of VoiceOver audio. This feature was also requested by one of the app testers.

The third feature we would like to see in a future version of the app is the ability to browse the app while listening to a broadcast. While users are currently able to use other apps while listening to a broadcast, they cannot browse within the app while doing so. Adding this feature would help give users more control over how they listen and use the app.

The final feature we want to be implemented is more skipping options for the audio playback. Apple's default media player includes buttons to skip 15 seconds forward or backward. Users can also use the progress bar to navigate to any point in the broadcast, but the issue is that it's not possible to do this using VoiceOver. When

using VoiceOver, you are able to move the progress bar by intervals of 10%. Since most Audio Journal broadcasts are one hour long, this means that VoiceOver users are only able to skip using intervals of 15 seconds, or 6 minutes. This is why extra skipping options could help give VoiceOver users more control over the playback of the broadcasts. When implementing this feature, extra care should be taken so that the media player's interface doesn't become overly crowded with buttons and features, as this can make the layout more difficult to understand and navigate.

In addition to implementing new features, work should be done to improve the features that are already in place. The two app features that we feel could benefit the most from additional work are the "Search" and "Search by Voice" features. The search function that governs both the search bar and search by voice could be improved to find entries that don't exactly match up with the user's input. This would be helpful for users who don't know the exact name of the show they're looking for. Another possibility to broaden the reach of the search feature could be to add tags to individual programs that describe the content of the show. This would be helpful for people who are searching for a particular type of show or for a show that covers specific issues that are important to them. There also should be work done with the Search By Voice feature to address the feedback given during the second round of testing and improve its accuracy. One possibility to alleviate the issue would be to add a second pop up message when the feature isn't able to parse words from the user's speech. This would give users more insight into why their search didn't register properly.

Additional Recommendations

Based on our experience with the project, there are some more recommendations that we would like to make for the future team that continues to develop the app.

The first thing that we would recommend changing is the primary form of communication for testing. The majority of our correspondence with testers was via email. While there are advantages to using email, particularly in larger scale studies, a smaller scale study like the one we conducted could have been better served if phone calls were the primary form of communication. Phone calls are a lot more effective for

communicating with testers because you are able to get their reply to questions immediately. It's also much easier for testers who are visually impaired to communicate verbally than in writing. While calling every tester would take more time than sending a group email message, it would likely result in less hassle for testers and faster responses.

When handling source control in XCode, careful attention needs to be taken when modifying the storyboard files, since doing so without planning can result in conflicts when pulling from the repository or when merging two branches. There were several times during development where app changes needed to be redone due to merge conflicts. To avoid these issues, the project group should coordinate when changes to the storyboard file are made. All members should make sure they have pulled the most recent version of the app before any modifications are made to the storyboard file. Once the modifications are done, all group members need to make sure they've pulled the most recent version again. Doing this will help the team avoid merge conflicts when dealing with the storyboard file, which will help them to avoid setbacks during development.

In addition to adding new features to the Audio Journal app, there is also more work that could be done to help out other radio reading services. Radio reading services that are members of the International Association of Audio Information Services (IAAIS) are typically small non-profit organizations without the resources to hire app developers. It would be extremely helpful to these other radio reading services if there were a version of the Audio Journal app that could act as a template where others could customize the template to create an app for their service.

CONCLUSION

Overall, we feel that the project was a success. The majority of testers were very satisfied with the app and its features, and we were able to launch the app without much issue. We submitted the app to the App Store on March 12, 2021, and the app was approved the next day. The development process for the app also went smoothly, with mostly minor bugs that we were able to fix quickly. And while testing did not go as

smoothly as we anticipated, we still received a lot of great feedback that allowed us to fix bugs and plan new app features. We're sure that if the next team takes our recommendations into account, development and testing will go smoothly and let the project continue its forward momentum.

We're excited for the future of the app and how it will help to improve access for Audio Journal's listeners. Based on the research done with Audio Journal's listeners in the IQP, we know we've chosen the best platform to let their listeners access archived broadcasts. Our research into Apple's accessibility features and guidelines has helped us to be sure we've designed the app to be accessible for people with blindness and visual impairments. And by testing the app with Audio Journal's listeners, we're confident that we've implemented the app features properly to ensure a smooth and seamless experience for visually impaired users.

Moreover, this app has the potential to be a stepping stone for other radio reading services, as well as Audio Journal. With there currently being very few radio reading service apps available to people with blindness and visual impairments, the Audio Journal app could become a trendsetter for future apps made by radio reading services. By making our code open source, and with future work to make a template app, the Audio Journal app could open the door for other radio reading services to create their own apps and further expand VIP's access to information. Looking forward, we're confident that the future of Audio Journal will continue to get brighter and brighter.

