Improving Media Access for Audio Journal's Print Disabled Listeners

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Abstract

The Audio Journal is a radio reading service in Worcester that broadcasts to the blind and visually impaired people in Central Massachusetts. They approached the Worcester Community Project Center with a specific goal of developing either a smartphone application or an Alexa skill to make it easier for their users to access their archived and live content on-demand. To achieve this goal, we interviewed 21 people with visual impairments, print disabilities, social service workers, and app developers and determined the best possible platform and features that were needed in the software. We found that a simple and easy to use, accessible iOS app was the best option for this population. We also created a concept design for the app as a model for future development of the application.

Acknowledgements

We would like to thank Mary Frandsen, Executive Director of the Audio Journal; it has been a great pleasure to work with such a kind and giving person, and it has made work on this project much more rewarding, knowing that it would help the Audio Journal and its listeners. We also would like to thank Liz Myska for welcoming us into the blind and visually impaired community. Whether it was inviting us to the WalkFit (a walk for the visually impaired people), sharing her wealth of contacts with us, or giving us advice on our project, all of her help was invaluable, and we sincerely thank her for her help. Additionally, we would like to thank Professor Loiacono for sharing her knowledge of app accessibility with us. We would also like to thank the students of the Envision Success Project, as well as Audio Journal's current and former listeners, whose experiences and knowledge helped us to shape our app design.

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Executive Summary

The Project and its Goals

Everybody knows visually impaired people are a part of our society. More than 2.2 billion people in the world are blind or visually impaired (World Health Organization [WHO], 2019b). However, many people have no idea of the struggles this population must overcome to function in today's technology-oriented world. There are several assistive technologies that VIPs (visually impaired persons) can use daily to make their life easier. In addition to assistive technologies, some organizations provide content to the blind, and one such organization is, Audio Journal, a nonprofit radio reading service that broadcasts programs to the blind, visually impaired, and print disabled listeners all day, every day. There are multiple ways for Audio Journal listeners to access their live content including smart speakers, landline phones, cable TV, and a special radio receiver provided free of charge to people who request one.

While there are many ways to access live content, the same cannot be said about their previous programs or archived content. That is why the Audio Journal approached us with a specific goal to find the best way for their listeners to access their content on-demand. Initially, there were two possible options, an Alexa skill or a concept design for an app, and our job was to determine the better one through research and write a report with recommendations for the future engineer team. In the case we decided an app was best, we also needed to create a concept design for the app.

Methods

The most important population that we needed information from was Audio Journal's listeners. The main goal was to learn more about how they access Audio Journal, how they'd prefer to access it, what assistive technologies they have, whether they need them to access Audio Journal's broadcasts, and what accessibility features they'd need to use a smartphone app. It was also important that we spoke with visually impaired people who use smartphones. While there are Audio Journal listeners who use smartphones, many of their listeners are older than 65 and less likely to use

smartphones as a result. To ensure that we got feedback from smartphone users, we expanded our target audience to include people with print disabilities who don't necessarily listen to the Audio Journal.

We also felt that it was important to meet with social service workers who work closely with the blind and visually impaired. While getting information from listeners directly was undoubtedly vital since it is a challenge for the Audio Journal to keep track of its listeners, our pool of known listeners was only a fraction of the population. Interviewing social service workers who work closely with people who are print disabled helped to fill in the gaps. Finally, it was important to learn more about best practices from actual software developers that had experience working with our platform. Ideally, we wanted to get in contact with developers that made software with the accessibility features that Audio Journal's listeners need.

Because of the qualitative nature of the information we needed, we decided to conduct interviews with our target populations. Due to the coronavirus outbreak, these interviews were done either over the phone or through video conferencing services like Zoom.

Findings

With all of the knowledge we had gained from 21 interviews and our background research, we were able to find the ideal way to create our concept design of the Audio Journal app. First, we determined the ideal platform to deliver the app on. Initially, we were considering either a smartphone app for Android or iPhone or a skill for the Amazon Echo. After our interviews, it was obvious that the best platform was the iPhone. We made this decision because of its popularity with Audio Journal listeners, as all Audio Journal listeners who had smartphones had an iPhone, and because of its tremendous accessibility features such as *VoiceOver* and *Zoom*, the magnifying feature not the video conferencing service. Apple's accessibility features received high praise from app developers and social service workers as well, solidifying the decision to have the iPhone as our platform.

After determining the platform, our data suggested that would make our app accessible to Audio Journal listeners. We separated the features into two categories,

primary and secondary features. The primary features were the features most important to the app's accessibility. These features were *VoiceOver* and *Zoom* compatibility, the ability to listen live, and a *search and browse* feature to access previous broadcasts. Without these features, the app would not be usable by most audio journal users. The secondary features include *voice control*, a *color palette* changer, a *favorites* section, and a *continue listening* option. The secondary features, while not as important as the primary ones, supplement the primary ones to make the user's experience as easy as possible.

Finally, we found implementation strategies that will make the app even more accessible and easy to use. The main strategy is keeping it simple. Keeping it simple is the most important implementation strategy that makes the app more intuitive and understandable for those who are not that technology literate. The other strategies are keeping the most important items at the top of the screen, and the other is to keep the app' layout static. These other strategies help keep the app simple and will aid the user in navigating the app more easily.

Conclusion & Recommendations

A future team that continues this project and turns our concept design into a fully functioning app should keep the target audience in mind when creating the app and keeping accessibility and functionality the main focus. We also recommend the app interface with Audio Journal's website to minimize maintenance for the app. The team should also be aware of some of the obstacles that can occur when trying to get an app on the App Store, such as the review process potentially taking longer than expected. We also encourage the future team to reach out to us if they have any further questions or concerns, as we have developed a lot of contacts and insight into the blind and visually impaired community that would be very helpful.

Chapter 1: Introduction

In the information age of today, where almost everything and everyone is connected through the Internet, the amount of online content at your fingertips is endless. From hit T.V shows, to popular music, to more books than any library in the world, finding entertainment on the internet is easy and accessible for almost everyone. This is true for most people, however, not everyone has such convenient access. If you fall in the 3% of people living in Massachusetts who are visually impaired or blind (National Federation of the Blind [NFB], 2019), making use of the content available on the internet becomes exceedingly difficult. Several organizations provide content and information for visually impaired people (VIPs). One such organization in Massachusetts is the Audio Journal in Worcester.

The Audio Journal is a nonprofit radio reading service that broadcasts programs to the blind, visually impaired, and print disabled listeners all day, every day. They have 130 volunteers and broadcast to thousands of listeners. However, the fact that many of their listeners are blind or visually impaired has presented some unique challenges for the organization. While there are many different ways to access their live content, at the moment there are few options for listeners to view previous broadcasts. Options for receiving live broadcasts include smart speakers, landline phones, cable TV, and a special radio receiver provided free of charge to people who request one (Audio Journal, 2019b). Meanwhile, the only way for listeners to access Audio Journal's archived content is through their website. However, accessing content in this manner is not nearly as convenient for those who are visually impaired.

This is why the Audio Journal approached us to help them start the process of creating an Audio Journal app that would allow their listeners to easily access previous broadcasts. While our project group did not develop the app ourselves, we determined the necessary features and created a concept design for the app. In addition, we made a determination on whether or not their listeners will need something else in addition to an app, such as a smart speaker skill. In order to accomplish this, we had to think creatively and do extensive research to understand the struggles associated with visual impairments and more specifically, Audio Journal's listeners. The unique demographics for their audience made designing their user experience a more complicated issue than

it may seem. This is because many of their listeners are 65 years or older and less technically experienced. In the end, we hope that our findings and recommendations will be used to create convenient and effective software so Audio Journal can better aid the print disabled in Massachusetts.

In this document, we have detailed the research done in preparation for our project, our methods for getting the information we needed, and our findings and recommendations.

Chapter 2: Literature Review

Everybody knows visually impaired people are a part of our society. More than 2.2 billion people in the world are blind or visually impaired (WHO, 2019b). However, many people have no idea of the struggles this population must overcome to function in today's technology-oriented world. In the 21st century, we have access to so much information that some may even say that an abundance of knowledge is a problem of today's society. We know how much information there is in articles, books, magazines, etc. and how many doors open with the use of the internet. But what happens when you are blind or visually impaired? Or print disabled[1]?

Many different conditions may cause someone to be print disabled and they face many unique challenges in their daily lives.

Print *Disabilities*

Visual impairments aren't the only reason some people have difficulties with reading. One such condition is dyslexia. Dyslexia is not a disease. It's a condition a person is born with. People with dyslexia tend to use different parts of their brains while reading compared to people without it. Because of that, reading is a very slow and hard process for a dyslexic person. Because there is no single test that can diagnose dyslexia, it becomes hard to tell the exact number of people with this condition. It was estimated that between 5-15% of Americans had dyslexia in 2004 (Society for Neuroscience, 2004).

Another condition that can make a person print disabled is Parkinson's disease. Parkinson's disease is a progressive nervous system disorder that affects movement. An estimated one million people in the United States are currently living with Parkinson's disease (Downward & Pool, 2019). The signs and symptoms of Parkinson's disease can be different for everyone. Common symptoms of Parkinson's are tremors, rigid muscles, impaired posture and balance, and loss of automatic movements. In

[1] The term 'print disabled' refers to any person with a condition that makes them unable to read printed material effectively (Beyene, 2018).

addition to all of these difficulties, “In PD, the saccades[2] tend to be slow, which means reading can be difficult if the eyes are unable to find the correct place on the next line.” (American Parkinson Disease Association [APDA], 2020).

Dementia also falls under the condition spectrum that can cause print disability. Dementia is a general term for diseases and conditions characterized by a decline in memory, language, problem-solving and other thinking skills that affect a person's ability to perform everyday activities such as reading the newspaper or surfing the web. Worldwide, approximately 50 million people have dementia (WHO, 2019a). All of these conditions that cause a person to be print disabled come with their own challenges and struggles as well.

Everyday Difficulties Faced by the Blind and Visually Impaired

In 1994 and 1995, the Center for Disease Control and Prevention (CDC) used the National Health Interview Survey (NHIS) to gather information about men, women, and children with disabilities living across the country (Zuckerman, 2004). They interviewed thousands of adults and children with disabilities including 779 people who were legally blind. The study found that most visually impaired people were elderly, usually over the age of 62. The majority of people with blindness or visual impairments lived alone and became blind due to accidents. Also, 19% of them lived in poverty and only 19% were employed. “Poverty is a problem for approximately one in five blind women, regardless of their age. Poverty is less common for older men. While almost equal numbers of legally blind men and women under 65 are living in poverty (21% and 24% respectively), the gender gap widens after the age of 65, with only 8% of men living in poverty and 21% of women living in poverty” (Zuckerman, 2004, p.10*)*.
This is interesting because we can see how much things have changed since the early 1990s. According to the Social Security Administration, if a person is receiving Social Security disability benefits and is blind, he/she can earn as much as $2,110 a month in

[2] Saccades are rapid eye movements that change the point of fixation (Purves, 2001).

2020. This is higher than the earnings limit of $1,220 a month that applies to disabled workers who aren't blind (Social Security Administration [SSA], 2020). Also, 44% of the blind population is employed, according to the American Foundation for the Blind (AFB), but this figure is still less compared to the 79**%** employment rate for those without disabilities. Also, it is estimated that 27% of visually impaired people in the United States live below the poverty line (NFB, 2019).

Due to their condition, there are many challenges people with visual impairments must overcome to operate “normally” on a day to day basis. According to Zuckerman (2004), when people with visual impairments were asked about emotional and mental health issues:

- 17% reported at least one emotional or mental problem, most commonly depression and anxiety.
- 13% were frequently confused, disoriented or forgetful.
- 9% had trouble coping with daily stresses.
- 7 % said they had trouble concentrating long enough to complete tasks

While living with these conditions can be incredibly challenging, there are several tools that people with print disabilities or visual impairments can use to read or access computers, software, and apps. Besides those tools, there are organizations like Audio Journal, whose specific goal is to provide information to those living with print disabilities, that they would otherwise have no access to.

Radio Reading Services

A radio reading service is 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. Most of these services use volunteers to read these information sources that are not normally available in a Braille or audio format. These services are mostly broadcasted “on a subcarrier channel of an FM radio station” (International Association of Audio Information Services [IAAIS], 2020), meaning that the listener must have a special radio receiver, typically given to them by the

organization, in order to tune into the program. In addition to this method, more and more radio reading services are making their content available for streaming online. Our sponsor, Audio Journal, is one such service.

