Enhancing the TV Experience for Visually-Impaired Users: Designing ten-foot interfaces with screen reading capabilities

Report Design Guidelines

Presented to the Broadcasting Accessibility Fund, Mr. Richard Cavanagh and the distinguished members of the Board.

By Rogers Communications Inc. (V. Primeau, M. Mamatkulov, Alwar Pillai, and the support of I. Posner, I. Pliner)

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1 This research project would not have been possible without the support of our partner, Akendi Toronto. These design guidelines have been created based on the insights gathered during the research and testing of the prototype.
Abstract

“Design Guidelines - Enhancing the TV Experience for Visually-Impaired Users” covers a series of guidelines and patterns for designers wishing to evaluate and support the conception of a screen reader system for ten-foot television interfaces. All guidelines introduced here are platform agnostic and are not reflective of any specific branded systems existing in the market. However, for the purpose of testing, generic concepts and models were selected to construct a potential system that would resemble a typical smart television environment, such as offering an electronic guide (EPG) or PVR functionalities (personal video recorder).

About this Document

This document has been produced following an extensive research engaging real participants. It is intended for this document to be public and accessible.

NOTE 1: The composition of this document was modified over the course of the project, with the addition of new sections as well as the removal of others, most notably project status updates.

NOTE 2: It is intended for this document to be read alongside the research accomplished by Akendi (Toronto).

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2 Such as smart TV systems, Set Top Boxes and remote-operated content services
3 In this context, refers to a system that does not currently exist as a whole but is constructed from commonly known patterns, features and technologies to allow testing.
4 This report also included updates on the ongoing usability testing as well as the overall research plan, which is well covered in the report produced by Akendi.
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Introduction

Although new products and technologies such as the Apple TV or the US-based Comcast X1 platform have built-in accessibility features, their availability is still limited throughout the Canadian market. Moreover, some products marketing their accessibility do not offer fully accessible features, but a subset only. Working with the Broadcasting Accessibility Fund and Akendi Toronto, the authors tackled the overwhelming challenge of rendering standard TV features accessible to visually impaired users through the conception of a screen reading tool.

Split in 3 Phases, “this project’s intent was to understand how screen-reading technologies could be applied to the smart TV environment through qualitative design research, as well as provide visually impaired users with a simplified and inclusive mechanism to discover and consume video content.”

Multiple rounds of tests were conducted throughout Phase 1, 2 and 3, and this report showcases the results of the team’s ongoing research: a set of preliminary guidelines aimed at helping designers work towards a better, more accessible TV future.

To read Akendi Toronto’s research results, please see the Accessibility Summary Report by Akendi (Toronto).

What is screen reading?

It is important to understand what screen readers are. Here is the definition of screen readers by the American Foundation for the Blind (AFB):

“Screen readers are software programs that allow blind or visually impaired users to read the text that is displayed on the computer screen with a speech synthesizer or braille display. A screen reader is the interface between the computer’s operating system, its applications, and the user. The user sends commands by pressing different combinations of keys on the computer keyboard or braille
display to instruct the speech synthesizer what to say and to speak automatically when changes occur on the computer screen.\textsuperscript{5}

\textbf{Project Summary}

\textbf{Project Phases}

This report aggregates our Design Guidelines, obtained after the execution of 3 research phases.

Phase 1: The first phase saw the aggregation of varied literary sources, as well as the creation of \textit{user personas}.

Phase 2: In the second phase, an initial iteration of the prototype was shown to a group of user participants, each belonging to one of the 2 personas created in Phase 1.

Phase 3: Following Phase 2, the prototype was updated and corrected based on the collected feedback. The new iteration was then presented to another group of participants, some of whom were returning from Phase 2. Phase 3 saw a significant decrease in critical usability issues.

\textbf{Objectives}

Leveraging the learnings from rounds of usability testing directed to the creation of a \textit{low-fidelity}\textsuperscript{6} prototype (an abstract form of the imagined system). This prototype was then used to validate some of our expectations and assumptions of how a screen reader would work in a realistic context, as well as highlight potential pain points.


\textsuperscript{6} A low-fidelity prototype is a testable mock-up system that can be used to uncover basic problems in a concept, unlike a high-fidelity prototype, which is used to mimic the end-result almost perfectly. High-fidelity prototypes are usually tested at the end of the design process.
Additional goals were to:

- Understand screen reading technologies by aggregating principles from known competitors as well as using guidelines from various web technologies (such as the W3C\(^7\)\(^8\));
- Design the architecture of a potential *ten-foot* device interface by using known standards from the industry;
- Craft a functional prototype based on that same architecture;
- Use a simple screen reading tool to allow for basic navigation;
- Conduct usability testing and gather feedback by reviewing the prototype with visually impaired participants;
- Validate our findings and assumptions.


\(^{8}\) World Wide Web Consortium. Last consulted on Dec 29, 2016. [https://www.w3.org/]
Design Methodologies

What is Design and why is it Important?

In recent years, there has been a transformation in the way individuals consume television content. The growth of technology and the internet has made it possible to consume such content anytime and anywhere we prefer, eliminating dependency on cable TV.

“The increasing interest in IPTV is being driven by remarkable advances in digital technologies and consumer electronic devices, broadband networking technologies, Web services, as well as more entertainment demands (enabled by decreasing costs of hardware and software technologies) from both consumers and content providers.”

This new development is giving room to new opportunities and challenges for social inclusion. In this report, design refers to the iterative process of creating a product or application. The iterative process has different elements and stages that help us, designers, to better understand the needs of our user group and design a product that not only meets their requirements but also is a pleasure to use. The following terms and techniques help designers understand the target user and make informed decisions for the design and functionality of a product.

User Experience Design (UX)

*User experience design* was a term coined by Don Norman and he describes it as: “user experience’ encompasses all aspects of the end-user’s interaction with the company, its services, and its products.”

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UX is a broad term but an important one to understand. All products are made for consumers or users and it is important to understand and analyse their interaction with every stage of the product to improve and enhance their experience.

In context of this project, the users are people with vision impairments. Currently, people with vision impairments cannot access television content independently, hence their user experience is poor. The purpose of this project is to improve the user experience of people with vision impairments and their ability to consume television content.

**User Interface (UI)**

*User interface* is another crucial term to know when talking about design of products and applications. UI can be defined as the means in which a person controls a software application or hardware device. A good user interface provides a user-friendly experience, allowing the user to interact with the software or hardware in a natural and intuitive way.¹¹

In the context of this project, *UI* refers to the elements of the interface a visually impaired user interacts with while accessing the screen reading application, the features available to the user, and the way information is presented to them.

**Usability, Usefulness Evaluation, and User Experience Methods**

Usability testing is a method to assess the UI and UX of an application. It helps understand how easy it is for a user to interact with the application. Usability, as defined by Nielsen in 2012, is “a quality attribute that assesses how easy user interfaces are to use.”

The word "usability" also refers to methods for improving ease-of-use during the design process. Usability is defined by 5 quality components:

- **Learnability**: How easy is it for users to accomplish basic tasks the first time they encounter the design?
- **Efficiency**: Once users have learned the design, how quickly can they perform tasks?
- **Memorability**: When users return to the design after a period of not using it, how easily can they re-establish proficiency?
- **Errors**: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
- **Satisfaction**: How pleasant is it to use the design?²

**Usefulness**

Another key attribute is utility, which refers to the design’s functional aspect (i.e. can the application fulfill a user’s needs?):

Usability + Utility = *Usefulness*³.

A combination of usability and utility equals *usefulness*. If the product is easy to use and caters to the requirements of the user, then it will be useful. The aim of this phase/project is to understand the usefulness of our screen reading application concept for television viewing.

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Predispositions

Screen Reading

Screen reading, a technology that converts text appearing on the screen into audible speech, has been present for a while and used predominantly on the web. New native systems have also appeared on individual devices, such as the VoiceOver in iOS (Apple).

Other systems also offer visual tools, such as magnifiable and adaptable fonts, or even voice activated search and control. While there are multiple methods for people with visual impairments to access the web, such options are not available in older generation television products and applications.

Although new additions like voice search are considered leaps in terms of accessibility, screen reading remains necessary for users to experience the same level of freedom and discovery that sighted users do. Today’s digital interfaces are mostly visual, which makes it easier for sighted users to explore and discover content. However, for a portion of the population, this phase of discovery is absent.

Assumptions

To build the screen reader prototype, a list of assumptions was drawn and leveraged to build the first iteration of the prototype. It would then be used to validate our design decisions.

Assumption 1: When watching television, visually impaired users desire parity in terms of features and functionalities within a system.

Assumption 2: A sizeable portion of visually impaired users understand web-based navigational systems, with or without screen reading.

Assumption 3: Most visually impaired users have a basic knowledge of accessibility standards in digital technologies, and expect their system to behave as such.
Prototype

A prototype is often used to test the user experience and usability of a product. This helps designers evaluate the overall usefulness of the product for its target audience. Here, a set of screens were created to emulate the architecture of a real system. The website, a text-only interface, was coded using basic web technologies such as HTML and CSS, and used on a local drive only (no internet connection was needed for the test). This became helpful when testing in participants’ homes. To simulate the screen reader, we used the ChromeVox application. This free application, available as an extension for the web browser Chrome, offered the necessary feedback for the system to work similarly to a regular TV system.

To navigate this interface, participants were provided with a universal remote, paired to the computer (fig.1) in a way that would enable the cursor to respond to remote key inputs (the remote was programmed before the tests).

![Fig.1 The remote was paired to the computer, simulating a real TV experience.](image)

The device itself is a basic, unbranded remote. Although some aspects of the remote were tested and taken into account, the core objective of this test was to focus on the interface and the way participants interacted with the prototype.
Architecture

The prototype’s architecture (content, sections, navigation, etc.) was assembled based on some of the industry’s standards that were identified in Phase 1. Moreover, the prototype was updated following Phase 2 in an attempt to correct some of the issues identified in that phase.

To read Akendi Toronto’s research results, please see the Accessibility Summary Report by Akendi (Toronto).

To see the prototype’s full content, go to p.26 Annex A: Prototype Architecture.
Guidelines & Recommendations

These guidelines, collected during the design phase and organised thematically, are meant to support the design and research around the possibility of a screen reader system for ten-foot interfaces, operated with either one or multiple peripheral devices (i.e. a remote). Most insights were drawn from the 2 rounds of usability testings accomplished with our partner, Akendi Toronto.

These guidelines can be used agnostically, but refer to the prototype created for this research. Each guideline refers to one or more principle, which helps to further identify their usefulness. Some of these guidelines also have illustrated examples.

Please note that the following list is not, in any way, exhaustive. It is rather a collection of insights and findings.

To read Akendi Toronto’s research results, please see the Accessibility Summary Report by Akendi (Toronto).
1. Onboarding
How the user is introduced to the system’s varied feature and its architecture. This category encompasses guidelines on how the system helps its users get acquainted with the different tools, features and terminology.

1.1. The screen reader should introduce its features in a way that is clear and concise.

(A) A tutorial or a series of contextual help tips should be exposed to the user at crucial moments of the interaction.

(B) Tutorials or help content should be accessible at any time; this includes allowing the user to backtrack within a tutorial or any contextual help tips when first exposed (fig.2).

Fig. 2 Help content in the prototype was positioned as high as possible in the architecture, in the main menu. When in need, users could reach this section by accessing the main menu.
1.2. The system should teach the user how to handle and use any of its features and peripheral devices.

(A) The system should, prior to its activation, offer clear indications on how it can be positioned in the intended usage location, oriented, handled and activated, in a format that is consumable by the user.

(B) The screen reader should offer a detailed tutorial on how to use the system peripheral device (i.e. the remote) (fig.3).

Fig.3 When entering the prototype, participants were presented with a tutorial on how to use the remote: “You have started your new TV system [...] in the package, you will find the new remote [...]”.

(C) Tutorials and contextual instructions need to offer specific guidance on how to move on to the next tip.