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Appendix A: Project Presentation Video

<https://youtu.be/NTZ-izV7fvQ>

Appendix B - IRB Consent Form

Informed Consent Agreement for Participation in a Research Study

Student Investigators: Irakli Grigolia, Kyria Nelson, Ryan Doyle

WPI Faculty Advisors: Rodica Neamtu, Lane T. Harrison

Contact Information:

Student Investigators:

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Faculty Advisors:

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Lane T. Harrison, Email: lharrison@wpi.edu

Title of Research Study: App For Audio Journal

Sponsor: Audio Journal

Introduction:

You are being asked to participate in a research study. Before you agree, however you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation.

Purpose of the Study:

We are working with Audio Journal. Audio Journal is a radio reading service in Worcester, Massachusetts that broadcasts to blind and visually impaired people in Central Massachusetts. In addition to broadcasting local news, they also have their own specialty programs. The purpose of our project is to test an Audio Journal iPhone/iPad app that would let listeners access previous broadcasts of Audio Journal's programs. We are looking for blind or visually impaired participants who own an iPhone or an iPad to help us with testing the app. We want to make sure that users will be able to navigate the app effectively, and that all of the features work as intended. While blind and visually impaired people are the main focus of this study, we are also looking for some people without blindness or visual impairments to test the app as well. As a part of this study, we will be writing a written report of our findings.

Procedures to be followed:

- All materials for this study will be sent via email.
- You will be sent a set of instructions that will tell you how to download the app and guide you through the first step of the testing process.
- At the end of this process, you will be asked to answer a set of questions.
- After you answer these questions, you will use the app on your own for one week. At the end of the week, you will be asked to answer a second set of questions to finish the testing process.
- Answers to questions should be sent as a reply to the email that sent you the questions and instructions.

- Your identity and responses to individual questions will be kept confidential.

Risks to study participants:

Standard risks associated with using smartphones

Benefits to research participants and others:

Your participation will help us to improve access to Audio Journal's content, giving listeners more control over how they listen. You will also be able to keep the app beta once testing is over, but you will no longer receive any app updates and cannot redownload the app if you delete it from your phone.

Your participation in this research is voluntary.

Your refusal to participate will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit.

For more information about this research or about the rights of research participants, or in case of research-related injury, contact:

Study investigators at gr-audiojournal@wpi.edu or

WPI IRB Manager: Ruth McKeogh, Tel. 508 831-6699, Email: irb@wpi.edu or

WPI Human Protections Administrator: Gabriel Jonson, Tel. 508 831-4989, Email: gjohnson@wpi.edu

By signing below, you acknowledge that you have been informed about the study, and consent to be a participant in the study described above. If you are under the age of 18, your parent or legal guardian must also sign this form. Make sure that all of your questions are answered before signing this form. You are entitled to retain a copy of this consent agreement.

Printed Name _____

Study Participant Signature: _____

Date:

(if participant is under 18 years of age)

Printed Name of Parent/Guardian: _____

Parent/Guardian Signature: _____

Date:

(for investigator use only)

Investigator Signature: _____

Date:

Appendix C: Round 1 Testing Instructions

App Information:

The Audio Journal app is being created for iPhones and iPads. The main purpose of the Audio Journal app is to allow Audio Journal's blind and visually impaired listeners to access previous broadcasts of Audio Journal's programs.

The app currently has the following features:

- The ability to tune in to Audio Journal's live broadcast.
- The ability to browse archived broadcasts
- Integration with Audio Journal's website
- The ability to "favorite" programs
- The ability to change the color palette of the app
- Compatibility with Apple's accessibility features

When the app is finished, it will also have the following features:

- The ability to use a search bar to find programs
- The option to continue listening to the last broadcast you opened
- The option to navigate the app using voice control.

We will be updating the app as we add new features and address issues, so check to see if a new version of the app is available before testing.

Testing Instructions:

The testing will begin with a guided testing phase, where you follow a set of instructions and observe the results. You should use whatever accessibility options you normally use to navigate apps on your iPhone. Once the guided testing phase is over, you will answer a set of questions about your experience. We encourage you to send your responses to these questions as soon as possible. After you've answered the initial questions, you will use the app on your own for a week at your leisure. At the end of the week, you will answer a second set of followup questions. The answers to both sets of questions should be submitted as a reply to this email.