The Audio Journal started “in 1987 with five volunteers to 300 listeners from an unused closet at the Worcester Public Library. It now reaches thousands of homes on special receivers, on cable television, via telephone, internet, and smart speakers with the help of over 150 volunteers.” (Audio Journal, 2019a). The Audio Journal here in Worcester directs many of its broadcasts toward the local population of Central Massachusetts, reading local community news, the Worcester Telegram and Gazette, and the bargain pages of the local supermarkets. The Audio Journal also produces a lot of their own original content, highlighted by the program Speaking Volumes, “a book club for those without sight” (Frandsen, 2019) which has won the International Association of Audio Information Services Program of the Year and has been featured in *O, The Oprah Magazine* in February of 2019 (Frandsen, 2019). Most of the community news, and original content the Audio Journal broadcasts is also available to play whenever on the Audio Journal’s website, not just live on the radio. In order to access the content online, the listener must use the computer which, if they are blind and visually impaired, will most likely require the use of an assistive technology[3].

Assistive Technology

In addition to radio reading services, there are a number of assistive technologies that the blind and visually impaired can use to get information. We needed to know the technology they use to access software to have better understanding what features an app for people with print disabilities needs.

The assistive technology that is most commonly used by the blind and visually impaired is screen readers. Screen readers can read on-screen text out loud, so the

[3] Assistive technology (AT) is a piece of equipment or software program that is used to improve the functional capabilities of persons with disabilities. (Assistive Technology Industry Association, 2020).

users do not have to. A screen reader is the gateway between the computer's operating system and the user. The user sends commands by pressing different combinations of keys on the computer keyboard to instruct the speech synthesizer to speak automatically when something changes on the computer screen. While most screen readers are computer software, there are some like the “Eye Pal Ace” (Figure 1) which are physical devices (AFB, 2019).

Figure 1: Eye Pal Ace Picture

Source: http://www.awadavision.com/portfolio_page/magnifiers-eye-pal-plus/

However, they’re not perfect. Not all online media is compatible with screen readers, especially if the media wasn’t designed with accessibility in mind. In addition to speech feedback, screen readers can provide information in Braille. An external hardware device, known as a refreshable Braille display, is needed for this.

Refreshable braille displays (Figure 2), like screen readers, read text from the screen, but instead of reading it aloud, they display the text in braille on the device. These devices can display between 40 to 80 characters depending on the device (AFB, 2019). This allows users to check things like spacing and indentation, and it also can be used silently. Unfortunately, these are a much less viable option for people with blindness due to the immense price. The cost of these devices ranges from $3,500 to $15,000 based on the number of characters it can display (AFB, 2019). But people like

Kevin Carey, executive Committee Member of ICEVI and Chair of the World Blind Union Technology Committee, are trying to address this problem. On March 23rd of 2016, Cary unveiled a 20-cell refreshable braille display at the CSUN Conference in San Diego. This revolutionary new device has the potential to be manufactured for around $320, making it a less expensive alternative to refreshable braille devices that are currently available on the market.

Figure 2: Braille display picture. Source : https://nelowvision.com/product/brailliant-bi-40/

For those who have difficulty with reading small print, there are screen magnifiers (Figure 3). Screen magnifiers are the hardware that allows users to enlarge anything that you put under it. Screen magnifier software is also available that allows users to enlarge sections of their computer or smartphone screens so they can better see text and images (Bureau of Internet Accessibility, 2017). It can be especially useful for finding the mouse cursor on computers.

FIgure 3: Screen magnifier

Source :https://penntoday.upenn.edu/news/how-technology-making-education-more-accessible

Most modern smartphones have assistive technology built in. The iPhone has a bevy of accessibility features that allow blind and visually impaired users to operate the device effectively. Their most advertised feature is the *VoiceOver* tool, which does many things to help their blind users. In addition to standard screen reading capabilities, the tool reads aloud each character when typing and can identify items shown in images (Apple, 2020). Other accessibility features for the iPhone include a screen magnification tool as well as dictation software. Similarly, there is screen reading software for android called Google TalkBack, which has similar features to Apple's *VoiceOver* (Androidcentral, 2014). In addition to Google's TalkBack, there is also BrailleBack, which allows you to use a BrailleDisplay in conjunction with TalkBack as an alternative to audio.

Another useful assistive technology is a smart speaker. A smart speaker is a device that makes it possible to interact with computing systems by voice, without touching a device (Bently et al., 2018). There are various smart speakers on the market

like Amazon Echo and Google Home and their popularity is increasing year by year (Figure 4).

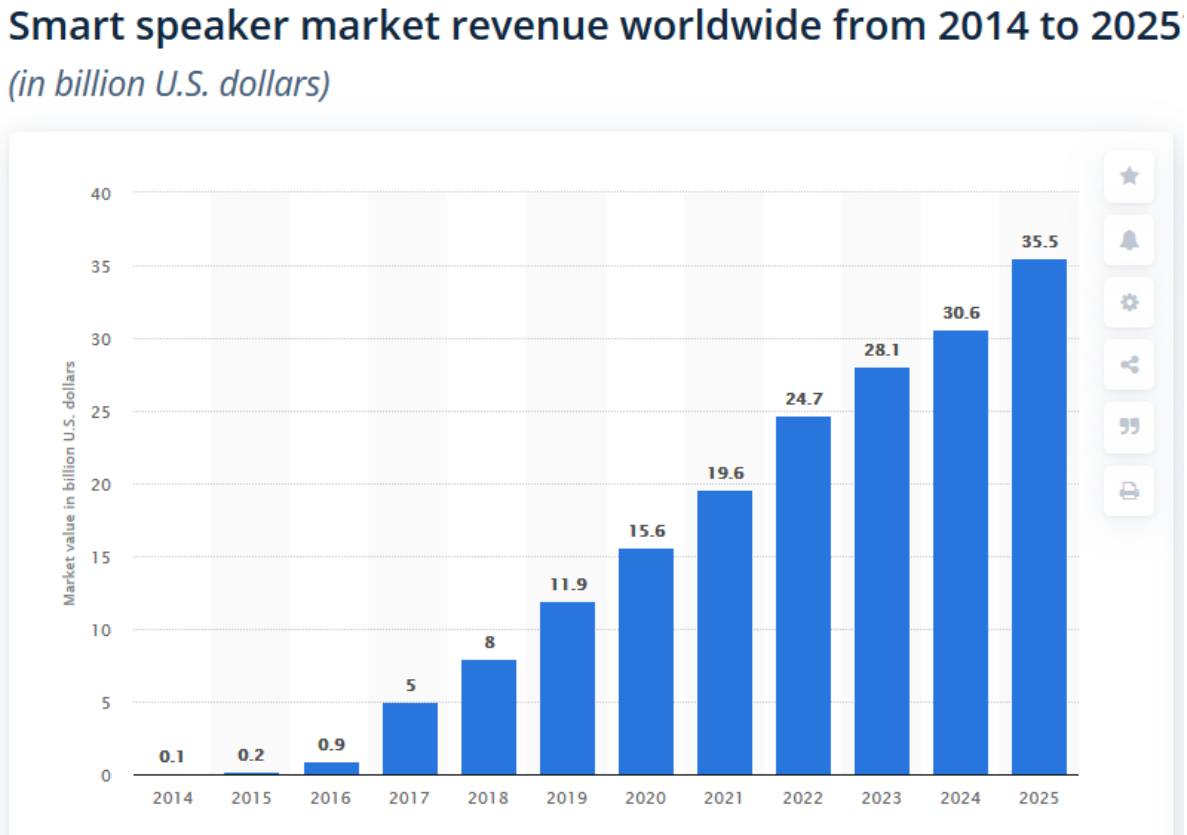


Figure 4: Smart Speaker Revenue

Source: https://www.statista.com/statistics/1022823/worldwide-smart-speaker-market-revenue/

Currently, Amazon dominates the market of smart speakers, and its virtual assistant Alexa is one of the most popular. “Amazon is the market leader and ships the largest share of smart speakers” (Statista Research Department, 2019). This is one of the reasons why we considered the development of an Alexa Skill as a supplement to an application (app).

Web Content Accessibility Guidelines

A set of standardized guidelines for making accessible software already exists in the form of the Web Content Accessibility Guidelines, or WCAG for short. The WCAG is made by the World Wide Web Consortium, which is the standards organization for the World Wide Web and is run by Tim Berners-Lee, the creator of the World Wide Web

(W3C, 2019). The most recent version of these guidelines, version 2.1, was published in June of 2018 (Kirkpatrick et al., 2018). These guidelines are meant to make the internet more accessible for people with visual, auditory, and speech impairments, among others. It is the gold standard in terms of website accessibility, and most of its guidelines are required by law in many countries, including the United States (Mueller, et al., 2018). The 13 accessibility guidelines in the document are divided into sections based on four principles, which state that content should be (1) perceivable, (2) operable, (3) understandable, and (4) robust (Kirkpatrick et al., 2018). While these guidelines are meant to address web content, the recommendations can also be applied in the context of app development in order to create accessible content. In fact, the W3C provides instructions on how to adapt the WCAG recommendations to other software (Korn et al., 2013). Understanding and implementing these guidelines is a vital part of designing software, web based or otherwise.

Software Development for Persons with Disabilities

Audio Journal approached us with a specific goal of developing a concept design of an app but before we could do that, we needed to know what benefit Audio Journal listeners would get from it and therefore what features would be necessary to accomplish our goal. A feature in an app is a tool for implementing what customers want, the way of meeting their needs and also the major part of UX (User Experience). There is no consensus on the definition of UX in literature, but it is a common belief that UX focuses on having a deep understanding of users, what they need and what they value. The main benefit that our target audience was looking for was accessibility, we needed to make Audio Journals content on demand more accessible to its listeners. From here we could start thinking about features that would make it possible and develop our UX starting from universal design.

When creating an app, the first thing developers consider is the need that the app will fill. If an app does not fill a need, then it has no use (Drew, 2013). The need that our product, a concept design of an app or an Alexa Skill, will fill is an easier way to deliver the Audio Journal's content to its listeners. When creating an app for persons

with disabilities, specifically visual impairments, the accessibility for the print disabled must be a primary focus as well. The design of a product with accessibility to users of all abilities in mind is called Universal Design. An example of this outside of the realm of apps is the inclusion of lowered curbs and crosswalks so people who require the assistance of a wheelchair can safely cross the street.

The key characteristics to remember when making something with Universal Design in mind are keeping it “simple, intuitive, equitable, flexible, perceptible, and a tolerance for error” (Sanchez & Togores, 2012, p. 47). The simplicity and intuitive characteristics help ensure that the design is easy to understand, regardless of the user’s cognitive ability. This means an app should be easy to use for someone with no prior knowledge of how the app works and without taking much concentration to use. The equitable aspect means creating an app that can be equally accessed by users of all abilities. This portion of Universal Design is very important for our project because our product should work regardless if the user is print disabled or not. Flexible design means that it can be accommodating or customizable to a diverse group of users so people can choose how they want to experience an app. A way this will fit into our project is making sure the font size of the text is adjustable to accommodate many different users with different needs. A perceptible app means that it can communicate information to the user “regardless of ambient conditions or the user's sensory abilities” (Zheng, 2020). Applying this to our project, a text-to-speech feature would fill this portion of Universal design, as information can be given to the user regardless of their ability to see. Building with a tolerance for error means to plan for human error when using the app, and that the app is forgiving to those mistakes. An example of this is being able to easily get back to the previous screen if the user accidentally touches the wrong area while navigating the app.

Unfortunately, Universal Design is hardly a primary design focus for most app developers as “The vast majority of the 425,000 iOS apps available at the App Store have been designed for sighted users”(Sanchez & Togores, 2012, p.48). Additionally, the accessibility features that do get added are layered over the normal app design as an afterthought. When Universal Accessibility is an afterthought, usability issues arise since more often than not, the accessibility features do not work as intended, because

they were not originally planned to be in the app (Sanchez & Togores, 2012). This is not the case with our project, however, as Universal Design has played a paramount role in designing our product from the very beginning. This has resulted in our product having features that allow it to be accessed by everyone, including those who are print disabled.

Accessibility Features

When it comes to making applications accessible to those with disabilities, there are many different ways to improve the user experience. One such way is alternative text for images. Alternative text allows web developers to embed text in images which can then be picked up by screen readers (Nengroo, 2017). By embedding text descriptions of the contents of a picture into the picture itself, users can understand the contents of an image or graph without having to look at it. This is especially important to people with blindness or visual impairments, since they may not be able to identify subjects of an image or figures in a graph. Having alternative text is especially important for time-based media such as videos. This is important because some people might have trouble reading subtitles quickly enough. Allowing users to adjust the size of the font is one small way to help improve the user experience for those with visual impairments. This type of feature is beneficial for people with mild visual impairments as opposed to those with more serious impairments or total blindness (Caldwell, et al., 2008). Similarly, improving the contrast between the text and the background can also improve accessibility for the same users by making the text easier to see.