1.3. The system should use a language that is accessible to the user.

(A) Specific terminology should be used consistently across the system.
(B) Within the same paragraph, it is preferable to reuse a feature or item’s exact name consistently and avoid synonyms. Synonym create a risk for confusion.

1.4. Help content should be prioritized in the system.

(A) Once taught how to use the system, the user should be able to access help content easily, meaning that this content should be located in a central position within the system’s architecture.

2. Discovery
Making features and tools discoverable is primordial in any system. This category collects insights on how parts of the system can help the user see and understand what’s available to them.

2.1. A feature or functionality should be accessible using both on-screen interactive elements (call-to-actions, links, etc.) and the peripheral devices such as the remote (buttons, etc.).

2.2. When displaying elements of the interface that are not usually textual, the screen reader should read a description of the element instead.

2.3. Lists should be presented clearly to the user.

(A) List of options should be kept concise.

(B) When entering a list, the number of items within that list should be announced to the user (fig.4).
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Fig. 4 The number of items in the list is announced as part of the section’s description.

(C) The use of lists should be used consistently across the system.
(note: for example, only interactive elements).

2.4. List items should announce information on their content contextually.

(A) When entering a list of selectable video content, such as completed recordings, the content’s name should be announced first.

Example: “Program Name. Season 1 Episode 1. Recording 1 of 17.”

(B) When entering a list of selectable video content, the positioning of each item within that list should be announced last.

Example: “Program Name. Season 1 Episode 1. Recording 1 of 17.”
2.5. Descriptions or instructions in a section can be read as one paragraph. Prompts for interactive actions should be read to the user after.

(A) The system should announce when it’s finished reading the instructions or description for a given section (fig.5).

(B) The system should announce the number of options following the instructions or description for a given section.

(C) The system should announce how to commence their selection of an option for a given section.

2.5. The granularity of the information and system cues offered to the user should be adjustable.

(A) The option to adjust the granularity of the information and system cues should be found in a clearly-identified section.

(B) The screen reader’s voice and tone should be adjustable.
(C) The screen reader’s reading speed should be adjustable.

3. Navigation
How the system can be navigated.

3.1. Navigating the system should be done in a linear fashion.

(A) An option to go back to the previous section in the system should always be available.

(B) User inputs, such as a previous selection, should be be retained if a user goes back past that same selection.

(C) Each section should be read from the beginning.

3.2. Optional interactions, such as using filters, should be presented in a linear fashion.

(A) The user should be asked to filter or sort before reaching the affected content.

(B) Setting up preferences can be done one setting at a time. Once finished, the user should be offered a confirmation of all effectuated changes.

3.3. The user should be able to determine at any time where they are in the system.

(A) A dedicated button can be added on the peripheral device or remote.
4. Browsing
This category speaks of guidelines that support browsing content, something that is still difficult today for visually impaired users in many television systems.

4.1. The way content is organized and read to the user by the screen reader should be consistent across the system.

(A) The screen reader should identify the nature of any items encountered within a section.

(B) Links and buttons (i.e. interactive elements) should be differentiated from descriptions and textual elements in general.

(C) Interactions should be worded as actions first, i.e. with an action verb.

Example: “Show me all channels” instead of “All channels”.

(D) Instructions on how to use the screen reader should be persistent across the system.

4.2. The system should allow for a section’s description or instruction to be re-heard or skipped at any time.

4.3. Any variation or change in interactivity should be mentioned in a section’s instruction.

4.3. Parts of the system that usually employ visual elements, like tables (i.e. the EPG, or Electronic Personal Guide), should be adapted for the screen reader.

(A) The screen reader should announce and prioritize a change in position when within the Guide or any grid system.

(B) Moving the cursor in the Guide should prioritize and announce a channel or time slot change.
5. Consumption
How the system’s content and features can be consumed and used.

5.1. When the user initiates the playback of video content, either on demand or linear (live) television, the screen reader should read all available options.

(A) When watching on demand content, common options such as PLAY or PAUSE should be easy to interact with.

(B) Variations in the availability of options when watching content should be announced by the screen reader.

5.2. Cancelling an action, when needed, should be presented consistently across the system.

(A) When offering to cancel an action, the system should take the user back to the previous section.

5.4. The user should be allowed to filter or sort in a way that prioritizes accessible content (fig.6).

Fig.6 “Only recommend me content that is Audio described” was one of the options offered to our participants.
5.5. Programs in the guide, and content in general, that are available with audio description should be identified.

6. Notification, Feedback and Errors
Design guidelines promoting a better notification system and ways to communicate efficiently with the user.

6.1. The screen reader should notify the user when any feedback is received from the system.

(A) Any completed actions happening in the background that do not require direct user interactions should be exposed by the screen reader, such as recently completed recordings or if the user’s Personal Video Recorder storage space is almost full.

(B) The volume of the currently playing video content should not disrupt the screen reader’s feedback.

(C) When notifying the user during playback, the concurrent audio track from the video content should be lowered momentarily.

(D) If, following a system notification, the user needs to input a decision by selecting an option, the volume of the currently playing live video content should be inaudible. If the content is on demand and can be resumed freely, then playback should be momentarily paused, to resume once the user has made a decision.

6.2. The screen reader’s language and tone should be clear, concise and familiar.

6.3. The system should indicate when the user reaches the end of a list or a section that does not wrap.
6.4. The user should be notified when attempting to use the peripheral device in a way that is either not allowed or unusable in the current context.

(A) Attempting to use the peripheral device incorrectly multiple times should prompt the user and let them access the peripheral’s manual or tutorial again.
Conclusion

Through all 3 phases, the design team gained a better understanding of difficulties experienced by visually impaired individuals when consuming television content. The design prototype helped us identify how design could support the research’s findings. Ultimately, the testing sessions with the participants (conducted by Akendi) proved that the addition of screen reading capabilities to basic TV systems is not only enjoyable, but also needed. The participants were excited about the possibility of such a service being available to them.

All guidelines created for this document are drawn from insights present in the research. Additional rounds of testing, as well as a development phase for a high-fidelity prototype, would be necessary to further validate the design.

We have also learned that in order to improve the design, additional co-design method, also known as Participatory Action Research (PAR). This method involves designers and participants solving the problem together. It is better described by the International Development Research Centre:

“Participatory action research seeks to understand and improve the world by changing it. It empowers and turns those who usually "participate" as subjects of research—those directly affected by problems—into active agents who can create new knowledge and act on it to produce change.”

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14 Note: this portion of the document was modified from the original Phase 2 report’s conclusion to accommodate this report, which encompasses guidelines from all phases of this project.

This method allows for participants and designers to be equal agents to improve the user experience of a screen reading application for television consumption. Participants need to be willing and trusting to share their opinions and ideas with the designers. Majority of people with visual impairments are seniors, and when user testing is conducted with seniors, it needs to be done in a respectful and mindful manner. A study by Nielsen Norman Group stated that 90% of seniors blamed themselves for not being able to complete a task. 

Through the PAR method, seniors feel a sense of ownership with the application, which will help them reflect on the application.

It has been a tremendously insightful experience working on this project. We hope that this research can serve the community and help major stakeholders in the world of telecommunications cater to their users in a more humane way.

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Annex A: Prototype Architecture

Each screen of the prototype contained textual elements as well as internal links. These links would take the user forward and enable them to accomplish their task (fig.7) (fig.8).

Fig. 7 The basic text interface was coded using HTML.
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Fig. 8 Once displayed in the browser, the text-based interface could be read using ChromeVox, a Chrome extension available for free.

Purchases. Your system offers a large selection of movies and TV shows, as well as your regular TV programming. A selection of this content can be purchased or rented. To purchase a movie or a TV show, you will need to create a Purchase Pyn. You can change your Purchase Pyn from the Settings later on.

Create a Purchase Pyn
Skip this step and start watching
Go Back to Personal Contents

To emulate a typical smart TV system, the following sections were created. Participants were able to move freely within the prototype, with some sections left empty.
Sections

1. Main Menu
The Main Menu is the central section of the system. It contains most points of access to the other sections.

1.1. Home
The primary section of the system that contains content that would typically be presented to users in the form of visual tiles. In the prototype, "Assets" or TV programs, are presented in textual formats.

1.1.1. Resume
The possibility to resume a program.

1.1.2. Recommended Movies and TV Shows
A list of recommended content.

1.2. Guide
The traditional EPG (Electronic Program Guide), which lets the user navigate the content available across various channels.

1.2.1. Channels Filters
Channels can be filtered to alleviate long browsing sessions in the Schedule.

1.2.2. Channels Schedule
A grid displaying all channels based on the previously selected Filter.

1.3. Movies
A collection of movies available to the user.

1.3.1. New Movies
Movie Filter.

1.3.2. Most Popular
Movie Filter.
1.4. TV Shows
A collection of serialized programs available to the user.

1.4.1. New TV Shows
TV Show Filter.

1.4.2. Most Popular
TV Show Filter.

1.5. Saved
The content that is owned by the user.

1.5.1. Favourites
Any program favourited by the user.

1.5.2. All Recordings
Any program recorded by the user.

1.5.2.1. Recorded
All completed recordings.

1.5.2.2. Scheduled
All scheduled recordings.

1.5.3. Purchases
Any program purchased by the user.

1.6. Settings
A collection of standard settings, some of which specific to the screen reader.

1.6.1. Languages Unbuilt
All completed recordings.

1.6.2. Parental Controls Unbuilt
All scheduled recordings.

1.6.3. Profiles Unbuilt
All completed recordings.
1.6.4. Accessibility
All scheduled recordings.

1.6.5. Screen Settings \textit{Unbuilt}
All completed recordings.

1.6.6. Purchases \textit{Unbuilt}
All scheduled recordings.

1.6.7. Troubleshooting \textit{Unbuilt}
All completed recordings.

1.7. Help
All available Help content.

1.7.1. FAQ \textit{Unbuilt}
All completed recordings.

1.7.2. Controls for Screen Reader
All scheduled recordings.

1.7.3. Billing \textit{Unbuilt}
All completed recordings.

1.7.4. Other \textit{Unbuilt}
All scheduled recordings.

1.8. Applications \textit{Unbuilt}
Potential section for a collection of applications

1.9. Search \textit{Unbuilt}
Potential section for direct searches.
Annex B: Prototype Architecture

AFB – American Foundation for the Blind
CCD – The Council for Canadians with Disabilities
CRTC – The Canadian Radio-television and Telecommunications Commission
EPG – Electronic Program Guide
IPTV – Internet Protocol Television
PAR – Participatory Action Research
STB – Set-Top Box
STU – Set-Top Unit
TTS – Text to Speech
UI – User Interface
UX – User Experience
W3C – World Wide Web Consortium
WCAG – Web Content Accessibility Guidelines
Bibliography


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Appendix

1. Literature Review
2. User Research
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ROGERS/BROADCAST ACCESSIBILITY FUND

Summary Report

Michelle Brown
Daniel Iaboni
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April 2017
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Example of talking menus used to navigate DVDs (Wlodkowski, T., Goldberg, L., 
talkingmenus)

**Figure 2 (Page10)**
Broadening Access To Digital TV Electronic Programme Guides. PsychNology 
Journal, 1(3), 229-241

**Figure 3 (Page12)**
(American Foundation for the Non-signted Announces 2013 Access Award 
about-us/press-room/afb-announces-2013-access-award-winners/125)

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American Foundation for the Non-signted Announces 2013 Access Award Winners. 
press-room/afb-announces-2013-access-award-winners/125

**Figure 8 (Page 16)**
Devices with Physical Buttons

**Figure 9 (Page 16)**
Default Remote
**Figure 10 (Page 16)**
Scopes & Magnifying Glass

**Figure 11 (Page 17)**
Smartphone Virtual Keyboard & VoiceOver

**Figure 12 (Page 17)**
Specialty Remotes

**Figure 13 (Page 20)**
The remote and initial button mapping used for testing purposes

**Figure 14 (Page 28)**
The revised remote button mapping based on results from Round 1 testing
Executive Summary

Television remains an important medium of communication in the day to day lives of most Canadians. Television is more than just entertainment; it is informative and helps build communities. However, a large and growing portion of the population lacks adequate access to the medium due to poor accessibility.