Guided Testing Phase:

1. Open the app to the main menu and press the "Listen Live" button. This should open a media player that tunes into Audio Journal's live broadcast (after a short advertisement).
2. Navigate back to the main menu and press the "Archived Programs" button. This will bring you to a screen where you can browse categories of Audio Journal's programs. Click on a category to find the name of a particular program. Use this menu to find the listing for an individual program of your choice.
3. Click on a particular program. The program listing contains the program title, the program description, and the list of previous broadcasts. There is also a button that allows you to favorite that particular program. Press this button. The button icon should change from gray to yellow. If you're using VoiceOver, the VoiceOver label should change as well.
4. Once you've favorited the program, press one of the buttons that leads you to a specific broadcast with a date. This will open the media player.
5. The media player has the options to pause the broadcast, skip 15 seconds backwards or forwards, and adjust your location in the broadcast. Take some time to familiarize yourself with these controls and listen to the broadcast (You do not need to listen to the entire broadcast).
6. Navigate back to the main menu and press the button labeled as "Favorites". This will bring you to your list of favorite programs. The program that you favorited earlier should be here. Clicking on this program will take you back to the program listing with the description and broadcast dates.
7. (This step is only for those who are fully or partially sighted) Navigate back to the main menu and press the "Color Palette" button. This is located in the top left corner of the main menu. Pressing the button will cycle between different color palette options. Cycle through all of the options until you get back to the default gray palette with colored buttons.
8. This marks the end of the guided testing phase. At this point, please answer the following questions about your experience.

Questions After Initial Testing Phase:

Which accessibility options did you use when navigating the app? Check all that apply

- VoiceOver,
- Display/Text Size
- Zoom
- Magnifier
- Motion
- Spoken Content
- Audio Descriptions
- Voice Control
- No Accessibility Settings

On a scale from 1 to 5, with 5 being most proficient, how would you rate your skill as an iPhone user?

Are you a current or former Audio Journal listener?

If Yes:

What is/was your main way of listening to broadcasts? Check all that apply

- Smart Speaker
- Smart phone
- Website link
- Landline phone
- Cable tv
- Receiver

Have you used the Audio Journal website to access previous broadcasts?

- Yes
- No

Opinion Based Numerical Questions:

Answer the following questions with a scale from 1 to 5, with 1 meaning you strongly disagree, and 5 meaning you strongly agree.

1 - 2 - 3 - 4 - 5
Strongly Disagree Strongly Agree

Navigating the app was easy and intuitive...

Using this app was easier than using most other apps...

Opinion Based Qualitative Questions:

What changes (if any) do you think should be made to the layout of any of the app screens?

Are there any features you feel don't work like you would have expected? If so, which ones?

Are there any features you feel are missing? If so, what would you add?

Questions to Determine if Features Worked

When navigating the main menu with VoiceOver, did all of the buttons have descriptive labels?

Are the buttons on the main menu arranged in a good order?

- Yes
- No

If no, what order do you suggest?

Listen Live 1

Archived Programs 2

Favorites 3

Help 4

Color Palette 5

For example if you answer 5,4,3,2,1 it would mean you want the button order to be:
Color Palette, Help, Favorites, Archived Programs, Listen Live.

Did the program categories load properly? (Local Newspaper, Retail Circular and Sales, Specialty Program, Twice Monthly)

Did the program listing load properly? For example if you choose Retail Circulars and Sales category, then program listing should show Bargain,Bargains - Grocery Ads, and Shoppers Guide - Department Store Ads

- Yes
- No

If no, what did you have to do to get it to load?

Were your favorite programs saved properly?

- Yes
- No

If any of the features tested did not work as intended, please describe in as much detail as possible what did not work properly...

Did you have any difficulty using the app?

- Yes
- No

If yes, what were the issues that you had?

(Answer only if you are fully or partially sighted) Are the color palette options appealing?

- Yes
- No

Are there any color palette options you think should be there that aren't?

Are there any features you feel are missing? If so, what would you add?

Now that you have access to the application, how long does it take you to access previous broadcasts?

Do you feel that the app makes it easier or faster for you to access previous broadcasts?

Do you see yourself using the application in the future?

Appendix D: Round 2 Testing Instructions

App Information:

The Audio Journal app is being created for iPhones and iPads. The main purpose of the Audio Journal app is to allow listeners to access previous broadcasts of Audio Journal's programs. These programs include local news from the Worcester, MA area, as well as a number of other specialty programs.