One major thing to avoid when designing something with accessibility in mind is utilizing images of text. This refers specifically to text that is formatted as an image and does not include text that is included as a part of an image. The main problem with using images of text instead of text is that users cannot adjust the contents of the image to their needs. If the text is part of an image, the user will not be able to change the font, font size, or color, making it more difficult for the visually impaired to access their content (Mueller, et al., 2018).

From our research we developed an understanding of the issues faced by our target audience as well as the assistive technologies they use to access information on

computers and smartphones. In addition, we outlined the basic principles of universal design and the types of accessibility features that we considered in the creation of the app concept. In the next section, we discuss our methodology for gathering information about our target audiences and the benefits they seek from the app which will be converted to features in the actual app design.

Chapter 3: Methodology

Project Goals

Our main project goal was to create a concept design for an app that makes it easier for Audio Journal Listeners to access their content on demand. To do this, we set out to learn how Audio Journal's listeners accessed their content, the difficulties they faced accessing it, and how they would have preferred to access it. Since their listeners may have been using assistive technologies to accomplish this, it was important to learn which assistive technologies they used, and any difficulties they had with using them. We also needed to learn best practices for our app's platform, and if Audio Journal's listeners needed something in addition to an app to easily access their content. To accomplish these goals, we decided to gather information from three different populations.

Target Populations

The most important population that we needed information from was Audio Journal's listeners. The main goal was to learn more about how they access Audio Journal, how they would prefer to access it, what assistive technologies they have, and whether they need them to access Audio Journal's broadcasts. In the case that they used smartphones, we also needed to learn what accessibility features would be most helpful to them. It was also important that we obtained information from listeners who listen in a variety of ways, to ensure we heard a wide range of perspectives. To do so, we split listeners into three main groups: (1) those who listen with the radio receiver, (2) those who listen over the phone, and (3) those who listen with a smart speaker.

In addition, it was also important that we spoke with visually impaired people who use smartphones. While there are Audio Journal listeners who use smartphones, many of their listeners are older than 65, and less likely to use smartphones as a result. To ensure that we got feedback from smartphone users, we expanded our target audience to include people with print disabilities who do not necessarily listen to Audio Journal.

We also felt that it was important to meet with social service workers who work closely with the blind and visually impaired. While getting information from listeners directly was undoubtedly vital, since it is a challenge for Audio Journal to keep track of its listeners, our pool of known listeners was only a fraction of the population. Interviewing social service workers who work closely with people who are print disabled helped to fill in the gaps. By doing so we were able to gain further insight into the unique needs of the blind and visually impaired, as well as how they interact with assistive technologies. Another reason it was important to speak with these people is that they have experience working with a multitude of clients. This means that in some cases social service workers have a more holistic view on the needs of the blind and visually impaired, while a person with a visual impairment can only really know about their own personal experience.

Finally, it was important to learn more about best practices from actual software developers that had experience working with our platform. Ideally, we wanted to get in contact with developers that made software with the accessibility features that Audio Journal's listeners need. Talking to these experts helped us learn about not only the fundamentals of the design process, but on the specific problems that a future team might encounter during app development. These software developer interviews were incredibly helpful for us in the process of creating a concept design and making recommendations to the future app development team.

Review of Possible Methods

In order to obtain the best information we could from our target populations, we needed to ensure that our methods were effective. To do so, we reviewed the methods used by previous IQP groups, as well as how effective those methods were for obtaining the information they needed. Most of the IQP groups reviewed dealt with blind or visually impaired subjects. We considered the following methods for gathering information from our target population.

Surveys

A survey involves giving participants a questionnaire with quantitative or qualitative information. They can be useful for getting information from a lot of people without having to talk to them all individually (Fink, 2003). Two of the projects we reviewed, “Online Music Store Accessibility” and “E-Commerce for the Blind and Visually Impaired”, used surveys to gather information from people with visual impairments. However, there were problems with this approach. The first project was not able to get anyone older than 65 to fill out the survey (Kiryazov, 2007). Also, only 15% of people who were sent the survey responded (Kiryazov, 2007). As for the other project, they were unable to get any participants at all (Khan, et al., 2000). The low response rate for these surveys, combined with the difficulty of getting people older than 65 to participate makes them a poor choice for use in our study.

Interviews

An interview entails speaking with a single person and asking them questions with the intent of getting qualitative information (Oltmann, 2016). We reviewed two projects that used interviews. Those projects were “Educational Web Page Accessibility for Blind and Low Vision Users” by Deloge, Morgan, and Lapp (2001), and “Improving Voter Privacy for the Blind” by Amato and Blaise (2011). Of the two, the one that stood out the most was the study concerning voter privacy for the blind. The group used one-on-one interviews to gather information from visually impaired people (Leeber & Amato, 2011). While they were able to gain useful information from these interviews, they were not able to get some of the information they needed due to the phrasing of the questions combined with the interviewees’ group affiliations (Leeber & Amato, 2011). The main takeaway from the results of this study is that it is important that you think hard about the questions you ask during interviews, and to whom you are asking them.

Observation

Observation entails directly observing the behavior of your subjects. One of the studies we reviewed used observation as a method of obtaining information. Unlike the

previous studies, this one did not involve people who were blind or visually impaired. One study's goal was to observe student behavior and identify inefficiencies in an online tutoring system (McElroy & Alshuqaiq, 2011). Their project yielded the results they were looking for, and they were able to identify inefficiencies in the system by having a clear sense of the types of behaviors they were looking for. In addition, they were able to get the information they likely would not have found with interviews or surveys. We were initially planning to observe social service workers working with their clients in order to get a better idea of how people with print disabilities interact with assistive technologies. Unfortunately, due to the coronavirus outbreak, we could not use observation for our project.

Procedure

IRB Approval

Our project and its details were approved by the Institutional Review Board at WPI. Our IRB Consent Form given to interview participants can be found in the appendices of this document (Appendix B). The consent form was read to participants over the phone or sent to them over email, depending on the primary form of contact with the participant.

Population 1: Our Target Audience

Since our target audience was people with visual impairments or print disabilities, surveys would not have been appropriate for obtaining the information we needed. Because of their print disabilities, it was unlikely they would be able to fill out a written survey. In addition, the qualitative and open-ended nature of the information we needed made surveys less effective and lent itself better to interviews. Because of this and our review of previous projects, we decided to conduct interviews with our target audience to obtain information.

We originally intended to conduct the interviews with listeners in person, as we wanted to see for ourselves how they accessed Audio Journal and how they used

assistive technologies to access computers and phones. However, due to the outbreak of coronavirus, we were unable to conduct the interviews in person. All interviews for our target population were conducted by phone or through Zoom (remote video conferencing software). Details on interview questions can be found in the appendices of this document (Appendix A).

Population 2: Social Service Workers

The qualitative information we obtained from social service workers was similar in nature to the information obtained from listeners. The open-ended nature of the questions we needed to ask lent themselves better to interviews. In addition, it was important to take into account the unique experiences of the social service workers when constructing the questions. The interviews we conducted with social service workers were done through video conferencing services like Zoom. When it came to finding social service workers to work with us, we found many organizations willing to help through the Audio Journal, including the Massachusetts Association for the Blind and Visually Impaired, and New England Low Vision and Blindness. Connections like these allowed us to have a wide pool of social service workers to learn from.

Population 3: Software Developers

Once again, due to the qualitative nature of the information we needed, interviewing software developers was the best course of action for obtaining the information needed. We originally intended to conduct interviews in person so our interviewees could have shown us the software they have developed, but not everything went as we planned. To get the most out of these interviews, we needed to ensure we had knowledge on the features that would be in the app so we could focus on discussing the implementation of those features. As such, these interviews were the last ones our group conducted.

Difficulties

Because of the coronavirus, we were unable to fully realize the plans made in our proposal. We did not visit listeners in person to see how they access Audio Journal and use assistive technology. We also were not able to observe social service workers working with their clients. Because of this, we could not get any visual information from interacting with our target audience, which meant that we undoubtedly missed out on some information that would have helped us in the creation of our app concept.

Another challenge was that a significant portion of our population could not be contacted via the internet. Only 50% of people with disabilities use the internet daily, 23% of people with disabilities never go on the internet at all (Anderson, 2017) and only 67% of people ages 65 and older use the internet (Thompson, 2018).

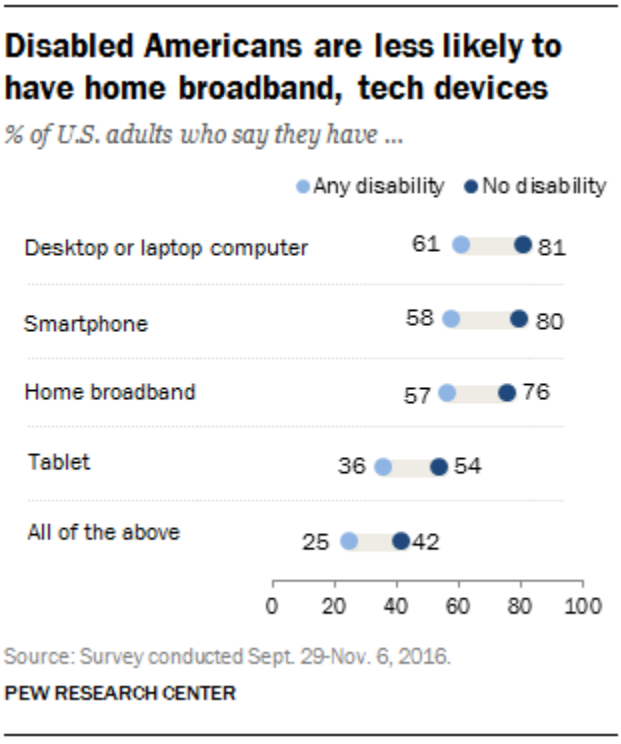


Figure 5: Disabled American Technology Use

Source: https://www.pewresearch.org/wp-content/uploads/2017/04/FT_17.04.06_techDisability_dotplot.png

Figure 5 shows that disabled Americans, in general, do not use technology as much as those without disabilities. These statistics combined with the fact that older Americans do not use technology as much as younger Americans (Thompson, 2018), shows that our target audience, older Americans living with disabilities, do not use technology as much as a non-elderly or disabled demographic. In addition, the Audio Journal does not have access to listeners' email addresses. Because of this, correspondence between us and listeners had to be done entirely over the phone.

As we knew from our sponsor, their listeners are mostly visually impaired or print disabled people, usually over 65 years old, who live alone. We had difficulties with contacting a population like this. The biggest challenge was recruiting interview participants because the Audio Journal has very little specific information about their listeners. For the most part, we only had specific listener information, such as names, phone numbers, and addresses only if the listener was given a radio receiver from the Audio Journal. It is challenging for Audio Journal to know who accesses their programming via their website, the Tune-in Radio app, or smart speakers. In the beginning our response rate was low, we conducted only 6 interviews out of 40 people we tried contacting. However, after talking to these people, the snowball sampling started to take effect, and we were able to find more interview participants.

To summarize, our methods consisted of interviews with VIPs, social service workers and app developers. The purpose of these interviews was to learn what features were needed for the app. In the next chapter we discuss the findings from our interviews and how we used those findings in the creation of our app concept.

Chapter 4: Findings and Analysis

In this chapter we discuss the results of our interviews. Our process for analyzing the data from these interviews started with compiling all the interview notes into a single document. Next, we split the interviews into groups based on whether they were a listener, another VIP, a social service worker, or a software developer. For each group, we created a table with important information about each interviewee. Some of this information included whether they owned smartphones or smart speakers, and if they would check out an Audio Journal smartphone app. Finally, we analyzed the interview notes, interview recordings, and information table to synthesize our results.

After talking to people from different populations, we developed a better understanding of the problem we needed to solve. From 21 people we interviewed, we learned a lot of useful information that we drew conclusions from.