The purpose of this research was to understand the current video discovery experience for low and non-sighted users and design a platform agnostic solution that could be used to improve the designs of a variety of devices across Canada.

Through a review of existing system and academic literature, as well as field research with low vision and non-sighted users, this research set out to identify guidelines to be used in the design of a standard solution that could address accessibility issues with television content discovery.

Based on field studies, two key user personas, Danielle and Omar, were identified. Personas help designers by bringing the users into the design process. In addition, an experience map was created to communicate the pain points that low and non-sighted users currently experience and highlight areas that need to be addressed.

From the background and field research, a set of guidelines on the design of input devices, audio description and navigation for low and non-sighted users were provided in a report entitled Rogers/Broadcast Accessibility Fund - Generative User Research.

Based on these guidelines a prototype of an accessible set-top-box was created by Rogers. The prototype was built to support the most common television usage scenarios that low and non-sighted users can currently not complete.
The prototype was evaluated through two rounds of usability testing with six participants per round, with improvements made after each round. Recommendations are included, based on the final round of testing.

Though the research opens up new opportunities for low and non-sighted users to interact with the video content accessed through the set top box, the resulting prototype is only the initial step. While the report includes recommendations on the design of the TV remote, additional design and testing is necessary to find a more usable remote. Furthermore, the scope of this project was limited to low and non-sighted users so further work is necessary to explore improvements to increase accessibility for users with motor or cognitive disabilities.
Introduction

While there is an increasing trend towards the consumption of video content on mobile devices, traditional television remains an integral part of the fabric of Canadian society. According to Statistics Canada, 94% of Canadians watch at least one hour of TV per week (Figure 1, 2007). In addition, in the United States it was found that traditional television viewing is not declining significantly in the last few years despite predictions that alternative viewing methods would take over the market (Nielsen, 2016). However, the full television experience remains inaccessible to a large audience due to the poor design of the tools needed to explore, discover and consume content. Users with partial or complete vision loss are unable to access the same content and functionality as sighted users. According to research by the American Foundation for the Non-sighted (Packer & Kirchner, 1997), low and non-sighted individuals are just as likely as their sighted peers to own a TV and to have cable.

There were approximately half a million individuals in Canada with significant vision loss in 2013 (CNIB Fast Facts, n.d.). This number is expected to increase in Canada in the coming years as many types of vision loss are age related and the population over 65 is increasing.
“As the number of people who have never lived without television continues to grow, the medium is increasingly taken for granted as an appliance, a piece of furniture, a storyteller, a member of the family.” (Gerbner, 1986)

In 1986 Gerbner et al. discussed the immense impact television had, (and still has), on modern culture. They discussed the different ways that it shapes heavy viewers to have a shared social understanding and to conform to displayed belief systems. Television is increasingly taken for granted as a device that everyone has access to and displays and reinforces cultural beliefs.

Additionally, television forms the basis of many conversational topics both in the workplace and at home (Goodman 1983; Hobson 1982). As television is such a prevalent medium in people's lives, it's no wonder that content is often discussed socially. Those without access to this content are excluded from the conversation.

The primary means of accessing video content from a service provider is through the set-top or cable box, a device that converts the signal into content that can be displayed on a TV. Control of the set-top box is primarily through the use of a remote provided by the service provider. The large number of buttons and variations in layout of the buttons limit the users to a small number of actions (turn on/off, change channels, change volume). Recently designed remotes that support greater accessibility make use of different textures, materials, and shapes to help users locate buttons, as well as a dedicated button to turn the descriptive audio feature on and off. Despite improving the accessibility of the remote, the complexity resulted in the need for external support when learning a new remote.

In addition to the challenges with the design of the remote, in 2009 the United States switched over to 100% digital broadcasting. A consequence of this transition was the increase in the number of set-top systems that rely on a visual interface as the primary means of discovering and accessing video content.

In advance of the switch to digital TV, the American Foundation for the Blind reviewed four different digital converter boxes to determine how well they
supported those with visual impairments (Burton, 2008). All of these converter boxes required the help of a sighted person to set up as they all had a visual menu set up. This visual menu also prevented users from taking advantage of many features of the system such as closed captioning, parental controls, the sleep timer, and emergency information settings. Finally, the user guides were only displayed in small print, or if there was a PDF version, the pictures were not described rendering the user guide useless.

There was concern over how considerations for accessibility during the digital changeover in the United States only focused on closed captioning and descriptive audio and not on the accessibility of the user interface (Pedlow, 2008). The changeover to a digital box removes many of the physical cues inherent in knobs and dials. Instead, with digital TV, programs needed to be accessed using only a visual guide for support. With the number of channels reaching well beyond 100, flipping to each channel and trying to guess the program was no longer an option. Many people with visual impairments expressed frustration over trying to find a show they want to watch.

“How many times have you turned on the TV and flicked through the channels or used the Guide to find a good show? It’s an easy task, to which many do not think twice about doing. However, for me and other non-sighted/visually impaired individuals, it is not such an easy task. In fact, speaking for myself, it can be quite daunting. Whenever I am trying to find something to watch/listen to, I really have to pay attention to sound, so that I can try to decipher the show/movie. Some channels may announce the upcoming show or movie, while others just flash the name across the screen, which frustrates me.” (Accessibility with Comcast, 2013).

When Portugal made the switch over to digital broadcasting in 2012, Oliveira et al. (2011) looked at the effect this would have on users with visual impairments. They spoke to twenty visually impaired users about their TV viewing habits and difficulties. All eleven participants who had contact with a digital television system thought it complicated watching TV. Seven of these eleven participants had access problems when interacting with the system, such as getting lost in menus or not knowing the option that was selected.
Work by Rice (2003), evaluating the state of television in the UK, pulled out a few key problems that users with visual impairments face when interacting with the television. Ten in-person interviews were conducted in users’ homes along with observation sessions. Common problems with navigation were with the size of text on the screen, the remote control design, and the lack of feedback. It is pointed out that controllers with raised keys, different key colours, different key sizes, and different key shapes would help improve the design of the remote.

In Canada, television service providers are not required to provide a system that is accessible for low vision and non-sighted users. Broadcasting Regulatory Policy CRTC 2015-104 (2015) recommends that subscribers should be able to identify audio described programming, and that system hardware should support activation of audio description with a single button. Consequently, there is no existing system on the market that is entirely accessible for low vision and non-sighted users.

**OBJECTIVES**

This report summarizes the research activities conducted by Akendi from February 2016 to April 2017, consisting of a literature review, user research with low vision and non-sighted TV consumers, and two usability tests. The purpose of the literature review was to identify previous attempts to address accessibility issues with TV, as well as explore novel interaction techniques that may be adopted for TV. The user research provided insight into how low vision and non-sighted users interact with their TVs as well as the other tools to help them achieve their daily tasks. The two usability tests evaluated areas for improvement in a developed prototype and made a set of recommendations for a final design. The first half of this report is described in more detail in the document Rogers/Broadcast Accessibility Fund - Generative User Research
SCOPE

In order to complete the research in a timely manner, the project scope was limited on two factors: user population and TV experience.

Usage of video devices, like a set top box, can be difficult for users that have a variety of physical and cognitive disabilities. However, to achieve a universal solution requires a larger scope of research than is possible within the confines of this project. Therefore, for the purpose of this research, the scope of the project is limited to users that only have uncorrectable vision loss. This allows the research to focus on low vision and non-sighted users.

In broad terms, the TV industry consists of the parties that create the content and those that distribute the content. The focus of this research is on user behaviour regarding content discovery, (browsing, searching, recording, etc.), so there is no consideration given to how the content is created in order to satisfy the audience of this research (low vision and non-sighted users).
Research

The initial phase focused on establishing the current state of video accessibility in Canada by reviewing academic and commercial solutions to video accessibility, and conducting in-field interviews with low and non-sighted TV users in order to understand their usage behavior and challenges encountered. Based on the background research Akendi created user personas and an experience map, as well as design guidelines, to assist Rogers in the design of a solution for accessing and navigating video content for low-vision and non-sighted users. For a more in-depth review of the work completed in the research phase of this project, please see Rogers/Broadcast Accessibility Fund - Generative User Research.
BACKGROUND RESEARCH

There are several academic papers on the topic of video accessibility for people with visual impairments.

In 2003 Wlodkowski et al. developed guidelines and a prototype for how a talking menu system should work on a set-top box system as well as at how talking menus are used in DVDs. They found that one of the requirements of the system they developed is that there should be a way to turn on, provide prompts and feedback, and provide menu structures in a way that is easy to verbally comprehend.

![Example of talking menus used to navigate DVDs](http://ncam.wgbh.org/invent_build/analog/talkingmenus)
Researchers have explored the use of text-to-speech systems (Freitasa and Kouroupetrogliou, 2008; Costa et al., 2011). These projects either used screen reading technology or embedded audio files. Embedded audio files were pre-recorded verbal cues that played when triggered by the user action. However, this approach was limited as there would be no embedded audio files for dynamic content, such as upcoming programming. Text-to-speech supports dynamic content; however, support for this feature requires increased computation power, which the set-top box may not support without an improvement in the hardware.

Another area of research is alternative interaction methods such as using gestures, a Wii remote, or voice interaction (Springett and Griffiths, 2007; Vatavu, 2012; Cox et al., 2012; Carmichael et al., 2003; Langdon et al., 2010). Gestures were found to be prone to error, fatiguing, and embarrassing for participants. Older participants found the Wii remote harder to use. In addition, many participants felt that some TV tasks were not suited for gestures as the tasks were too abstract. Carmichael et al. evaluated how well a virtual assistant, shown in Figure 2, would work in helping users navigate a television guide. They found that while the design was appreciated by visually impaired participants, often participants would have a hard time determining what they should say to the system.

Figure 2
Final academic works we reviewed focused on the design of the remote control. To reduce the need for relearning between different remotes, Dezfuli et al. (2012) evaluated the use of the palm and fingers as a remote replacement. Users could interact with the video system by touching various parts of their hands. Unfortunately, there were only five spots on the palm that performed well, which limits the number of actions a user could perform. Laisa et al. (2012) looked the design of current controllers against requirements needed for those who have a visual impairment. Five features were highlighted as being very important. These were: a clean design with few buttons, different shaped buttons, different coloured buttons, feedback when a button is pressed, and buttons labeled with a reference haptic mark.

There have also been several commercial solutions developed to assist low vision and non-sighted users with controlling the television. Comcast, Panasonic, TVOnics, Samsung, Apple, and Goodmans all developed voice guidance systems to assist non-sighted users. The TVOnics Text To Speech accessibility menu is depicted in Figure 3.

These systems provided features such as:

- A dedicated button to turn on voice guidance
- Different voice settings
- Audio feedback when changing channels
- Reading of visual menus
- A ‘Where am I?’ button
- Keyboard support

Usually these systems are not complete solutions and suffer usability issues in some area of the design. The most common issues are due to users being unable set the system up independently or make changes to the voice settings. The most complete voice guidance system of the six systems mentioned above is the Apple TV.
Instead of a voice guidance system, AT&T and YouView have app based solutions. AT&T’s app functions as a mobile remote control that allows users to operate the television, (American Foundation for the Non-sighted, 2013). This app, shown in Figure 4, allows users to use voice commands to choose shows or channels. Apple VoiceOver is used on iOS devices as a screen reader to read Guide information to users. The YouView app is different as programs are watched within the app, rather than on an external television. This app allows users to use text-to-speech throughout the application to locate programs to watch (YouView introduces new accessibility updates, 2014).
USER PERSONAS

A key component of a user centered design methodology is the completion of user research to aid in the design process.