The app currently has the following features:

- The ability to tune in to Audio Journal's live broadcast
- The ability to browse archived broadcasts
- Integration with Audio Journal's website
- The ability to "favorite" programs
- The ability to change the color palette of the app
- Compatibility with Apple's accessibility features
- A search bar to help users find programs
- The option to continue listening to the last broadcast you opened
- To option to navigate the app using Voice Control

We will be updating the app as we add new features and fix bugs, so check to see if a new version of the app is available before testing.

Testing Instructions:

The testing will begin with a **guided testing phase**, where you follow a set of instructions and observe the results. Use whatever accessibility options you normally use to navigate apps on your iPhone. These instructions will not guide you step by step on how to use the app, but will instead ask you to find and test the features on your own. We encourage you to look through the app's Help Menu to learn more about the features. If you still have trouble

completing any of the instructions after reading through the Help Menu, please skip the current step and move on to the next.

Once the guided testing phase is over, you will answer a set of questions about your initial experience. If you would like to set up a phone call for us to ask you the testing questions, please send an email to gr-audiojournal@wpi.edu, and we'd be happy to accommodate you. It is important that you answer these questions as soon as you can after testing, so please plan accordingly.

After you've answered the initial questions, you will use the app on your own for a week at your leisure. At the end of the week, you will answer a second set of followup questions, either by email or over the phone. Please read the next section for the guided testing instructions.

Guided Testing Phase:

1. Tune into Audio Journal's live broadcast. A media player will open that automatically plays Audio Journal's live broadcast (after a short advertisement).
2. On the live media player screen, familiarize yourself with the various controls.
3. Use the app's Browsing Menu to find a program listing. Each listing includes the program's description and a list of previous broadcasts by date.
4. Once you're on the listing for a particular program, you have the option to add that program to your "Favorites List". Add a program to your Favorites List, then choose a broadcast to listen to by date.
5. When playing an archived program, familiarize yourself with the media player controls. Notice that the archived media player has more controls than the live media player.
6. Access your selected Favorite program from the Favorites Menu. Do not use the Browsing Menu.
7. If you know the name of a particular program you want to hear, or are looking for news specific to your community, you can use the search function. Try searching for "Accent on Ability", "Community News - Gardner", or "Speaking Volumes".
8. Use the Voice Control feature to search for the same program from the previous step.
9. This marks the end of the guided testing phase. At this point, you should answer the initial testing questions.

Questions After Initial Testing Phase:

Which accessibility options did you use when navigating the app? Check all that apply

- VoiceOver,
- Display/Text Size
- Zoom
- Magnifier
- Motion
- Spoken Content
- Audio Descriptions

- Voice Control
- No Accessibility Settings

On a scale from 1 to 5, with 5 being most proficient, how would you rate your skill as an iPhone user?

Are you a current or former Audio Journal listener?

If Yes:

What is/was your main way of listening to broadcasts? Check all that apply

- Smart Speaker
- Smart phone
- Website link
- Landline phone
- Cable tv
- Receiver

Have you used the Audio Journal website to access previous broadcasts?

- Yes
- No

Have you previously participated in testing the Audio Journal app?

Opinion Based Numerical Questions:

Answer the following questions with a scale from 1 to 5, with 1 meaning you strongly disagree, and 5 meaning you strongly agree.

1 - 2 - 3 - 4 - 5
Strongly Disagree Strongly Agree

Navigating the app was easy and intuitive

Using this app was easier than using most other apps

Opinion Based Qualitative Questions:

Did you find all the app features during the guided testing?

If No, which features were you unable to find and why?

What needs to change to make these features easier to find?

Which app features were difficult to use?

Please describe, in detail, what you didn't understand or why the feature was difficult to use.

Did the app features work like you expected?

If not, which feature, and how did you expect it to work?

Do you recommend any changes to the layout of the app?

If yes, please describe.

Did the app have all the features you expected to find?

If not, what features do you recommend be included.

Did you notice any bugs or other unintended app behavior? Some examples of bugs could include:

- The favorites menu contains multiple buttons for a single entry
- Button text stretching outside of the button's border
- The media player not playing any audio

If yes, please describe in as much detail as possible what didn't work.

Did the information on the help pages aid you in learning how to use the app?

If not, which features need better descriptions?

Did you have any other difficulty using the app?

If yes, what was difficult?

(Only answer the next question if you used VoiceOver when testing the app)

When navigating the app with VoiceOver, did all of the buttons have descriptive labels? If not, which labels would you change?

(Only answer the next 2 questions if you are fully or partially sighted)

Did the app features work like you expected? If not, which features did not work like you expected?

What features could be added to the app?

Will you use the app in the future?