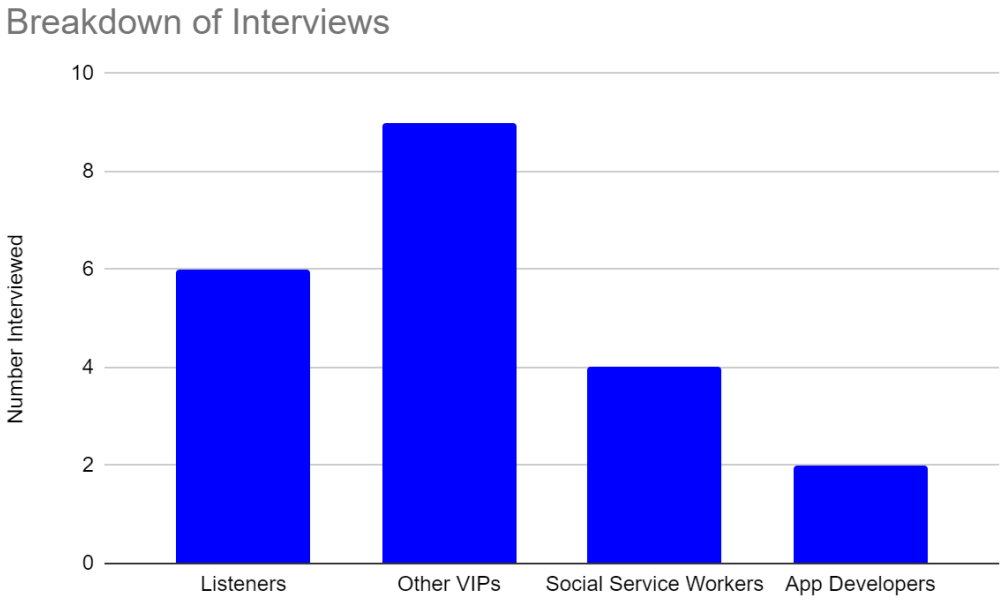


Figure 6: Breakdown of Interviews

From each group of participants, we got valuable insights on how visually impaired people make use of technology and what problems they face. From the audio Journal listeners we interviewed, we learned that all of the listeners who had smartphones, 100% of them had iPhones, which greatly influenced what platform we

decided to have the app on. Additionally, from social service workers we learned that most VIPs use a screen magnifier or a screen reader software to assist them while using technology, which had an impact on what features we decided to include in our app. From the ESP students, we learned how younger VIPs used technology, and from them is where we first learned of the iPhone's *Zoom* feature. Lastly, from app developers we learned that the most important thing our app needed to be was simple, from this we were able to develop strategies on how to implement our features into the app in a simple and easy to use manner.

Based on our data, we determined that our final deliverable was going to be a concept design for an iOS app rather than an Alexa skill. We also determined the features our app needed to have in order to be accessible to its users. We learned that an essential feature was *VoiceOver*[4]. In addition, our app needed to be compatible with the iPhone's other built-in accessibility features like *Zoom*[5], as well as the display and text size settings. We also got recommendations on how features needed to be implemented in our concept design. The most important thing we hypothesized, and later confirmed, was that we had to make our app design as simple as possible. What it means is that the screen should not be cluttered with different buttons and layout objects. From our interviews, we also learned that the layout needed to be consistent throughout the whole user experience, and the most important information needed to be on top of the screen. We were happy to see that most of the time, our findings were consistent across many different interviews, which strengthened our assumptions even more.

[4] VoiceOver is an iPhones built-in accessibility feature that makes it easier for people with visual impairments to use their phones.With VoiceOver, users can have their iPhone screen read to them, including buttons, icons, links, and other interface elements, and use gestures to navigate and select their options.

[5] Zoom is an iPhones built-in accessibility feature that allows users to magnify their screens. It is a very useful tool when you want to zoom in or out on specific text or objects or magnify your screen in general.

Themes from Interviews

There were a few themes that arose when we started conducting interviews. One of the first things we noticed was that all the listeners we were able to get in contact with were elderly. The average age of listeners that we spoke to was 69 years old. This meant that we initially had difficulty finding VIPs who used phones. However, once we did get in contact with them, we noticed very quickly that iPhones were the phones used most by the blind and visually impaired community. In fact, of the VIPs who had smartphones 100% of them had iPhones. All of our interviews with VIPs, both the elderly and young, pointed us towards Apple as being the best app platform for people with disabilities. This was reinforced by the social service workers we spoke with who told us that the accessibility features on the iPhone were second to none and told us that the vast majority of their clients had iPhones.

Another theme from our interviews with social service workers was the importance of screen readers like *VoiceOver* and *JAWS*, which is commonly used on computers. From this we knew that the app should have a screen reader. However, from app developers, we learned that the app should not have an independent screen reader, as this would mess up the screen reader that the listener was already using, and actually making the app less accessible. From these themes combined we determined that the app should be compatible with *VoiceOver* instead of having its own screen reader.

Another theme from our interviews was that most things in life are not naturally accessible to VIPs. One of the VIPs we interviewed recounted that in their neighborhood “there are no sidewalks, so [navigating] is a little more difficult because you have to stay real close to the curb”. The VIP community has to work very hard to do things that most people take for granted. If our app could make things easier for them in even a tiny aspect of their life, it would be very helpful to them.

Our Choice of Platform

Our main project goal was to start working on the creation of an Audio Journal app. But were people interested in an Audio Journal app in the first place? Of the 15 VIPs we interviewed, 11 of them owned smartphones. However, there was one group we interviewed that was less likely to own smartphones, and interestingly, they were Audio Journal's current listeners. Eight out of the nine non-listeners we interviewed owned smartphones, while only three out of the six listeners we interviewed owned smartphones. There are a few possible reasons as to why this was the case. The first is that we were only able to get in contact with those whom Audio Journal had given radio receivers, so we were not able to hear from many people who listen through other means such as smart speakers, landline phones, cable TV, and a special radio receiver provided by Audio Journal. In addition, we had a very low response rate from calling listeners. This means that we were unable to contact a very large portion of the listening population, and our sample size was very small as a result. The second reason is that the non-listeners we interviewed were much younger than Audio Journal's listeners. Seven out of the nine non-listeners we interviewed were under 25 years old, whereas most of the Audio Journal listeners were older than 50. If the ages of the people from the two populations were closer, the percentage of users with phones would likely be closer as well.

However, those who did own smartphones were excited about the prospect of being able to access Audio Journal's content on demand. All three listeners who used smartphones expressed interest in an app. In addition, when we asked non-listeners with smartphones if they would check out an Audio Journal app, all but one of the eight non-listeners said that they would. From these results it's clear that there is indeed interest for an Audio Journal app among the blind and visually impaired in central Massachusetts.

When doing our research, we also needed to consider the possibility that a smartphone app may not be the best platform to deliver Audio Journal's content to its listeners. Another possibility we considered was a smart speaker application. Seven out

of the 15 VIPs we interviewed owned smart speakers. Unlike smartphones, the likelihood of them owning a smart speaker did not vary much by age. Nearly half of listeners and non-listeners owned smart speakers. In the end, while the interest among Audio Journal listeners for a smart speaker application was about the same as the interest in an app, non-listeners were significantly less interested in a smart speaker app. Based on these interviews, we've determined that a smartphone app would be the most effective in both helping current listeners, and drawing in new younger listeners. With the delivery method decided, our next task was to determine the best platform for the app.

Our interviews with VIPs and social service workers made one thing crystal clear: The preferred app platform for people with blindness and visual impairments is iOS. All 11 of the VIPs we interviewed that used smartphones owned Apple devices instead of Android devices. Many of our interviewees named Apple's excellent built-in accessibility features as the main reason for choosing their phones. For example, one non-listener we interviewed said "Doing some research, I use my iPad too because it is also an Apple device [and] Apple's accessibility is really good" , when asked about what he used his phone for other than calling. The feature that was the most important for them to successfully navigate an iPhone was *VoiceOver*. Seven out of 11 of the people we interviewed with iPhones used *VoiceOver* as their primary method of navigating their phones. Our discussions with social service workers and app developers also pointed us in the same direction.

App Features

After talking with members of all of our populations, we came up with several features that would be helpful for Audio Journal listeners. Furthermore, we broke down the features into two categories: primary features and secondary features. The primary features category is made up of features that are essential for allowing someone who is blind or visually impaired to navigate the app. The secondary features category is made up of features that, while not mandatory, would make it easier for the user to navigate the app.

The primary features section consists of five features which fulfill the basic requirements of letting a blind or visually impaired listener listen to Audio Journal's live and archived broadcasts. These features are *VoiceOver* compatibility, *Zoom* compatibility, display and text size compatibility, the ability to listen live, and the ability to search and browse previous broadcasts. It is vital that the app be compatible with *VoiceOver*, which is Apple's fantastic screen reading software. The ability to use *VoiceOver* in an app is necessary for a blind person to navigate it. Similarly, the app must also be compatible with *Zoom,* which is Apple's built in screen magnification software. *Zoom* is a feature commonly used by those with visual impairments as opposed to blindness and is thus an important navigation tool for those people. It is also important that the app be compatible with the *display and text size* settings. This means that any text used in the app will adjust its size based on these settings. When doing this, it will be important that the layout is adjusted to accommodate the new font size. More details on this can be found in the concept design documentation (Appendix D).

The *listen live* feature would allow app users to directly listen to the live feed of Audio Journal's broadcasts. Finally, there is the *search and browse* feature. The *search and browse* function for archived broadcasts is actually a combination of two features. The browse portion would allow app users to navigate through Audio Journal's archived broadcasts to find specific broadcasts for a program they are interested in. The *search* function would allow the user to search and find a program or broadcast they already know they want to listen to. The search feature can be completed by either typing into the search bar or dictating the name of the program or broadcast the listener wants to hear. With these five features, the user will be able to navigate their way through Audio Journal's content and listen to their broadcasts.

The secondary features are meant to enhance the experience of the app and make it easier to use. These features include *voice control*, a *color palette changer*, a *favorites* section, and a *continue listening* option. The *voice control* option allows the user to search for the program they want to listen to with their voice. The *color palette changer* is to accommodate those who are color blind or can see some colors better than others. The user is able to switch through a number of different pallets in order to

have colors that make the app easiest for them to use. Another secondary feature is a *favorites* section. This feature allows the user to favorite programs they like and puts them in an easily accessible place, so they don't have to go through the process of searching for the programs every time they want to listen to them. Finally, the last secondary feature is a *continue listening* feature which allows users to pick up where they left off on a broadcast they have not yet finished listening to. Our interview participants said that “It should definitely have your library or your recently listened, like what you recently listened to, and the ability to tag something and then go back to it.” With all of these features combined, the Audio Journal listener will have an easy to use app that lets them access Audio Journal’s live and archived broadcasts, easily access the programs of their favorite broadcasts, select programs that they would like to listen to later and continue listening to programs they have yet to finish. Once the features were determined the next step was to find the best way to implement these features into the app to create the easiest user experience possible.

Implementation Strategies

Based on what we learned through our interviews, we have developed some implementation strategies in order to make the best use of the app’s primary and secondary features. There are three main strategies and principles that we have learned that enhance the features to their fullest potential. The first of these strategies is simplicity. Keeping the app simple is the most important strategy for implementing these primary and secondary features into the app. As one of the app developers we interviewed suggested, “The ability to adjust color background, the ability to change the size of text and amount of text on a page, and easier interface to use, not really complicated and easy to use with *VoiceOver* when it describes the screen to you. In many apps there is a lot of stuff going on and with a simpler interface it would be easier to understand.” Another app developer we interviewed said “Mainly try not to clutter it up too much” and “make it as simple as you can.” We heard over and over again from every population that simplicity is the key for making an app accessible. If it is complex, it is harder to navigate and would discourage listeners from using the app. If it is not

compatible with Apple's *VoiceOver* software, it is unusable for the majority of Audio Journal listeners.

The next two strategies both stem from the concept of simplicity. One of the things we heard from our conversations with social service workers was to ensure "the most important things are up at the top, so you'll hit them first when you use the accessibility software." Keeping the most important items at the top of the screen is an important strategy when making an app easy to use with *VoiceOver*, as *VoiceOver* starts to read left to right from the top of the screen then moves downwards. This means that if the items the user is most likely to click on are at the top of the screen, they will have to wait less time for *VoiceOver* to read it out to them. If an important item is at the bottom, then the user must wait for the *VoiceOver* to read out the whole page before they can get to the item they wanted.

The next important strategy was to keep a static layout for the app. In software design, there are often elements of the app layout that are added, removed, or updated depending on certain conditions. An example of using a dynamic layout in the context of a media player could be the addition of a "recently listened" section that only appears after you've watched something. When people with sight are navigating an app, they can easily pick up on these subtle changes to the layout, but that is not as easy for people with visual impairments or blindness. To that end, when designing this app for Audio Journal's listeners, it was important to keep dynamic elements to a minimum. However, we will not be able to completely remove these elements. For example, it is a common convention in media players like iTunes and YouTube for the play and pause buttons to be the same button; its function changes depending on whether the media is playing or paused. It is in situations like these that changing the common convention could harm accessibility more than it would help it. Using these strategies that we learned from talking with our target populations, we created the concept design for the app, which can be found in Appendix D.