Prior to commencing field research with users, 4 interviews were conducted by Akendi with experts in the field of accessible design or designing for non-sighted users. The objective was to define the parameters that would be used in recruiting participants for the field research, as well as gather any insight on designing for non-visual users.
Based on the expert interviews, 15 participants were recruited using the BALANCE for Blind Adults mailing list. The 7 male and 8 female participants ranged in age from 20 to 65, and lived within the Greater Toronto Area. The participants were divided into 3 equal groups representing low vision users, users without sight from birth, and users that lost vision later in life. Of the 15 participants, 2 participants were living independently, while the remainder were living with others, (roommate, partner, parent, family).

The participants were interviewed within the primary environment where they consume video content, and were asked to demonstrate how they currently use various devices to access and discover content.

From the observed and recorded data, Akendi’s researchers created user personas. A user persona is a representation of a fictional individual that is an aggregate of user behaviours, goals, skills and motivations of a larger user group. Personas are a tool that helps:

- Focus development on the target audience, rather than trying to design for everyone, and failing
- Facilitate communication and consensus building to avoid designs determined by opinions rather than data
- Make and defend decisions based on data from actual users, rather than opinions of designers, developers and management
- Evaluate the effectiveness of a design from the user’s perspective, when the user is unable to be present

Based on the user interviews and demonstrations of their video content consumption behaviours, a clear factor that differentiated users’ behaviour is their attitude towards technology. Two user personas were defined: Danielle, and Omar, based on ‘attitude towards new technology’ as the key differentiating factor. A summary of each persona is provided below. For a more detailed report about each of the personas and their experiences see Rogers/Broadcast Accessibility Fund - Generative User Research.
USER EXPERIENCE MAP

In addition to the user personas, the data from the interviews is useful in the creation of an experience map. An experience map outlines the user journey and acts as a catalyst for the identification of opportunities by highlighting the existing pain points. Each pain point in the map is assigned a recommendation on how it can be resolved.

For the list of pain points associated with each of the journey stages, and opportunities for improvement, see The Digital TV Experience on pg 18.
Old-School

OMAR

Omar, 60, is slowly losing his vision after a long career working for the government. He has difficulty accepting the increasing challenges he is encountering on a daily basis, making him more reluctant to spend the time exploring and trying out new assistive technologies.

When at home, Omar will give up control of the TV to sighted family members because he doesn’t want to interfere with their enjoyment. He’s less likely to participate in social events with other visually impaired users, so he doesn’t discover new technologies to help cope with the challenges of losing his vision. Following a TV series has become frustrating, so he only navigates between a couple of channels that have news, sports and music.

Social Engagement: Low
Tech Awareness: Low
Most Likely to: Abandon TV

He uses ZoomText to browse the web, and primarily relies on YouTube for online content because he finds Netflix too difficult to navigate. If he uses JAWS, Omar is unlikely to make any changes to the defaults, such as the default voice (Paul).

Omar uses the default remote provided and uses only a limited number of buttons. Omar is less engaged in the non-sighted community and relies on his immediate network of friends and family to help out. He will give up control of the TV to others so as to not be an “inconvenience”.

Omar is unlikely to be a “cord cutter”, since there are no other alternatives, other than radio; however, he is unlikely to get anything more than the most basic package offered by a service provider.

He uses scopes or a magnifying glass to help navigate the system, but not to view the content.

When he watches traditional TV, he places himself within a couple feet of the large screen, and looks for the channel. If there are other people around, Omar will sit further back so as to not obstruct the screen, and will rely on a scope to see what is happening. Omar will not turn on described audio. He prefers to put on sports or documentaries, which can be enjoyed without described audio.
Danielle, 35, has been non-sighted since a very young age. Danielle has always sought to be very independent, which she achieves by seeking new technologies that will empower her.

At home, she currently uses a smartphone with VoiceOver to explore the web for video content, and has tried using online streaming services with limited success. She sometimes uses Siri to interact with her phone, but only in a private setting. On her laptop she uses JAWS to browse the web, and has tweaked the settings so that she has found the right voice, at the right speed that works for her.

Danielle is very close to giving up her set-top box due to the lack of support for non-sighted users. She will either “cut the cord” and switch to a service like AppleTV or give up on TV altogether. With her existing set-top box she has managed to program the remote so that she can easily test the secondary audio programming to see if described audio is provided.

She may use Google to see when a particular show is going to be on, and to find the channel, and has bought described audio content from iTunes. Troubleshooting the system is a pet peeve since she doesn’t want to touch the system and risk making things worse, so she has to wait for help from a sighted friend or family member.

Danielle makes use of universal or accessible remotes but still needs help with programming and troubleshooting. If she is going to watch TV, Danielle will go into the basement to watch on her own so that the described audio does not bother her sighted family.

Danielle is always looking for described audio content since she wants to be able to watch the latest shows and to be able to talk to friends and colleagues about them. She’s very engaged in the non-sighted community, and shares anything new she learns with others. With others she will go out to the movies, but will call ahead to let the manager know that she will need audio description services.
DIGITAL TV EXPERIENCE

Challenges & Solutions

The following information maps the journey of people with low to no vision and their challenges. Bringing the digital TV experience into accessibility compliance will empower and enrich the lives of people with disabilities making TV content accessible to every Canadian.

Personas

Digital Danielle
Danielle is constantly looking for ways to improve her quality of life and achieve greater independence. By being socially engaged with the non-sighted community, Danielle is always learning about new technology.

Old-school Omar
Omar would like to be able to interact with the world the way that he used to, but is gradually accepting that he has less control. Omar will rely more on his immediate family for assistance and is not engaged with the larger, non-sighted community.

Pre-use

GETTING STARTED

RESEARCHING

→ Employees not knowledgeable of accessibility offerings in store or on phone  

→ Provider websites not accessible

INITIAL LEARNING

→ Switching between remotes is hard

→ Inconsistencies between old remote and new remote

→ Targeting box with remote is difficult

→ Little tactile guidance given

→ Buttons are not discoverable

→ Misplace/lose remote

SETTING UP

→ Technician unaware of accessibility offering

→ Supporting material not given in other formats

→ No assistance with setup of features, audio description or using a single remote

→ Can’t get into assistive menus

→ Box swapping inconvenient, setup difficult

In-use

ONLINE

SEARCHING

→ Apple Store audio description search not comprehensive

ONLINE BROWSING, STREAMING & WATCHING

→ Netflix is not accessible with screen-readers

→ Netflix does not retain settings between programs

→ Zooming software does not work well with Netflix

→ Difficult to operate fast forward and reverse

INTERACTING WITH SYSTEM

→ Unable to skip ads on YouTube

→ YouTube video error messages are not readable by screen-reader

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.
HOW TO ELEVATE THE TV EXPERIENCE

1. Provide training to customer facing employees about how to interact with customers who have disabilities
2. Bring website into compliance
3. Provide support material in formats other than standard print
4. Provide multiple methods to box swap
5. Provide an on-boarding experience
6. Provide auditory feedback of actions
7. Provide an improved remote design
8. Provide ability to improve visibility of the interface
9. Provide method to find remote
10. Provide non-visual method of accessing on screen information
11. Provide information about which shows are described
12. Provide an easy-to-use data entry method
13. Provide a method to record the audio description
14. Enable filtering of content by audio description
15. Improve system performance
16. Maintain users’ settings
17. Allow users to independently listen to audio description
18. Allow for less precise targeting

SET TOP BOX

BROWSING
- Low contrast in the Guide
- Mini Guide font size too small
- Mini Guide disappears quickly
- Users are lost while channel surfing
- No info about programming is given when surfing
- No method to find audio description content

SEARCHING
- Data entry keyboard layout difficult to use
- Results cannot be seen
- Deleting and making corrections is difficult

WATCHING & BROWSING ON DEMAND
- Menus not visible
- Menus are difficult to navigate
- Low contrast in these services

CUSTOMIZING
- Difficult to find Settings menu
- Difficult to navigate Settings menu
- Unable to identify the current setting
- Difficult to change settings
- Difficult to save settings

SAVING
- Unable to see if a recording has started
- Unable to find saved PVR content
- Unable to record the audio description
- Difficult to operate fast forward and reverse
- Can’t delete/save content
- Can’t schedule a recording

INTERACTING WITH SYSTEM
- Slow
- No feedback from user actions
- No individual audio description
- Weather/amber alerts only visible on some channels

MOBILE APPS

SEARCHING
- Rogers app not functional with screen-readers

IN-APP ONLINE BROWSING, STREAMING & WATCHING
- Anyplace TV, Home Edition, and Rogers NHL are not completely functional with screen-readers

TROUBLESHOOTING
- Can’t see on screen errors
- Can’t see network errors
- Resetting the box can be difficult
- Poor customer service

Research by Akendi
Proposed Design

Rogers decided to implement a text to speech system that was capable of communicating dynamic system content to the users.

To ensure that the proposed solution would work with any of the systems currently used by Canadian service providers, the design of the remote was considered out of scope. Each service provider designs their own remote, so a solution could not restrict the service providers to a single remote design. However, the proposed solution does make suggestions around the type of buttons that the remote would require as well as positioning and design of the buttons, to ensure ease of discovery and use.
Rogers developed the prototype using a series of HTML pages read by Google’s ChromeVOX extension. The voice reading the text was the ‘Alex’ voice found in MacOS. This prototype was controlled by a WD remote that was connected to a computer with the prototype HTML pages.

The prototype consisted of a tutorial/setup portion where users would learn the buttons on the remote and set up basic TV settings (such as parental controls and a purchase PIN). It also had an electronic program guide, search, settings, recordings, recommended content, movies, and TV shows. Apart from introduction information at the beginning of each menu section, the initial prototype read out on-screen text exactly as displayed to the user. For example, the system would read the following message when the user entered the Guide.

“Guide. The Guide contains the Electronic Program Guide, also called the Schedule. Use the [Right] arrow to navigate between the page’s elements. Listen to the channel’s program to see if you wish to tune to a program. Press [OK] to enter a channel and select a program.”

This message was intended to orient the user to the section they were in and provide basic information.

The prototype was built to support the tasks identified in the protocol used in the usability testing (see appendix A) and based upon features available in existing TV systems.
Usability Testing

Usability tests are controlled studies where the designed product or service is tested with representative users, in this case people with substantial vision loss. The goal of this testing is to uncover problems with the design before the product is final, in order to make fixes and improve the experience.

There are three main factors we look at when conducting a usability test: effectiveness, efficiency, and satisfaction. The objective is to ensure that users can complete their goals in a reasonable amount of time and feel good about using the product.

For this project there were two usability tests completed, with revisions made to the prototype after each usability test. Running multiple usability tests is an important part of usability testing. This allows improvements to be measured and ensures that the changes we make to the prototype fix the problems we found. In addition, it will find any additional problems that may be introduced by any changes.

Any difficulties users encountered were observed and recorded, and a usability issue was flagged if three or more participants encountered a similar problem. Usability issues were identified as critical, major or minor. Critical issues indicate a problem that will prevent users from completing their tasks or will cause them to take a very long time. Major issues indicate that users will take a long time or make errors when completing tasks. Minor issues indicate that users will be able to complete tasks, but they may be annoyed with the process. Testing of the initial Rogers prototype revealed 6 critical, 19 major, and 13 minor issues with the design.
METHODOLOGY

Usability sessions occurred in the participants’ residences, in a manner that represented how they would normally consume video content. Participants would be seated in a chair or on the couch, and the moderator would represent the TV, and would be positioned in front of the participant. The remote was placed in front of the participant, in a position that did not suggest which end was the top, i.e. the end to point towards the TV. Participants were instructed to pick up the remote and asked to complete the following nine scenarios, one at a time.