Ancillary Findings

In addition to our findings that pertained to software development, we also found some other findings that would be helpful for our sponsor. One of the first things we discovered during our project was that Audio Journal's contact list was not an accurate representation of the current listening population. As part of the process of contacting listeners, we checked the obituaries for the almost 500 people on their contact list. Unfortunately, we found that 22% of the people on the list had passed away. In addition, many of the people from the list that we contacted did not currently listen to Audio Journal. There was even one person on the list that we contacted who said that they had never heard of Audio Journal. It's clear that the list is no longer an accurate representation of current radio listeners and would need to either be fully updated or redone.

By speaking with listeners, they were able to provide some feedback which could be used to improve Audio Journal's service. The main reason that the listeners we interviewed listen to Audio Journal is to be informed with what is happening in the area. However, listeners expressed interest in other shows like Radio-Active Theater and Speaking Volumes. We also encountered some listeners and former listeners who had some difficulties accessing Audio Journal's content. Here were some of the issues people have encountered:

- One radio listener stopped listening because they took a break and when they came back, they did not know what shows were on at what times
- Static when using the radio receiver
- One listener used to listen over TV but did not know it was available online.

We hope these ancillary findings will help Audio Journal to better serve their listeners in the future.

Chapter 5: Conclusions and Recommendations

Audio Journal is a radio reading service that broadcasts to print disabled listeners in Central Massachusetts. We have developed a concept design for an app that gives their listeners easy access to their content. For our research, we looked at the difficulties faced by Audio Journal's listeners and the assistive technologies they use to access computers and phones. We also looked into the app development process to learn what features make an app accessible for people with print disabilities.

To get the rest of the information we needed to develop our concept design, we interviewed Audio Journal's listeners, other people with visual impairments, social service workers, and software developers. The purpose of these interviews was to get an in-depth look at the needs of people with print disabilities, and what features are necessary in order for them to efficiently use an app.

We have found that in order for the app to be accessible to Audio Journal listeners, it needed to be compatible with *VoiceOver*, have a *screen magnifier*, have a *search function* for previous broadcasts, as well as an easy way for listeners to listen live. Additionally, we have supplemented these primary features with secondary features including *voice control* that will overall improve the listener's experience. In order to get the most out of our features and ensure the listener's ease of use, we developed several strategies in order to best implement the features into the app format. These strategies, such as keeping it simple, keeping important items at the top of the screen and a static layout, are all strategies we used in order to make the concept design of our app as accessible as possible.

A future team that picks up this project should remember who Audio Journal's listeners are when developing the app. It is important to keep the needs of the blind and visually impaired in mind so that the app works for them. They should also remember that aesthetics are not as important as they would be in an app for sighted people. The main focus when developing the app should be on accessibility and functionality. If these two are not at the forefront of the development process, then the app will not have

fulfilled its purpose. In addition to helping our target audience, we also want to minimize the work needed to maintain the app. The best way to ensure Audio Journal won't have to put in extra work to maintain the app is to have the app interface directly with Audio Journal's website. Any broadcasts that are added to the website should automatically be added to the app so that Audio Journal does not have to put in extra effort to add broadcasts to the app. Finally, the future development team should be aware of the various obstacles that occur when trying to get an app onto the Apple App Store. These obstacles include the price of Apple's App Developer program and the lengthy approval process. We also recommend that the future team reaches out to us, as we have gotten to know the listeners and the visually impaired community quite well and have a lot of knowledge to share with them.

Over the course of our project, we have come to learn that the blind and visually impaired community is made up of incredibly kind and giving people and it has been an honor and a privilege to be able to work with them. We hope that the future team comes to appreciate the community as much as we have and deliver to them a great app, because they truly do deserve it.

References

American Foundation for the Blind. (2019). *Expanding possibilities for people with vision loss*. https://www.afb.org/

American Foundation for the Blind. (2020). *Reviewing the disability employment research on people who are blind or visually impaired*. https://www.afb.org/research-and-initiatives/employment/reviewing-disability-employment-research-people-blind-visually

American Parkinson Disease Association. (2020). *Parkinson's effects on vision*. https://www.apdaparkinson.org/what-is-parkinsons/symptoms/eye-vision-issues/

Anderson, M., & Perrin, A. (2017, April 7). *Disabled Americans are less likely to use technology*. https://www.pewresearch.org/fact-tank/2017/04/07/disabled-americans-are-less-likely-to-use-technology/

Androidcentral. (2014, September 16). *What is Google TalkBack?*. https://www.androidcentral.com/what-google-talk-back

Apple. (2020). *Vision accessibility - iPhone*. https://www.apple.com/accessibility/iphone/vision/

Assistive Technology Industry Association. (2020). *AT definition*. https://www.atia.org/home/at-resources/what-is-at/

Audio Journal. (2019a). *About Audio Journal.* https://audiojournal.org/about/

Audio Journal. (2019b). *Listening with SCA receivers.* https://audiojournal.org/listening-with-sca-receivers/

Bently, F., Luvogt, C., Silverman, M., Wirasinghe, R., White, B., & Lottridge, D. (2018) Understanding the long-term use of smart speaker assistants. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous. 2*(3). https://doi.org/10.1145/3264901

Beyene, W. M. (2018). Digital Inclusion in Library Context: A Perspective from Users with Print Disability. *Journal of Web Librarianship*, *12*(2), 121-140. https://www.tandfonline.com/doi/full/10.1080/19322909.2018.1427657

Bureau of Internet Accessibility. (2017, July 24). *Screen magnifiers: Who and how they help*. https://www.boia.org/blog/screen-magnifiers-who-and-how-they-help

Caldwell, B., Cooper, M., Reid, L. G., & Vanderheiden, G. (2008, December 11). *Web content accessibility guidelines (WCAG) 2.0*. https://www.w3.org/TR/WCAG20/

Downward, E., & Pool, J. J. (2019, September). *How common is Parkinson's disease*. https://parkinsonsdisease.net/basics/statistics/

Deloge, J. W., Morgan, M. J., & Lapp, R. W. (2001, January). Educational web page accessibility for blind and low vision users. https://digitalcommons.wpi.edu/iqp-all/4840/

Drew, J. (2013). How to develop and publish a mobile app. *Journal of Accountancy, 215*(2), 24-31,8. http://ezproxy.wpi.edu/login?url=https://search.proquest.com/docview/1287418999?accountid=29120

Fink, A. (2003). What is a survey? When do you use one? In: *The survey handbook* (1-29). https://dx-doi-org.ezpxy-web-p-u01.wpi.edu/10.4135/9781412986328.n1

Frandsen, M. (2019, January 14). *Speaking Volumes in O, the Oprah Magazine!* https://audiojournal.org/2588-2/

Google. (2020). *Android accessibility overview*. https://support.google.com/accessibility/android/answer/6006564?hl=en

International Association of Audio Information Services. (2020). *About IAAIS*. https://iaais.org/

Khan, A. D., Amaral, L. P., & Chan, M. K. (2000, January). *E-commerce for the blind and visually impaired*. https://digitalcommons.wpi.edu/cgi/viewcontent.cgi?article=5868&context=iqp-all

Kirkpatrick, A., O Connor, J., Campbell, A., & Cooper, M. (2018, June 5). *Web content accessibility guidelines (WCAG) 2.1*. https://www.w3.org/TR/WCAG21/

Kiryazov, T. V. (2007). *Online music store accessibility*. https://digitalcommons.wpi.edu/cgi/viewcontent.cgi?article=4084&context=iqp-all

Korn, P., Normand, L. M., Pluke, M., Snow-Weaver, A., & Vanderheiden, G. (2013, September 5). *Guidance on applying WCAG 2.0 to non-web information and communication technologies (WCAG2ICT)*. https://www.w3.org/TR/wcag2ict/

Leeber, B. W., & Amato, J. L. (2011, May). *Improving voter privacy for the blind*. https://digitalcommons.wpi.edu/iqp-all/3250/

McElroy, B. E., & Alshuqaiq, M. A. (2011, December). *Field observation of student behavior in ASSISTments*. https://digitalcommons.wpi.edu/iqp-all/3279/

Mueller, M. J., Jolly, R., & Eggert, E. (2018, March 21). Web accessibility laws and guidelines. https://www.w3.org/WAI/policies/

National Federation of the Blind. (2019, January). *Blindness statistics*. https://www.nfb.org/resources/blindness-statistics

Nengroo, A. S., & Kuppusamy, K. S. (2017, December). Accessible images (AIMS): A model to build self-describing images for assisting screen reader users. *Universal Access in the Information Society*, *17*(3), 607–619. https://doi.org/10.1007/s10209-017-0607-z

Oltmann S. (2016). Qualitative interviews: A methodological discussion of the interviewer and respondent contexts. *Forum: Qualitative Social Research,17(2).* http://www.qualitative-research.net/index.php/fqs/article/view/2551/3998

Purves, D. (2001). Types of eye movements and their functions. In: Augustine, G. J., Fitzpatrick, D., Katz, L. C., LaMantia, A., McNamara, J.O., Williams, S. M., eds. *Neuroscience.* https://www.ncbi.nlm.nih.gov/books/NBK10991/

Sanchez, J. N., & Togores, J. R. (2012). Designing mobile apps for visually impaired and blind users. *ACHI 2012: The Fifth International Conference on Advances in Computer-Human Interactions*. https://pdfs.semanticscholar.org/9366/7d0fd55ecda75e1c4377cabfd336b9c3ce0e.pdf

Society for Neuroscience. (2004). *Dyslexia: What brain research reveals about reading*. http://www.ldonline.org/article/10784/

Social Security Administration (2020) *If you're blind or have low vision- how we can help*. https://www.ssa.gov/pubs/EN-05-10052.pdf

Statista Research Department. (2019, June). *Smart speaker market revenue worldwide from 2014 to 2025*. https://www.statista.com/statistics/1022823/worldwide-smart-speaker-market-revenue/

Thompson, B. (2018, October 12). Elderly seniors internet usage statistics (InfoGraphic). https://news.eldercare.expert/technology/elderly-seniors-internet-usage-statistics-info-graphic/

U.S. Food & Drug Administration. (2019, April 18). *Institutional Review Boards frequently asked questions*. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/institutional-review-boards-frequently-asked-questions#IRBOrg

W3C. (2019). *About W3C*. https://www.w3.org/Consortium/

World Health Organization. (2019a, September 19). *Dementia*. https://www.who.int/news-room/fact-sheets/detail/dementia

World Health Organization. (2019b, October 8). *WHO launches the first World report on vision*. https://www.who.int/news-room/detail/08-10-2019-who-launches-first-world-report-on-vision

Zheng, R. (2020, January). *Learn to Create Accessible Websites with the Principles of Universal Design*. https://www.interaction-design.org/literature/article/learn-to-create-accessible-websites-with-the-principles-of-universal-design

Zuckerman, D. M. (2004). *Blind adults in America: Their lives and challenges*. Washington, DC: National Center for Policy Research for Women & Families. http://center4research.org/wp-content/uploads/2010/05/blind02041.pdf

Appendix A – Interview Protocols

Introduction Protocol

Q1: Hello, am I speaking to (listener name)?

A: Yes, who is this calling?
GO TO Q2

A: No, I don't know that person
Sorry we must have the wrong number, have a nice day.

A: I know them and they're here.
Ok, would you mind if we speak with them?
(Refer to Q2 if they ask why)

A: I know them but they're not here.
Alright, could you give them a message for me?

Refer to Q2.

If he/she is interested in participating, they can reach me at (PHONE NUMBER) or email our group at gr-ajo@wpi.edu. Thank you and have a nice day.

Q2: Hello, my name is (your name). I'm a student from Worcester Polytechnic Institute. My group is doing a research study for our Interactive Qualifying Project. We're working with the Audio Journal in Worcester to help find a better way for their listeners to access their content on demand.
We were wondering if you would be interested in participating in an interview that will help the Audio Journal's Listener Experience?

A: No
Alright, thank you for your time, and have a nice day.

A: Yes

//Introduce consent form

One of our team members will conduct the interview with you over the phone and will take about 30 minutes.

If you give your separate consent, we may record the interview. Agreeing to the recording is not required to participate in the study.

Do you have any questions?

Q3: Ok great! Would you like to participate now? Or would another time be better for you?

A: Now is good.

GO TO INTERVIEW QUESTIONS

A: Another day would be better

Q4: Ok what day would be best for you (As we get more interviews, make sure we have a calendar so we don't overbook).

A: xxxxday

Q5: Ok on xxxxday we can call you at _____.

A: ok I can do _____

(MAKE SURE TO WRITE THIS DOWN)

Q6: OK so just to confirm, the interview is set for xxxday the 99th at _____pm/am

A: Sounds good, see you then

Thanks you very much and have a great day

Protocol 1: Audio Journal Listeners

INTERVIEW PROTOCOL

Audio Journal Listeners

Would it be ok if we record the interview, this isn't a requirement but it would help us with our project?

Y; Ok great

N: Ok that's fine

If at any point in the interview you'd like to stop, or skip a question you don't want to answer, that is perfectly fine

Interview Questions:

Please tell us something about yourself.

Name:

Age:

Disability:

Education:

Live Alone:

Do you listen to Audio Journal?

Y: Why do you listen to Audio Journal

Y: How often do you listen

Y: What time of day do you usually listen?

Y: Do you listen to other radio reading services (list examples)

Y: How do you currently listen to Audio Journal?

Smart speaker?, Phone? Receiver?

Y: Do you listen to programs via the website

Y: What Audio Journal programs do you listen to?

What Audio Journal program do you listen to the most, and why?

N: Why did you stop listening to Audio Journal?

N: What was your favorite program to listen to, and why?

Do/Did you have any difficulties accessing Audio Journal's content?

Would you like Audio Journal to help you get reconnected?

Are there any ways to access Audio Journal's content that you cannot currently?

What tools do you use to help you with the challenges you face (Ex. Screen readers, magnifiers, smart speakers?)

Smart speaker- which do you have

What do you use it for

What functions do you think are valuable

(When they mention radio reading service, ask – Which radio reading service do you use? Why?)

Do you have a smartphone?

Yes

What type of smartphone do you have?

What do you use your phone for, other than calls

What apps do you use often? Why?

What features make an app accessible for you?

No

Why do you not use a smartphone (Have they tried before?)

What features would be necessary in order for you to use one

Do you think if AJO had an app, you would use it?

What features do you think this app should have? (Suggest features)

Do you use the internet?

Do you have a smart speaker (Amazon Echo, Google Nest Mini)?

Do you know any other Audio Journal listeners that we could talk to?

Thank you for your time and sharing your knowledge and experiences with us. Is there anything else you would like to tell us or share with us? Thank you once again.

Protocol 2: People with Blindness or Visual Impairments

INTERVIEW PROTOCOL

Non-Listeners

Please tell us something about yourself.

Name:

Age:

Disability:

Live Alone:

Technologically Literate:

Have you heard about Audio Journal?

Y: How did you hear about Audio Journal

N: (explain what audio journal is and what it does)

Do you listen to other radio reading services(list examples)

Y: Why do you listen to those specific radio reading services

Y: What is your favourite program to listen

N: Why not?

What tools do you use to help you with the challenges you face (Ex. Screen readers, magnifiers, smart speakers?)

which do you have

What do you use it for

What functions do you think are valuable

Do you have a smartphone?

Yes

What type of smartphone do you have?

What do you use your phone for, other than calls

What apps do you use often? Why?

What features make an app accessible for you?

No

Why do you not use a smartphone (Have they tried before?)

What features would be necessary in order for you to use one

Do you think if AJO had an app, you would use it?

What features do you think this app should have?(Suggest features)

Do you use the internet?

Do you have a smart speaker (Amazon Echo, Google Nest Mini)?

Thank you for your time and sharing your knowledge and experiences with us. Is there anything else you would like to tell us or share with us? Thank you once again.

Do you know any other people with blindness or visual impairments that we could speak to?

Protocol 3: Social Service Workers

INTERVIEW PROTOCOL

Social Service Workers

What services do you offer at your organization?

How comfortable are your clients with technology?

What types of assistive technologies do your clients make use of?

Which assistive technologies are most important and why?

How many of your clients use smartphones?

- Smart speakers? Computers?

What types of phones do your clients use the most?

What features do you think would be important to have in software designed for the blind and visually impaired?

Protocol 4: App Developers

INTERVIEW PROTOCOL

App Developers

Please tell us something about yourself

How long have you been developing apps?

Can you name a few apps you developed?

Have you developed apps for people with disabilities?

- Can you name some of them?
- How difficult was it?
- How long did it take?
- What succeeded and what didn't?
- How did it help their clients?

What's your approach to user experience and design principles in software development?

What difficulties do you often encounter when developing an app?

What other software examples do you recommend us to look at?

What features do you believe would be essential for our app to fit its purpose?

How do you think our app should be structured?

What accessibility guidelines do you have to follow on your platform?

Which WCAG guidelines do you think will be most important to implement in our app?

What do you expect the biggest barriers will be for people to access the app?

How long would you expect development for our app to take?

- How big of a team is needed to develop it?
- How much would it cost to make it fully accessible?

What recommendations do you have for the future team that creates the software?

Can you recommend some app developers who specialize in developing accessible apps?

Appendix B – IRB Consent Form

Informed Consent Agreement for Participation in a Research Study

Principal Investigator: Sarah Strauss

Co-Investigator: Purvi Shah

Student Investigators: Irakli Grigolia, Brendan Marion, Ryan Doyle

Contact Information:

Ruth McKeogh, Tel. 508 831-6699, Email: irb@wpi.edu

Gabriel Jonson, Tel. 508 831-4989, Email: gjohnson@wpi.edu

Title of Research Study: Improving Media Access for Audio Journal's Print Disabled Listeners

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 on behalf of Audio Journal, a radio reading service based in Worcester, Massachusetts that broadcasts to the blind and visually impaired in Central Massachusetts. The purpose of our project is to create a concept design for an Audio Journal smartphone app that would allow listeners to access Audio Journal's content on demand. To accomplish this, we are gathering information from Audio Journal's listeners, people with print disabilities, social service workers, and software developers to learn what features would be most important for the app. As a part of this study, we will be writing a written report of our findings.

Procedures to be followed:

In order to get necessary information, one or more of our team members will conduct an interview with you. This will be done either over the phone or via online video conferencing services like Zoom or Skype. The interview will last between 20-40 minutes. If you give your separate consent, we will keep an audio recording of the full interview for our own review. Consenting to the audio recording is not required to participate in the study. You may also revoke this consent at any time during the interview. Contact information and addresses will not be gathered for use in the study. Your identity and responses to individual questions in the interview will be kept confidential unless separate consent is given. We may ask for your consent at a later date to use your name and/or individual responses for our report on a per case basis.

Risks to study participants:

Since we may be discussing issues pertaining to disabilities you might have, such as blindness, visual impairments, and other print disabilities, there may be the potential for minor emotional discomfort.

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.

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.

	Yes	**No**
I consent to have the audio of the interview recorded	□	□
I consent to have interview responses paraphrased without identification	□	□

By signing below, you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

Printed Name _____ Date:

Study Participant Signature: _____ Date:

Appendix C – Project Timeline

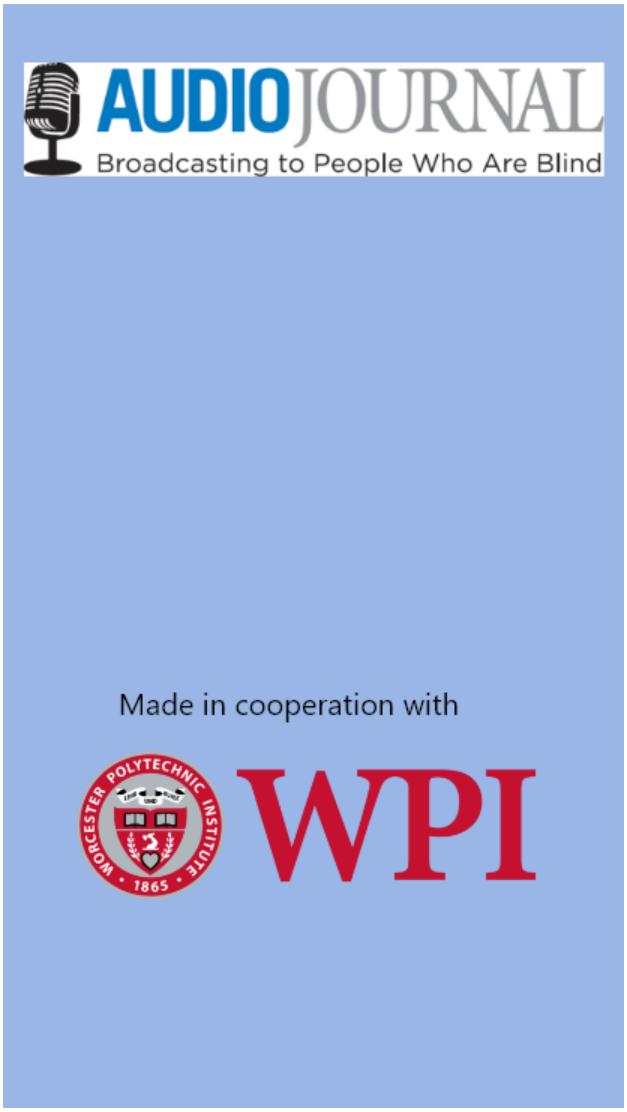
Week	1	2	3	4	5	6	7
Listener Interviews	✔	✔	✔	✔			
People with Blindness/Visual Impairments		✔	✔	✔			
Social Service Worker Interviews		✔	✔	✔			
Software Developer Interviews				✔	✔	✔	
Complete Final Report					✔	✔	
Software Concept Design					✔	✔	

Appendix D – Concept Design and Documentation

In this section, we will show how the app concept is laid out, and how a fully functioning version of our concept design should operate. Each screen will be shown with a summary of its purpose, followed by a description of all the elements on the screen. Elements that are found on multiple screens will be discussed in detail on the first screen they appear in.

Here is the link to the final version of our concept design.
https://xd.adobe.com/view/ab91120b-46c8-45e5-4312-fd0bb7ace909-dda0/

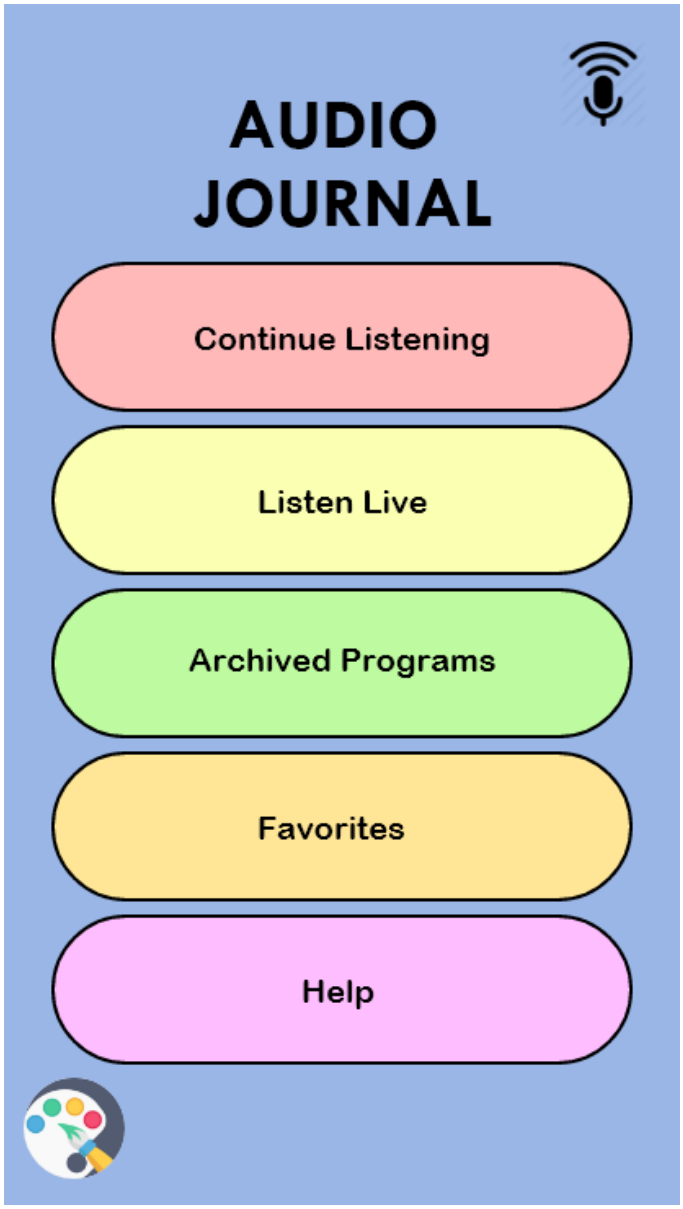
Startup Screen



Synopsis

Here is the first screen of the app, which appears when the app is loading. Contains the Audio Journal and WPI Logos. After the app is loaded it will transition to the main menu.