› Complete the tutorial
› Find a program using the Guide
› Turn on audio description
› Record a program
› Turn off voice guidance
› Locate a recorded show
› Use search
› Discover content on the main page of the TV system
› Filter content to only see described content

For the second round of usability testing the search task was removed, as this task proved to be difficult and cumbersome for sighted and non-sighted users. Based on the findings from this study and previous usability tests of set-top systems, the fastest and most satisfying manner for performing a search of video content is through a voice-command system, similar to Apple’s Siri, as it removes the need for an on screen keyboard which is slow for sighted and non-sighted users.

The participant controlled the prototype through the remote, and when necessary the moderator could make corrections and simulate the correct behaviour if an error with the prototype occurred.
In addition to an audio recording of the session, a note taker was nearby and recorded observed behaviour.

A task was recorded as a pass if the participant achieved the goal of the task; otherwise the task was recorded as a failure.

For the full details of each of the task scenarios, please see appendix A and B.

PARTICIPANTS

For the first round of usability testing six users with no prior experience with the voice to text prototype set-top were recruited. Every participant had a paid television subscription and indicated that they always or sometimes control the TV themselves.

<table>
<thead>
<tr>
<th>Vision</th>
<th>Number of Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blind from birth</td>
<td>2</td>
</tr>
<tr>
<td>Blind later in life</td>
<td>2</td>
</tr>
<tr>
<td>Gradual loss of vision</td>
<td>2</td>
</tr>
</tbody>
</table>

The second round of usability testing had a similar breakdown of participants as the first round, except 3 of the round 2 participants were participants from round 1. This allowed for the comparison in performance between the round 1 and round 2 prototypes to measure the improvement in the design.
ROUND 1 TESTING RESULTS

Based on the round 1 testing there were three general areas for improvement:

1. Improvements to the remote button mappings and the introduction to the remote to better prepare users for independent operation
2. Provide clear information about where users are and how to proceed
3. Provide complete and descriptive feedback to users after they perform an action

On the remote, there were a couple of buttons that did not perform as well. The button labelled as the “advance button”, which is used to jump to the next interactive element, was confused with the right arrow, which is used to move to the next element, regardless of whether it was interactive or not. Similar confusion occurred with the left arrow and the “Back” button, used to move to the previous page. The lettered buttons ("A", and "B"), used for localizing the user, and turning on audio description, located in the coloured row on the remote were difficult to find based on the description.

The functionality of some buttons was not well understood. Once users began to use the back button, they expected this to take them to their last selection, not the last page in the system. The “Localization” button, used to communicate the current location of the user in the system, was unfamiliar to participants and so its functionality was not well understood. In addition, participants found it strange that the advance and back button were not opposite each other.

Also, the tutorial did not provide information about all the buttons to participants or basic information such as how to hold the remote.

Once participants got to the main setup of the system they were unsure how to navigate, as the system did not provide much guidance. In addition, the features that they were setting up during the setup process (parental controls and purchase PINs) were unfamiliar to them. Because participants have been unable to use these
features before in their previous set-top box systems, they were unsure what they were setting up or what they should do. Labels such as ‘Next’ did not provide enough information about what selecting this item would do. This problem of vague labels continued throughout the rest of the system.

Once participants completed the system setup and were navigating through the set-top box they encountered some difficulty with remembering less often used controls (such as turning the voice assistant on and off). There was no way for participants to look these controls up once they had forgotten them. In addition, some buttons did not work as expected. When participants selected the menu button, they expected to be immediately brought to the menu. Unfortunately, the system required users to press the ‘OK’ button after selecting the menu button to open the menu. Pressing the menu button simply brought focus to the menu option on screen.

The electronic program guide’s structure was also a source of confusion for many participants. The nested structure was not well understood and participants expected that if they hit ‘OK’ after hearing a show name that they would be taken directly to the show. Overall, participants did not receive enough guidance from the system to understand where they were or what their options were. The tabbed structure of the ‘Saved’ section was also not well understood by many participants. This structure did not perform well in a non-visual context as it was not clear what tab the participant was currently in.

Based on the results from the study, we provided several recommendations for the improvement of the prototype.

**Recommendations to Improve Remote Usage and On-Boarding**

- Provide a basic introduction to the remote (orientation, layout)
- Introduce users to all the buttons
- Rename the ‘Localization’ button to something that is more meaningful to users (such as the label “Where am I?”, used in Goodmans Smart Talk Digital Receiver)

- Provide tactile feedback on the remote so that users can locate the number pad

- Provide an introduction to TV features that are new to non-sighted users, like the Guide, and purchase PIN

- Provide clear direction of how to progress through the system

- Recommendations for Feedback in Regular Operation

- Open the menu automatically when the ‘Menu’ button is pressed

- Allow users to circle through the Menu without leaving the main page

- Change the ‘Back’ button to take users to the last selection rather than the last page

- Provide more information about where a user currently is within the system

- Provide more clear labels to indicate available actions

- Change the structure of the Guide to allow navigation by time slot

- Announce to users how many items are in each menu or section

- Consider clarifying what content is contained in the ‘Recommended for you’ section

- Allow users to filter for DVS across the entire TV system

- Allow users to access system options through the ‘Options’ button on the remote or through the main menu as well

These recommendations were provided to Rogers to use when updating the prototype to the next iteration.
ROUND 2 TESTING RESULTS

The prototype was updated based on the recommendations from the initial round of usability testing. Information that is not presented on the screen to sighted users was added, through the voice assistant, to support non-sighted users. For example, all menus now contained information about the number of options present in each menu and information about which option you were currently on. In addition, navigational instructions were included at the end of each section introduction to remind users how to navigate through the system. The tab style navigation, found in the last prototype, was abandoned for a consistent menu style throughout the system. These changes provided a more complete picture to the user regarding where they were within the system and what options were available.

The second round of usability testing revealed 2 critical, 2 major, and 6 minor issues with the design.

Overall, the results were more positive than the first usability test. Participants who had participated in the last round of usability testing commented that they
found the new prototype easier to use. Participants accomplished most tasks without any problems.

Based on the results from the study, there are several recommendations to improve the design.

**Recommendations to Improve Remote Usage and On-Boarding**

- Update remote to provide more tactile feedback, such as more clearly defined shape, and tactile landmarks, like a ridge along one edge of the “Select” button
- Provide feedback to the user when they press an invalid button in the tutorial
- Provide option to receive audio feedback when a button is pressed on the remote
- Allow users to immediately perform data entry actions, without having to first navigate to the input field, when that is the only action the user can perform

**Regular Use Recommendations**

- Modify the description of the controls used to navigate through to Guide
- When navigating through the Guide, announce the channel first when moving through channels (up and down), and announce the time when navigating through the same channel (left and right)
- The placement of the audio description settings should be placed in a category that will make it easier for users to find
- Provide options in a final version to change the verbosity and the speed of the voice Assistant

These recommendations should be used to resolve final usability issues with the prototype before going on to build a release version.

We recommended further usability testing to evaluate the impact of the changes to the design based on the second usability test. Furthermore, a usability test with a larger sample size will determine if there are any usability issues that are difficult to discover with a low number of participants.
Summary

The results from this research are a significant step forward in improving the accessibility to video content for low and non-sighted users. Participants in the usability tests were able to complete tasks that, while trivial for sighted users, are impossible for low vision and non-sighted users.

The resulting prototype provides screen reading capabilities, with additional voice assistance instructions, to support users from the initial setup, through to the usage of common features like Video On Demand (VOD), Guide, Personal Video Recording (PVR), and personalization of the system settings.

However, the proposed design is only the initial step in realizing a fully accessible solution. Additional technical and design challenges remain.

The prototype from this research was a simulation of the set top experience which allowed for rapid, iterative user testing. However, the design will need to be implemented on an existing set to box platform to evaluate any impact of the existing technology on the design and performance of the proposed solution.

While it may be possible for other 3rd party devices, such as a mobile device, to serve as a remote, service providers should still make an accessible remote available to their customers. This research included guidelines on how to ensure that a remote is more accessible and has the required button mappings for a voice assisted system, but does not include a proposed design for an accessible remote. To arrive at an improved remote design, further research is necessary to ensure that any proposed remote is not only appropriate for low and non-sighted users, but also for a larger range of users.
The decision was made at the beginning of the project to limit the scope to low and non-sighted users, given the size of the population and the rate at which it is growing. However, there are still a large number of potential users that have different accessibility requirements, such as users with motor and cognitive difficulties.

Continuing the work that this research started will ensure that all Canadians will be able to enjoy an important day to day medium of communication.
Appendix A: Usability Tasks – Usability Test 1

Below is a list of each of the tasks that participants were asked to complete in the first usability task.

**Task 1:** “You have just received a new set top box from your service provider and are eager to begin using it. You turn it on for the first time and begin the setup process.”

**Task 2:** “Your friend just called to tell you that a really funny show is airing right now called Kim’s Convenience. You turn on your TV to watch Kim’s Convenience but don’t know what channel it’s on. Please show me what you would do.

*If participant tries channel surfing:* Is there any other place you would go to find out what’s on right now?”

**Task 3:** “You know that the program you are currently watching has audio description and want to turn it on. Show me what you would do.”

**Task 4:** “Can you show me how you would get back to the main menu of the system?

You’ve been invited to a party tonight and are going to miss the next episode of Game of Thrones. You want the system to save this episode so that you can watch it when you return. Please show me what you would do. You know the episode airs at 6:30 pm on the HBO channel.”

**Task 5:** “You are going on holiday for two weeks and a friend is staying at your home while you are away. Your friend is sighted and you want to set your TV up so that she can control it like she usually does at her home. Please show me what you would do.”
**Task 6:** “Can you show me how you would get back to the main menu of the system? Now that you are back from your vacation, there are a lot of programs that the system kept for you while you were away. You want to find these programs and watch the latest Suits episode. Please show me what you would do.”

**Task 7:** “You are having some friends over for a movie night and want to watch the movie Captain America: The Winter Soldier. Show me how you would find this movie.

*If looking in the movies section:* Is there a way for you to find this without browsing through all the movie content?”

**Task 8:** “You are looking for something to watch and have heard that this system will recommend content based on your preferences. Please show me how you would find this recommended content.”

**Task 9:** “You prefer to watch described content and find it frustrating sorting through programs that don’t offer this. You want to make it easier to just see this content when you are browsing the system. Please show me what you would do.”
Appendix B: Usability Tasks – Usability Test 2

**Task 1:** “You have just received a new set top box from your service provider and are eager to begin using it. You turn it on for the first time and begin the setup process.”

**Task 2:** “Your friend just called to tell you that a really funny show is airing right now called Kim’s Convenience. You turn on your TV to watch Kim’s Convenience but don’t know what channel it’s on. Please show me what you would do.

*If participant tries channel surfing:* Is there any other place you would go to find out what’s on right now?”

**Task 3:** “You know that the program you are currently watching has audio description and want to turn it on. Show me what you would do.”

**Task 4:** “Can you show me how you would get back to the main menu of the system?

You’ve been invited to a party tonight and are going to miss the next episode of Game of Thrones. You want the system to save this episode so that you can watch it when you return. Please show me what you would do. You know the episode airs at 8:30 pm on the HBO channel.”

**Task 5:** “You are going on holiday for two weeks and a friend is staying at your home while you are away. Your friend is sighted and you want to set your TV up so that she can control it like she usually does at her home. Please show me what you would do.”
Task 6: “Can you show me how you would get back to the main menu of the system?

Now that you are back from your vacation, there are a lot of programs that the system kept for you while you were away. You want to find these programs and watch the latest Suits episode. Please show me what you would do.”

Task 7: “You are looking for something to watch and have heard that this system will recommend content based on your preferences. Please show me how you would find this recommended content.”

Task 8: “You prefer to watch described content and find it frustrating sorting through programs that don’t offer this. You want to make it easier to just see this content when you are browsing the system. Please show me what you would do.”
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ABOUT AKENDI

Akendi is a human experience design firm, leveraging equal parts user experience research and creative design excellence. We are passionate about the creation of intentional experiences, whether those involve digital products, physical products, mobile, web or bricks-and-mortar interactions.

We provide strategic insights and analysis about customer and user behaviour, combine this knowledge with inspired design, and architect the user experience to meet organization goals. The result is intentional products and services that enable organizations to improve effectiveness, engage users and provide remarkable customer experiences.

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ACCESSIBILITY FUND

Generative User Research

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June 2016
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Introduction

While there is an increasing trend towards the consumption of video content on mobile devices, traditional television remains an integral part of the fabric of Canadian society. According to Statistics Canada, 94% of Canadians watch at least one hour of TV per week (2007). However, the full television experience remains inaccessible to a large audience due to poorly designed tools that are needed to explore, discover and consume content. Users that have partial or full vision loss are unable to access the same content and functionality as their sighted peers. According to research by the American Foundation for the Non-sighted (Packer & Kirchner, 1997), low and non-sighted individuals are just as likely as their sighted peers to own a TV and to have cable.

There were approximately half a million individuals in Canada with significant vision loss in 2013 (CNIB Fast Facts, n.d.). This number is expected to increase in Canada in the coming years as many types of vision loss are age related and the population over 65 is increasing.

Current set-top boxes rely on interaction through a visual interface. Control of the set-top box is primarily through the use of the remote control, which contains a large number of buttons that are difficult to discover and use by low vision and non-sighted users. Other than a small set of activities, like switching the channel and adjusting the volume, non-sighted users are not able to use most of the features of the system, without the assistance of others.
“As the number of people who have never lived without television continues to grow, the medium is increasingly taken for granted as an appliance, a piece of furniture, a storyteller, a member of the family.” (Gerbner, 1986)

In 1986 Gerbner et al. discussed the immense impact television had, (and still has), on modern culture. They discussed the different ways that it shapes heavy viewers to have a shared social understanding and to conform to displayed belief systems. It is taken for granted that television is a device that everyone has access to.

Additionally, television forms the basis of many conversational topics both in the workplace and at home (Goodman 1983; Hobson 1982). As television is such a prevalent medium in people’s lives, it’s no wonder that content is often discussed socially. Those without access to this content are excluded from the conversation.

In 2009, the United States switched over to 100% digital broadcasting. This caused a number of challenges for television users who are visually impaired.

In order for many people to access digital television they needed to purchase and set up a digital converter box. In advance of the switch to digital TV, the American Foundation for the Blind reviewed four different digital converter boxes to determine how well they supported those with visual impairments (Burton, 2008). All of them required the help of a sighted person to set up as they all utilized a visual menu. This visual menu also prevented users from taking advantage of many features of the system such as closed captioning, parental controls, the sleep timer, and emergency information settings. However, switching on descriptive audio was easy as there was a dedicated button on all the remote controls. Some of the remote controls were not as good for tactile use as the buttons did not vary in size and shape and they were not arranged by function. Finally, the user guides were only displayed in small print, or if there was a PDF version, the pictures were not described rendering the user guide useless.
There was concern over how considerations for accessibility during the digital changeover in the United States only focused on closed captioning and descriptive audio and not on the accessibility of the user interface (Pedlow, 2008). The changeover to a digital box removes many of the physical cues inherent in knobs and dials. Instead, with digital TV, programs needed to be accessed using only a visual guide for support. With the number of channels reaching well beyond 100 for some people, flipping to each channel and trying to guess what program was on was no longer an option.

Many people with visual impairments expressed frustration over trying to find a show they wanted to watch.

“How many times have you turned on the TV and flicked through the channels or used the Guide to find a good show? It’s an easy task, which many do not think twice about doing. However, for me and other non-sighted/visually impaired individuals, it is not such an easy task. In fact, speaking for myself, it can be quite daunting. Whenever I am trying to find something to watch/listen to, I really have to pay attention to sound, so that I can try to decipher the show/movie. Some channels may announce the upcoming show or movie, while others just flash the name across the screen, which frustrates me.” (Accessibility with Comcast, 2013).

When Portugal made the switch over to digital broadcasting in 2012, Oliveira et al. (2011) looked at the effect this would have on users with visual impairments. They spoke to twenty visually impaired users about their TV viewing habits and difficulties. All eleven participants who had contact with a digital television system thought it complicated watching TV. Seven of these eleven participants had access problems when interacting with the system, such as getting lost in menus or not knowing the option that was selected.
Work by Rice (2003), evaluating the current state of television in the UK, pulled out a few key problems that users with visual impairments face when interacting with the television. Ten in-person interviews were conducted in users’ homes along with observation sessions. Common problems with navigation were with the size of text on the screen, the remote control design, and the lack of feedback. It is pointed out that controllers with raised keys, different key colours, different key sizes, and different key shapes would help improve the design of the remote control.

In Canada, television service providers are not required to provide a system that is accessible for low vision and non-sighted users. Broadcasting Regulatory Policy CRTC 2015-104 (2015) recommends that subscribers should be able to identify audio described programming, and that system hardware should support activation of audio description with a single button. Consequently, there is no existing system on the market that is entirely accessible for low vision and non-sighted users.

**OBJECTIVES**

This report summarizes the research activities conducted by Akendi from February 2016 to April 2016, consisting of a literature review and user research with low vision and non-sighted TV consumers. The purpose of the literature review was to identify previous attempts to address accessibility issues with TV, as well as explore novel interaction techniques that may be adopted for TV. The user research provided insight on how low vision and non-sighted users interact with their TVs as well as the other tools to help them achieve their daily tasks. Combined effort allows for the creation of a set of design recommendations and requirements that will be used to guide the creation of a national, if not international, standard approach to improving the accessibility of systems used for consuming video content by low vision and non-sighted users.
To achieve this goal, the research met the following objectives:

- Exploration of related works, from industry and academia, to identify best practices and opportunities for improvement
- Identification of the current user behaviour and motivations to guide future research, design and testing activities
- Capture the current, overall experience of non-sighted video content consumers

**SCOPE**

In order to complete the research in a timely manner, the project scope was limited to two factors: user population and TV experience.

Usage of video devices, like a set-top box, can be difficult for users that have a variety of physical and cognitive disabilities. However, to achieve a universal solution requires a larger scope of research than is possible within the confines of this project. Therefore, for the purpose of this research, the scope of the project is limited to users that only have uncorrectable vision loss. This allows the research to focus on low vision and non-sighted users.

In broad terms, the TV industry consists of the parties that create the content and those that distribute the content. The focus of this research is on user behaviour regarding content discovery, (browsing, searching, recording, etc.), so there is no consideration given to how the content is created in order to satisfy the audience of this research, (low vision and non-sighted users).
Related Work

Awareness of the accessibility challenges with digital television is not a recent phenomenon. There have been a number of proposed solutions to the current difficulties that were developed and tested within academic and commercial settings.
ACADEMIC SOLUTIONS

In 2003 Wlodkowski et al. developed guidelines and a prototype for how a talking menu system should work on a set-top box system as well as how talking menus are used in DVDs. They found that one of the requirements of the system they developed is that there should be a way to turn on, provide prompts and feedback, and provide menu structures in a way that is easy to verbally comprehend.

Figure 1
Springett and Griffiths (2007) looked at two different interaction methods to control the television. The first one was a gesture based system and the second was a combination of a remote control, a numeric keyboard, and a character keyboard all in a fixed location. For the gesture system, participants were allowed to come up with their own gestures to control the system. Despite using a human for gesture recognition, there were still errors in this system as it wasn’t always clear when a gesture was intended or not. In addition, participants found controlling the television with gestures to be more tiring than with the remote control. For the keyboard interface, participants who could touch type wanted the keyboard to be QWERTY as it made inputting information easier. Participants found both these interaction methods insufficient for navigation as they were still unable to decipher information on the screen and they indicated that they would like voice guidance.

Vatavu (2012) also explored the use of gestures in twelve common television tasks. These tasks included activities such as Volume up and down, Select, Close, Next or Previous, and Yes and No. Some user defined gestures had high agreement rates with almost all of the 12 participants performing the same gesture. These gestures were Select, Next, and Previous. For Select, participants would point at the object and push their finger toward the screen, imitating a clicking gesture that they might use with a mouse or tablet. For Next, participants would move their dominant hand to the left and, for Previous, they would move it to the right. Other user defined gestures had much lower agreement rates. Overall, one handed gestures were preferred and many TV functions were found to be too abstract for gestures.

Another interaction method that was explored was the use of a Wii remote control to operate the television. Bhanchu (2011) ran a study with younger and older adults to test this interaction method. Users felt like their attention was more on the screen, however both groups felt like it took some time to get used to the system and both required instruction. The older group tended to get stuck more and needed more assistance using the system. The effects of fatigue were not looked at.
Cox et al. (2012) also evaluated how well the Wii remote control performed in operating an iTV system. He evaluated how well this and other control systems performed against each other. Specifically, the Wii remote control, the Microsoft Kinect, and two methods of using an Android tablet were compared, (relative and absolute positioning). Participants were asked to perform a drag and drop task and then were asked to complete a number of navigation tasks on an iTV system. Overall, the Wii remote control performed the best in terms of completion time, errors, and user satisfaction. The Kinect performed the worst; participants found it difficult to use and had high error rates. Also, in the post task interviews participants said that while they appreciated that there was no physical device, they found using the Kinect fatiguing and embarrassing.

Carmichael et al. (2003) evaluated how well a virtual assistant, shown in Figure 2, would work in helping users navigate a Television Guide. They tested the developed system with two groups: a visually impaired group and an elderly group. Overall there was positive feedback from the visually impaired group who found that the benefits of having such a system outweighed the flaws in the system. However, the elderly group had an overall negative reaction to the system. Participants interacted with the virtual assistant through voice commands and often participants would have a hard time determining what they should say to the system.

Figure 2
Langdon et al. (2010) also tested a speaking guide avatar with a focus group of six participants, (two of whom had visual impairments). None of the participants liked the avatar and indicated that they would want an avatar that was more appealing and realistic. The concept of gesture interaction was also tested with the focus group and there was a lot of concern among the group with operating the television using gestures. They believed that it would be difficult to operate the system and have their gestures correctly register. This belief was particularly strong among participants with visual impairments or physical impairments.

Freitasa and Kouropetrou (2008) discussed many different forms and applications of speech technologies from talking alarm clocks to talking dictionaries. One of the talking devices that they mention is a talking electronic program guide. Their description of the Guide involves a text to speech converter on the user’s end in their set-top box. The electronic program guide information is seen by users as an easier item to parse since it is already in text form.

Another proposed solution was the use of smart cards to store user preferences. Gill and Perera (2003) proposed that smart cards could be used to store information such as text size, content layout, speech output, colour combinations, subtitles, and audio description. These cards would be capable of being inserted into multiple systems so that the users’ settings remain consistent regardless of which television they are using.

Vlachogiannis et al. (2008) built a prototype of a multimedia application based on the MPEC-21 standard. This system is based on profiles that detail information about a user’s particular requirements. The system will then recommend programs that will suit a user’s profile. This system requires that content be tagged in order for it to be appropriately recommended to the user.
In the paper by Costa et al., (2011) two solutions are proposed to incorporate locution services into the set-top box to create talking menus. The first is to embed audio files that contain audio tracks for all the on screen text items and the second is to use a speech synthesizer that can read out the on screen text. Use of a speech synthesizer allows for dynamic text, like the electronic programming guide, however it requires more processing resources from the set-top box. Furthermore, the quality of speech synthesizers was very poor at the time. Therefore, in their implementation of the set-top box system, the authors used embedded audio files which limited the system to audio information of the fixed elements in the system, (i.e. menus).

Dezfuli et al. (2012) were concerned with users having to look down at their remote controls in order to operate them. In their research they evaluated the use of the palm and fingers as a remote control replacement. In a study with 10 people this method of control was evaluated to determine how accurately users could touch different parts of their hand without looking. The palm was the most easily located area with most participants finding it successfully. The fingers performed the worst, with users having a particularly hard time locating their pinky fingers. There were five spots on the palm that performed well, which limited the number of actions a user could perform when using gestures on their hand to control the set-top box. Furthermore, in order to capture the gestures, the researchers needed to position cameras behind the participants, and control for lighting in the environment, which makes this approach infeasible in consumer households.