Main Menu



Synopsis

This is the main menu, and the first screen the user can interact with. The button colors we decided to use are red, yellow, green, orange, and purple by default. This color scheme is used throughout the app, but can be changed with the color palette button. Coloring the buttons increases visibility and helps the user differentiate easier between the buttons. In addition, all of the buttons must have labels in *VoiceOver*, including whether they are selectable or non-selectable (grayed out). The text size used is the default text size for the iPhone. We decided to use this size because it is more compatible with the iPhone's accessibility settings, as opposed to a larger font. Some further explanation on the font sizes in the app can be found in the "Display and Text Settings" section of the documentation below. Note as a limitation In our design, there is no shortcut to return to the main menu, the user must manually select the back button on each subsequent screen to return to the main menu.

- ### Continue Listening

  The continue listening button lets the user resume the last broadcast that was playing. If there aren't any unfinished broadcasts, or if the broadcast was taken down from Audio Journal's website, the button will be grayed out.

- ## Listen Live

  The listen live button tunes in immediately to Audio Journal's live broadcast.

- ## Archived Programs

  The Archived program button brings the user to a menu where they can search for previous broadcasts of various Audio Journal programs.

- ## Favorites

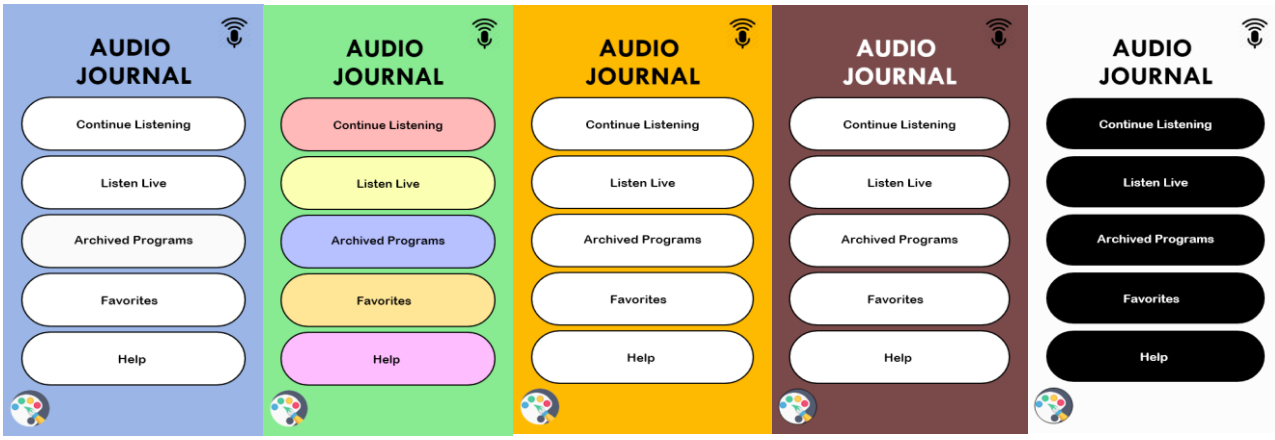
  The Favorites button brings the user to their favorites menu, where they can easily access shows that they have marked as their favorites.

- ## Help

  The help button brings the user to the help menu, which explains various aspects of the app in more detail.

- ## Color Palette

  Clicking the color palette button, located in the bottom left of the main menu, changes the background, button, and text colors to various color presets. Tapping the button multiple times will cycle through several various presets, allowing the user to choose a color scheme that fits their needs. There are six total options for color palettes, the standard version shown above, and five variants shown below. The color palette button should be labeled in *VoiceOver* to increase accessibility.



- **Voice Control**

The voice control button allows the user to use built-in voice commands to navigate the app. The *Voice Control* button can be found on most of the app screens, so the user can use them almost everywhere in the app. The voice control button should be labeled in *VoiceOver*, in order to make it compatible with *VoiceOver.* The commands are universal, meaning that the same commands can be used on any screen and have the same effect. All voice commands will prompt an audio feedback. An invalid command, meaning that the app does not recognize the command the user is trying to input, will result in the app saying, “Command not recognized.” A valid response will repeat the command back to the user, so the user knows that their command was successful. These commands include:

-Saying the name of the program will take the user to all of the broadcasts available for that specific program.

ex) Pressing the voice control button and saying “Community News Auburn” will the listener to this screen:

- Saying “Play” then the name of a specific broadcast will prompt the app to play that specific broadcast

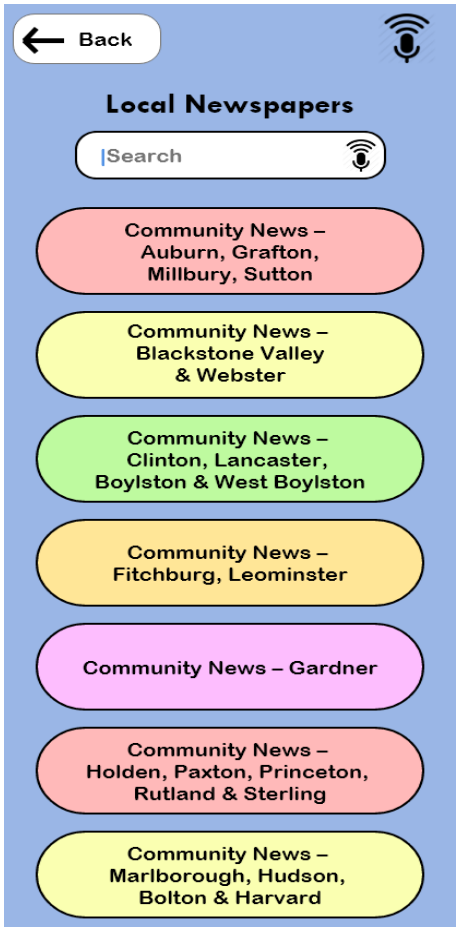
ex) Saying “Play Flash Fiction April 26th” will play the Flash Fiction broadcast that aired on April 26th

-Saying “Play the most recent” then the name of the program, will play the most recent broadcast of that program

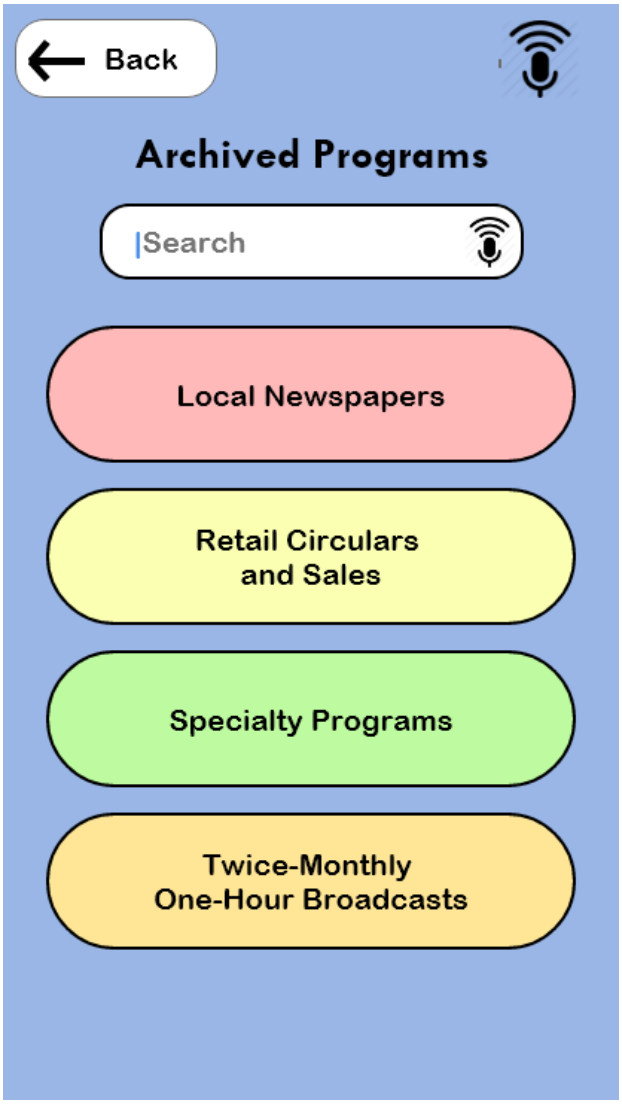
ex) Saying “Play the most recent Speaking Volumes” will prompt the app to begin playing the most recent Speaking Volumes broadcast.

- Saying the name of a program category will take the user to that category and display the programs in that category

ex) Saying “Local Newspapers” will take the listener to the screen shown below, where they then can select a specific program.



Archived Programs



Synopsis

This menu allows you to search or browse previous broadcasts. It is accessed from the main menu. The categories are taken directly from Audio Journal's website, with the programs split up by the four categories on the site. The app must interface directly with Audio Journal's website so Audio Journal will not have to put in any extra work to add or remove broadcasts from the app. As such, this menu should be able to accommodate the addition or removal of categories on the site. This screen also allows for the same voice control commands.

- ### Back Button

This button brings the user to the previous screen. It is present on all screens except the main menu.

- ### Search Bar

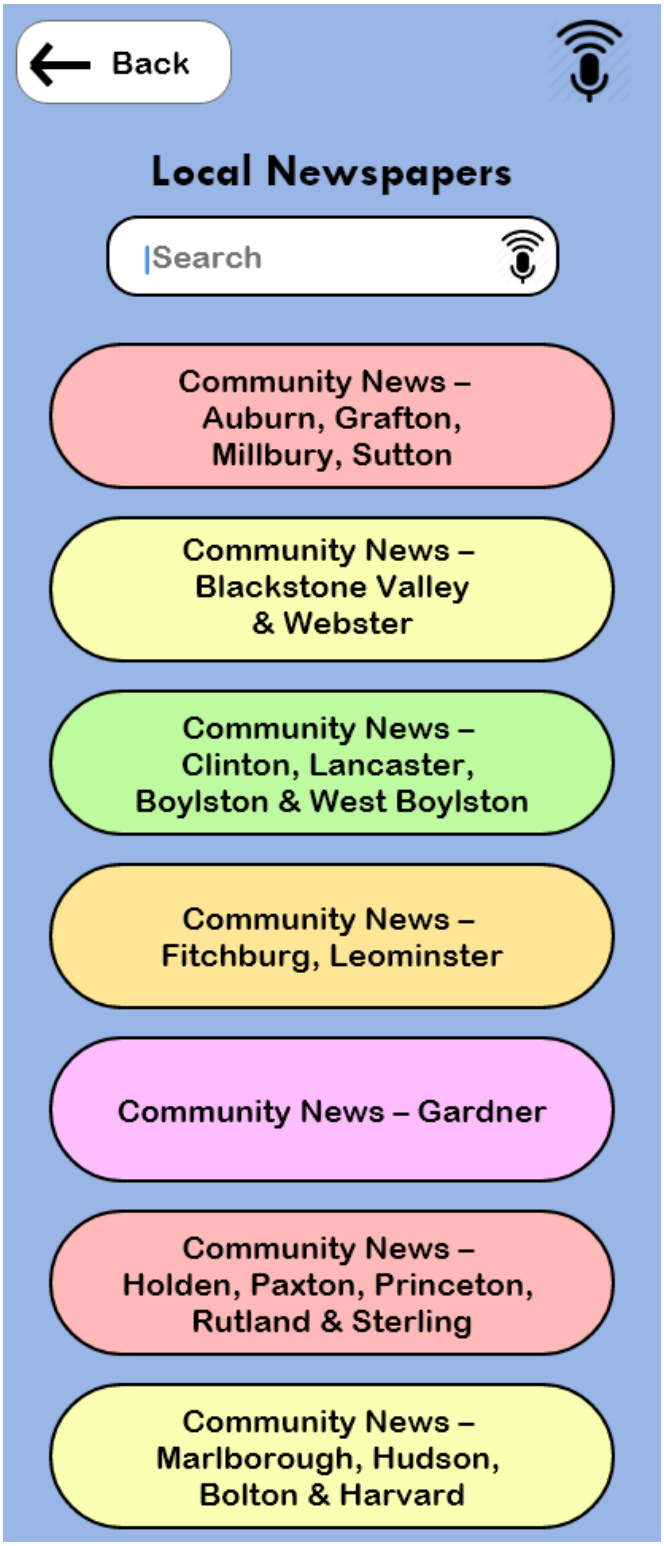
The search bar allows the user to either type in or dictate the name of the show they want to watch. It will then show them the closest search results for what they typed in. This should use the iPhone's built-in dictation software, allowing those who cannot see the keyboard to simply say what they want to search for.