Laisa et al. (2012) were also concerned with the design of the controls on the remote. They looked at the design of current controllers against requirements needed for those who have a hearing impairment, a visual impairment, physical disability, or a cognitive disability. Three models of controllers were considered. For users with a visual impairment, five features were highlighted as being very important. These were: a clean design with few buttons, different shaped buttons, different coloured buttons, feedback when a button is pressed, and buttons labeled with a reference haptic mark.
COMMERCIAL SOLUTIONS

There have also been several commercial solutions developed to assist low vision and non-sighted users with controlling the television.

Comcast in the United States has recently released their new voice guidance system on one of their set-top boxes (Kendrick 2014; X1 Talks 2014). The voice guidance system will read off options for the DVR, Guide and system menus. Currently customization of the voice settings is not possible, (such as speaker gender, speed of speech, or amount of description). To turn voice guidance on and off there is a dedicated button on the remote control that will quickly get users to the settings.

Another developed voice guidance system is the Panasonic Voice Guidance (American Foundation for the Non-sighted, 2013), shown in Figure 3. This system was developed for some of their television models in partnership with The Royal National Institute for the Non-sighted. This system will provide information such as the channel name, current program information, on screen program guide, recording and setting reminders, finding and playing recorded content, and on screen alerts. The user of this system also has the ability to set the level of guidance she or he will receive and the speed of the speech, unlike in the Comcast design. Unfortunately, not all system menus are supported by voice guidance and a sighted person is needed for set up as basic tuning is not supported.

Figure 3
Another system developed in partnership with The Royal National Institute for the Non-sighted is the TVOnics Text To Speech, (American Foundation for the Non-Sighted, 2013), for digital set-top box. This system, shown in Figure 4, is very similar to the Panasonic system in design, however it provides more updates about status and the voice is more pleasant.

The 6400 series televisions by Samsung also have a voice guide (Holton, 2014). The setup of these televisions requires sighted help as the initial setup wizard is all visual. Also, like the Panasonic system, not all menus are supported. Options are provided to customize speed, volume, pitch, and level of guidance. In addition to voice guidance, there are also options to change to a high contrast mode and enlarge the font size of menus. These televisions have a quick accessibility button on the remote control for toggling on and off the voice guidance. Unfortunately, when Voice Guide is enabled you can no longer use voice commands.
Goodmans Smart Talk Digital Receiver, shown in Figure 5, is another voice guidance system that was designed with people who are non-sighted or partially sighted. (American Foundation for the Non-sighted, 2013). This system is unique in that it has a dedicated, “Where am I?”, button to establish where the user is currently located within the system. This system also has an audio indication whenever the user is on a program where audio description is available. A feature that also makes this system unique is the large, high-contrast buttons on the remote control.

Figure 5
The fourth generation of the Apple TV has a strong set of features for users who are non-sighted or partially sighted (Pérez, 2015). Voice guidance, called VoiceOver, is turned on with a triple click of the menu button. This can be done during setup so that this system can be set up without the help of a sighted individual. There are options for increasing text size of menus, setting how closed captions look, increasing contrast, and reducing motion. Siri, Apple's voice recognition system, can also be used to navigate around the system and search for content. Additionally, Apple has provided a magnification feature called Zoom which will magnify the screen up to 15x.

Instead of a voice guidance system, AT&T created a remote control app to control the television, (American Foundation for the Non-sighted, 2013). The U-verse Easy Remote control App allows users to use voice commands to choose shows or channels. Apple VoiceOver is used on iOS devices as a screen reader to read Guide information to users. The app, shown in Figure 6, also features settings to control font sizes in the app as well as contrast options. Gesture commands were also built into the app as an alternative way to control shows.

Figure 6
An on-demand TV service in the UK, YouView, is mobile application based (YouView introduces new accessibility updates, 2014). Text to speech can be used throughout this application to read off listings in the Program Guide or menus in the app. In addition, a high contrast option and the ability to zoom in on the Program Guide are included, improving the ease with which partially sighted users can select programs. An example of the YouView app is shown in Figure 7.

![YouView App Screenshot](http://www.rnib.org.uk/youview-introduces-new-accessibility-updates)

Figure 7
User Research

A key component of a user centered design methodology is the completion of user research to aid in the design process.

Prior to commencing field research with users, four interviews were conducted by Akendi with experts in the field of accessible design or designing for non-sighted users. The objective was to define the parameters that would be used in recruiting participants for the field research, as well as gather any insight on designing for non-visual users. Details on the experts interviewed can be found in Appendix A.

Based on expert interviews (conducted in February, 2016), 15 participants were recruited using the BALANCE community mailing list. The 7 male and 8 female participants ranged in age from 20 to 65, and lived within the Greater Toronto Area. The participants were divided into 3 equal groups representing low vision users, users without sight from birth, and users who lost vision later in life. Of the 15 participants, 2 participants were living independently, while the remainder were living with others (roommate, partner, parent, family). For more details on the participants’ interviews (conducted in March, 2016), see Appendix B.

The participants were interviewed in the primary environment where they consume video content, and were asked to demonstrate how they currently use various devices to access and discover content.
USER PERSONAS

From the observed and recorded data, Akendi’s researchers created user personas. A user persona is a representation of a fictional individual that is an aggregate of user behaviours, goals, skills and motivations of a larger user group.

Personas are a tool that help:

› Focus development on the target audience, rather than trying to design for everyone
› Facilitate communication and consensus building to avoid designs determined by opinions rather than data
› Evaluate the effectiveness of a design from the user’s perspective, when the user is unable to be present

Based on the user interviews and demonstrations of their video content consumption behaviours, a clear factor that differentiated users’ behaviour was their attitude towards technology. Two user personas were defined, Danielle and Omar, based on ‘attitude towards new technology’ as the key differentiating factor.
Old-School

OMAR

Omar, 60, is slowly losing his vision after a long career working for the government. He has difficulty accepting the increasing challenges he is encountering on a daily basis, making him more reluctant to spend the time exploring and trying out new assistive technologies.

When at home, Omar will give up control of the TV to sighted family members because he doesn't want to interfere with their enjoyment. He's less likely to participate in social events with other visually impaired users, so he doesn't discover new technologies to help cope with the challenges of losing his vision. Following a TV series has become frustrating, so he only navigates between a couple of channels that have news, sports and music.

Social Engagement: Low
Tech Awareness: Low
Most Likely to: Abandon TV

Figure 8
Devices with Physical Buttons

He uses ZoomText to browse the web, and primarily relies on YouTube for online content because he finds Netflix too difficult to navigate. If he uses JAWS, Omar is unlikely to make any changes to the defaults, such as the default voice (Paul).

Figure 9
Default Remote

Omar uses the default remote provided and uses only a limited number of buttons. Omar is less engaged in the non-sighted community and relies on his immediate network of friends and family to help out. He will give up control of the TV to others so as to not be an “inconvenience”.

Omar is unlikely to be a “cord cutter”, since there are no other alternatives, other than radio; however, he is unlikely to get anything more than the most basic package offered by a service provider.

Figure 10
Scopes & Magnifying Glass

He uses scopes or a magnifying glass to help navigate the system, but not to view the content.

When he watches traditional TV, he places himself within a couple feet of the large screen, and looks for the channel. If there are other people around, Omar will sit further back so as to not obstruct the screen, and will rely on a scope to see what is happening. Omar will not turn on described audio. He prefers to put on sports or documentaries, which can be enjoyed without described audio.
Danielle, 35, has been non-sighted since a very young age. Danielle has always sought to be very independent, which she achieves by seeking new technologies that will empower her.

At home, she currently uses a smartphone with VoiceOver to explore the web for video content, and has tried using online streaming services with limited success. She sometimes uses Siri to interact with her phone, but only in a private setting. On her laptop she uses JAWS to browse the web, and has tweaked the settings so that she has found the right voice, at the right speed that works for her.

Social Engagement: High
Tech Awareness: High
Most Likely to: Move to streaming

Danielle is very close to giving up her set-top box due to the lack of support for non-sighted users. She will either “cut the cord” and switch to a service like AppleTV or give up on TV altogether.

With her existing set-top box she has managed to program the remote so that she can easily test the secondary audio programming to see if described audio is provided.

She may use Google to see when a particular show is going to be on, and to find the channel, and has bought described audio content from iTunes. Troubleshooting the system is a pet peeve since she doesn’t want to touch the system and risk making things worse, so she has to wait for help from a sighted friend or family member.

Danielle makes use of universal or accessible remotes but still needs help with programming and troubleshooting. If she is going to watch TV, Danielle will go into the basement to watch on her own so that the described audio does not bother her sighted family.

Danielle is always looking for described audio content since she wants to be able to watch the latest shows and to be able to talk to friends and colleagues about them. She’s very engaged in the non-sighted community, and shares anything new she learns with others. With others she will go out to the movies, but will call ahead to let the manager know that she will need audio description services.
USER EXPERIENCE MAP

In addition to the user personas, the data from the interviews is useful in the creation of a Digital TV Experience Map. An experience map outlines the user journey and acts as a catalyst for the identification of opportunities by highlighting existing pain points. Each pain point in the map is assigned a recommendation on how it can be resolved.

The digital TV experience map consists of the two phases users will encounter as part of the video consumption journey: pre-use and in-use. Pre-use consists of all the activities that a user may perform prior to consuming video content. The in-use phase consists of all the activities that a user may conduct, in an ongoing manner, when consuming video content. Troubleshooting occurs in both the pre-use and in-use phases and is represented in the lower right corner of the Experience Map.

The in-use phase is comprised of three different platforms that are used: Online, Set-Top Box, and Mobile Apps. Online represents any streaming service that is accessed through a website, regardless of the device (phone, tablet or laptop/desktop). The Set-Top Box experience is defined by the device and service from the service provider. Mobile apps encompass installed software applications, (excluding website) on mobile devices, (phones and tablets).

For the list of pain points associated with each of the journey stages and opportunities for improvement, see the Digital TV Experience Map.
DIGITAL TV EXPERIENCE

Challenges & Solutions

The following information maps the journey of people with low to no vision and their challenges. Bringing the digital TV experience into accessibility compliance will empower and enrich the lives of people with disabilities making TV content accessible to every Canadian.

**Personas**

**Digital Danielle**
Danielle is constantly looking for ways to improve her quality of life and achieve greater independence. By being socially engaged with the non-sighted community, Danielle is always learning about new technology.

**Old-school Omar**
Omar would like to be able to interact with the world the way that he used to, but is gradually accepting that he has less control. Omar will rely more on his immediate family for assistance and is not engaged with the larger, non-sighted community.