- ### Category Buttons

These buttons are used to select the type of program you want to watch. These are the same categories that can be found on Audio Journal's website. It is also

important that the categories are interfaced with the ones on Audio Journal's website, so if they add, subtract or change the name of a category it is reflected here as well. Pressing one of these buttons will bring you to the list of programs in that category.

Archived Programs Sub-Menu



Synopsis

The sub-menu for selecting archived programs is accessed by selecting one of the categories on the main “Archived Programs” page. It contains a list of programs that fall under that category. These programs are taken directly from the website. All menus should be capable of vertical scrolling if necessary. While scrolling, the back button, voice control button, page title, and search bar should stay in place.

- ### Program Buttons

These buttons bring the user to the list of broadcasts for that particular program. These should also reflect the programs displayed on the website under each category.

Program Menu

Synopsis

This menu contains all of the broadcasts for a specific program. It is accessed by selecting one of the programs on the Archived Program Sub-Menu. The broadcasts are sorted from newest to oldest, which is the same order as the website.

- ### Favorite Button

Pressing this button will add the program to the user's favorites list, which is accessed from the main menu. Pressing it again when it is already favorited, will remove it from the favorites menu. The gold star indicates that the program has been favorited. If the program has not been favorited, it will be blank instead. These icons should be labeled in *VoiceOver* to make this feature accessible to *VoiceOver* users.

- ### Broadcast Buttons

Pressing these buttons will bring the user to the "Archived Media Player" and play the specific broadcast listed on the button.

Archived Media Player

Synopsis

The media player for Audio Journal's archived broadcast is displayed after a user selects a specific broadcast to listen to from the list of archived broadcasts.

- **Play/Pause Button**

This button either plays or pauses the broadcast, depending on its current state. If the broadcast is playing this button pauses it, and if it is paused, this button plays it.

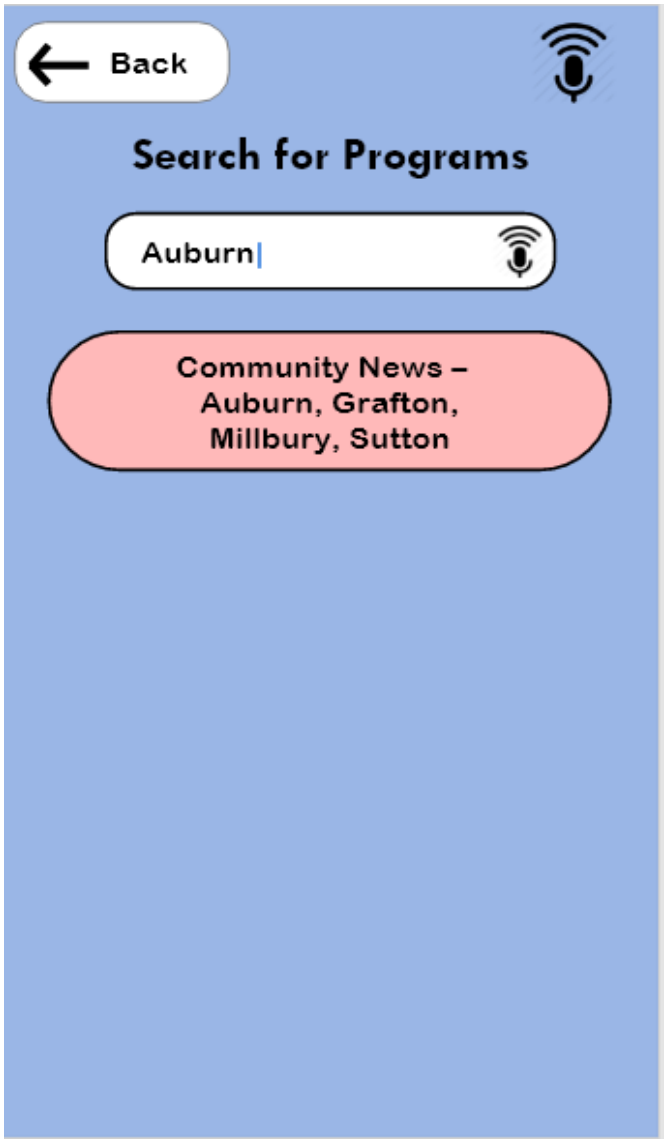
- **Previous Broadcast Button**

This button, the double arrow button pointing to the left, plays the previous broadcast on the list (less recent). If it is the first broadcast on the list, the button will be grayed out.

- **Next Broadcast Button**

This button, the double arrow button pointing to the right, Plays the next broadcast on the list (more recent). If there are no broadcasts left, the button will be grayed out.

Search Menu



Synopsis

The search menu for Audio Journal's archived programs is accessed by typing something in the search bar on the "Archived Program" menu or sub-menu.

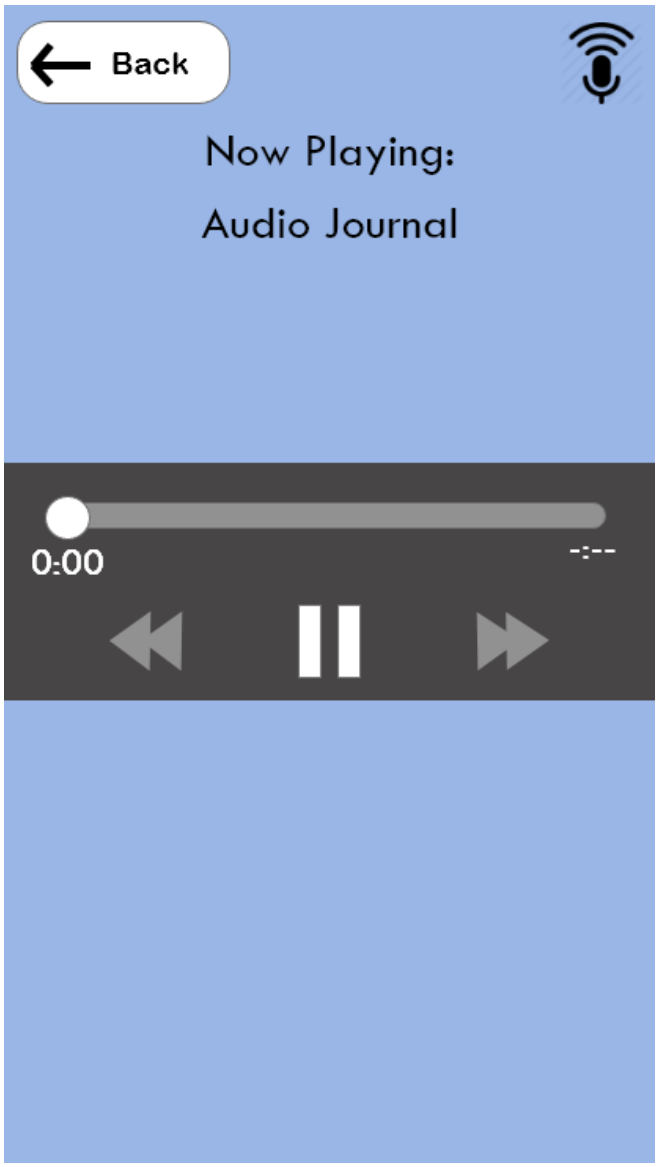
- **Search Bar**

Typing the name in the search bar gives the user the name of the desired broadcast. If there is no such broadcast, the screen will remain the same. If the search is ambiguous, it will show multiple results.

- **Program Button(s)**

Pressing the program button will bring the user to the list of broadcasts for that program.

Live Media Player



Synopsis

The media player for Audio Journal's live broadcast is accessed from the "Listen Live" button on the main menu. Unlike with the Archived Media Player, the previous broadcast and next broadcast buttons are grayed out.

- **Play/Pause Button**

This button either plays or pauses the broadcast, depending on its current state. If the broadcast is playing this button pauses it, and if it is paused, this button plays it.

Favorites Menu

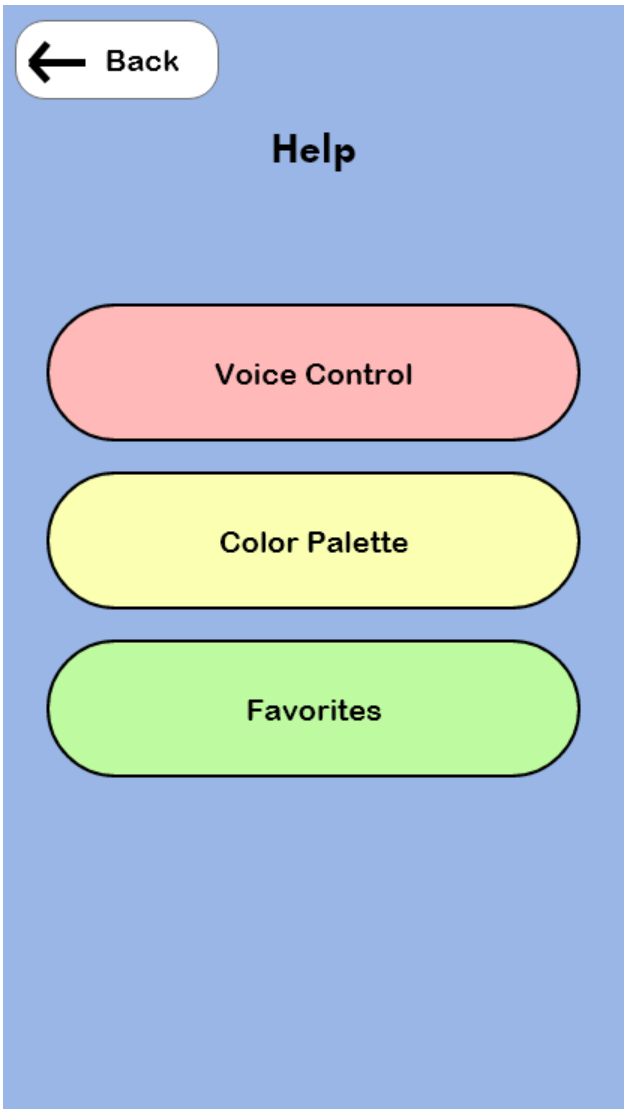
Synopsis

The favorites menu is where every favorite broadcast of the user is displayed. It is accessed from the main menu. A user can make a broadcast their favorite by clicking the “star” icon next to it. Clicking the star icon again will unfavorite it.

- ### Program Button(s)

Pressing the program button will bring the user to the list of broadcasts for that program.

Help Menu

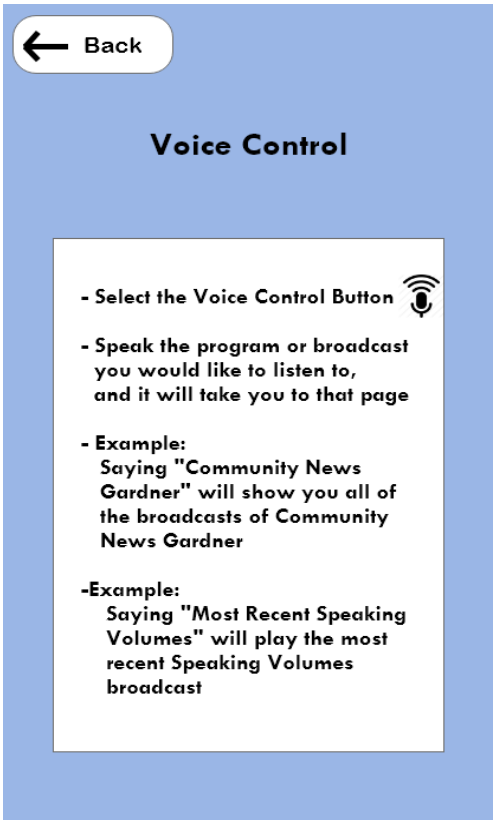


Synopsis

This menu gives explanations on various app features. Accessed from the main menu.

- Help Buttons

These buttons bring the user to a menu explaining the app features listed on the button. See the example below for what these menus look like.



Display and Text Settings

The app should be able to accommodate larger text sizes. The default text size is small because it should be compatible with the iPhone's "Display and Text Size" settings. It will do this by vertically extending the elements of the app that contain text. An example of this is shown below.

Other Notes

- We are open to options to improve the visual appeal, as long as it does not harm accessibility or functionality.
- All icons and buttons MUST be labeled in *VoiceOver,* indicating the type of input required in addition to any text that is placed on the button.
- This is only a concept design. We strongly recommend that a more detailed version be made before starting development.
- We encourage the future team to consult with us if they have any questions, concerns, or suggestions. We want this to be a success.