**GETTING STARTED**

**PRE-USE**

**RESEARCHING**
- Employees not knowledgeable of accessibility offerings in store or on phone
- Provider websites not accessible

**INITIAL LEARNING**
- Switching between remotes is hard
- Inconsistencies between old remote and new remote
- Targeting box with remote is difficult
- Little tactile guidance given
- Buttons are not discoverable
- Misplace/lose remote

**SETTING UP**
- Technician unaware of accessibility offering
- Supporting material not given in other formats
- No assistance with setup of features, audio description or using a single remote
- Can’t get into assistive menus
- Box swapping inconvenient, setup difficult

**ONLINE**

**SEARCHING**
- Apple Store audio description search not comprehensive

**ONLINE BROWSING, STREAMING & WATCHING**
- Netflix is not accessible with screen-readers
- Netflix does not retain settings between programs
- Zooming software does not work well with Netflix
- Difficult to operate fast forward and reverse

**INTERACTING WITH SYSTEM**
- Unable to skip ads on YouTube
- YouTube video error messages are not readable by screen-reader
HOW TO ELEVATE THE TV EXPERIENCE

SET TOP BOX

BROWSING
- Low contrast in the Guide
- Mini Guide font size too small
- Mini Guide disappears quickly
- Users are lost while channel surfing
- No info about programming is given when surfing
- No method to find audio description content

SEARCHING
- Data entry keyboard layout difficult to use
- Results cannot be seen
- Deleting and making corrections is difficult

WATCHING & BROWSING ON DEMAND
- Menus not visible
- Menus are difficult to navigate
- Low contrast in these services

CUSTOMIZING
- Difficult to find Settings menu
- Difficult to navigate Settings menu
- Unable to identify the current setting
- Difficult to change settings
- Difficult to save settings

SAVING
- Unable to see if a recording has started
- Unable to find saved PVR content
- Unable to record the audio description
- Difficult to operate fast forward and reverse
- Can’t delete/save content
- Can’t schedule a recording

INTERACTING WITH SYSTEM
- Slow
- No feedback from user actions
- No individual audio description
- Weather/amber alerts only visible on some channels

MOBILE APPS

SEARCHING
- Rogers app not functional with screen-readers

IN-APP ONLINE BROWSING, STREAMING & WATCHING
- Anyplace TV, Home Edition, and Rogers NHL are not completely functional with screen-readers

TROUBLESHOOTING
Summary of challenges low vision and non-sighted users encounter when trying to resolve technical problems with their video systems.
- Can’t see on screen errors
- Can’t see network errors
- Resetting the box can be difficult
- Poor customer service

Research by Akendi
Guidelines & Recommendations

Based on the review of background literature and data collected from the user research, a set of guidelines to aid with design of a solution for non-sighted users is proposed with a focus on the key issues of input, audio description, screen reading and navigation.

INPUT

A consistent finding from the literature review was that supporting multiple modes of providing inputs into the system is of benefit to users.

REMOTE CONTROL

The remote control is the traditional and primary manner for interacting with the receiver. However, when designing the remote control for non-visual users the following must be considered, (Springett and Griffiths, 2007; UK Digital TV Usability and Accessibility Guidelines, 2014):

- Reduced cognitive overload due to memorization, by limiting number of buttons on the remote control
- Place most frequently used buttons in an easy to reach location, using standardized layouts
- Provide tactile cues, (shape, size, texture, etc.), that help the user orient themselves on the remote control, but limit the tactile cues to key buttons, (“5” on numpad, Power, Volume and Channel, Toggle for audio description)
Provide feedback to the user about the button they are about to enter to prevent triggering of an incorrect button, (example Apple Voiceover), and feedback when the button is successfully pressed

- Buttons should not be too sensitive such that the user may accidentally press while brushing their fingers along the top

- Support for turning audio description on and off without having to navigate through menus would allow users to accommodate social viewing

- Button labels should be clear and legible by maximizing the contrast between the label and the background

- Provide a means for relocating a misplaced remote control
  
  Eliminate the need for accurate targeting of the remote control at the receiver

**COMPANION DEVICES**

Connectivity between the receiver and secondary devices, either keyboards, (QWERTY and Braille), or mobile devices like smartphones should be supported, (UK Digital TV Usability and Accessibility Guidelines, 2014). Use of secondary devices leverages the user’s existing knowledge, improves the interaction’s accuracy and efficiency, and eliminates the reliance on screen text entry which is difficult and cumbersome, even when supported with screen reading.

When designing for secondary devices the solution should provide:

- Search and connect with external devices automatically once confirmed by the user

- Indication of loss of connection between devices

- Feedback from the system as the user enters commands or characters on the companion device
**SPEECH**

Improvements in speech-based interaction methods, like the widely available Siri from Apple, can improve system accessibility, but this is not a solution that works for all users and should only be considered as an additional alternative for the users who desire and are able to use it.

**AUDIO DESCRIPTION**

Audio description (AD), is an optional service used by non-sighted and partially sighted users that provides additional narrative with visual elements that are important to the story. Although AD content is only available for a small percentage of the current content, the quantity and quality of AD is increasing. Currently there is no means of quickly locating content that is available with audio description, other than a single accessible media channel, AMI, and turning on the AD programming requires users to navigate through inaccessible menus.

Since AD content is essential to non-sighted and low-sighted users, the solution must provide:

- Ability to filter or search for AD content
- Clear indications, (either through audio alerts or text to speech), to presence of AD content when browsing the Guide and Mini-guide or changing the channels
- An indication of the state of AD, (on or off), which should be maintained as users change channels, turn system on and off, or update the system
- Means for saving the AD when recording content to be watched later
- An option to send AD to different outputs, (headphones, mobile devices, etc.), when there is a mixed, (sighted and non-sighted), audience

SCREEN READING

Assistive technologies, like JAWS on personal computers and VoiceOver on mobile devices, are the primary means for navigating existing digital systems, so a similar model for text to speech, (TTS), should be reflected with the set-top box.

- TTS support should be present as soon as the user first turns on the system to set it up, but should default to turn off unless otherwise indicated by the user.
- Audio feedback should be provided whenever the user triggers an action (through a remote control, companion device, or on the receiver), or the system triggers an action (rebooting, starts a scheduled recording).
- Presentation of new information should override older information to increase efficiency.
- Delays in the system to complete user requests must be communicated.
- Feedback should occur in a timely manner.
- Users should be able to modify the speed, pitch, voice, volume and verbosity, (i.e. “AD is on” versus “audio description is on”), to accommodate users of varying skills levels and ensure assistive audio is distinguishable from content audio and AD.
- Presence of error messages or pop-ups must be communicated prior to the message contained within the pop-up being communicated.
- Empty screens must provide an indication of system status even though there is no visual information present.
- Ability to stop audio feedback when there is a large amount of information being communicated, (i.e. content details when navigating the Guide, Mini-guide or changing channels).
NAVIGATION

On screen navigation is the largest challenge for non-sighted users of set-top box systems. While the navigation can be facilitated through TTS, the design of the underlying navigation structure must be considered.

- Minimize the need to navigate to multiple sections (Guide, On Demand, PVR, etc.), of the system in order to find and play content
- All areas of the system should support audio navigation, from setup to troubleshooting
- Audio cues should be provided so that the user always knows where they are within the system, and when they transition from one location to another
- When navigating in a grid, the location in the grid, as well as the contents in the grid location should be communicated, (i.e. in the Guide, the channel ID and time are the coordinates, the name of the show selected is the grid content)
- Only provide new content details for efficiency. For example, if scrolling within a channel in the Guide, only update the content and timing information. When browsing within time, only update channel and content information
- Provide TTS of alt text when navigation requires users to interact with icons, (e.g. content image tiles currently used in On Demand services)

When changing between channels the following information should be presented to the user:

- Channel number
- Channel service
- Content title
- Content duration and time remaining
- Presence of AD
- Content synopsis
- Flag if content requires additional payment
DESIGNING FOR LOW VISION USERS

From the literature review and based on the field research, designing for low vision users is difficult due to the wide range of differences in their levels of vision. One user might require a larger font size and another may need a smaller size with a shorter line length. In addition, a solution that works well for one individual in the morning might no longer work by the time it is evening. (W3C, 2016). As such, designing for low vision users focuses primarily on the level of control the user has over the presentation of visual elements like text and colour.

Text

Users should be given the capability to adjust text presentation settings, such as:

- Size
- Colour
- Line length
- Letter spacing
- Justifications
- Borders

The design should use a legible font such as the Tiresias screen font which has been evaluated by the Royal National Institute for the Non-sighted (RNIB) as being acceptable to low vision users, (Carmichael, 1999).
Text should be placed on a solid background to maximize contrast, and
gradients, textures, patterns or images for backgrounds should be avoided,
since they decrease legibility. Users need to be able to either configure the text
and background colours to find a combination that works for them, or select
from a set of predefined combinations (white on black, black on white, etc.).

Changes made by an individual must be preserved as the system is updated or
is turned off. Individual user settings should also be managed through a profile,
which would allow users to quickly switch the system for use between sighted
and low or non-sighted users.

**Visual Settings**

In addition to text, low vision users need control over several visual settings that
impact perception of on screen information, (Springett and Griffiths, 2007):

- Brightness
- Contrast
- Background colour

Use of on screen magnification is an approach that low vision users are
comfortable using, based on their experience using magnification on
computers. However, there are complications in using magnification for
the set-top box regarding movement around a magnified display, such as
tracking of the cursor, cursor sensitivity, and behaviour of interactive
elements, (Springett and Griffiths, 2007).

- Users need to be able to control the level of screen magnification
- Magnification of selected items on screen can focus user attention
- Controls for navigating around a magnified screen must be simple
- Users must have the ability to customize the sensitivity of an on screen cursor
- On screen elements should require user action to trigger, and not occur
  automatically, (i.e. pop ups should be dismissed by the user rather than
disappear after a fixed period of time)
Icons

There are two factors to consider in the design of icons: the graphical design and the placement, (Rice and Fels, 2004).

- Icons must be simple in shape and easily distinguishable from each other
- Icons must be meaningful to users
- The icons must be in a consistent position on screen
- There must be sufficient spacing between icons and other visual elements

The concept of a user profile should carry information about particular accessibility settings required by the user in addition to other personal information. While concepts to keep in mind are discussed, no specifics are provided around contrast values or font size.

For formal and precise criteria on designing the visual elements, refer to the Web Content Accessibility Guidelines, (WCAG), published by W3C.
Usability Principles

When there are no clear guidelines, Akendi has a defined set of usability principles to aid with creating and evaluating a design. There are seven usability principles:

› Distinguishable
› Similar
› Empowering
› Efficient
› Responsive
› Forgiving
› Humane
Distinguishable

Prior to any user action, the user must be able to discern the presence of a signal or a target to trigger the interaction. The signal can appeal to any of the five senses, like text on screen as a visual stimulus, or audio cues to indicate if an action is successful or not. The challenge is that there is noise that distracts the user or obscures the signal. The design must maximize the success of detection of the desired signal.

Some examples:

- Text to Speech voice is distinct from content or audio description voices
- Optimizing contrast, text type, text size on screen to improve text legibility

Similar

Users interact with new systems based on their knowledge and experience with existing systems. By ensuring consistency between the new and existing systems, the need for users to learn is reduced. Leverage existing user knowledge and understanding to achieve the “walk up and use” experience.

Some examples:

- Avoid changing the layouts of the buttons on the remote controls, or structure of menus between system redesigns
- Use language that the user is familiar with, and avoid jargon or technical terminology
Empowering

When interacting with and exploring the system, the users need to feel comfortable where they are and in control of where they are going. The design should empower the user by providing a clear navigational infrastructure regarding how to move forward, and how to move back to a safe location when they get lost.

Some examples:

- Provide navigational cues, visual and audio, when moving through a menu system
- Provide a button or means for returning “home” in case the user gets lost

Efficient

Do not make tasks unnecessarily difficult for the user. Apply Fitt’s law and other means to optimize layouts and users’ paths to save time and reduce effort. Provide support for improved efficiency for expert users.

Some examples:

- Use appropriate system defaults to reduce user effort
- Provide shortcuts to frequently performed actions
Responsive

For every user action, there should be an appropriate and timely response from the system. Changes in the state of the system must be communicated to the user, and there must be feedback on the completion of a user action.

Some examples:

- Communication of current state when changing channels
- Audio cues as the user presses buttons on the remote control, indicating success

Forgiving

Design to prevent errors, but when errors occur, ensure that users understand the mistake, and that the design minimizes the impact and helps them recover.

Some examples:

- Prevent or warn users from making changes to system settings that may impact their use
Humane

The manner in which the user can interact with the system will be restricted by the physical and cognitive limits of the individual. While automation can alleviate some demands placed on the user, the user should never be completely out of the loop.

Some examples:

- Ensure buttons on the remote control are large enough to press, and that there is sufficient space between them to ensure multiple buttons are not pressed simultaneously.
- Ensure that no interaction with the system requires the user to locate or track a visual element in order to complete a task.

Adherence to these seven principles will maximize the usability of the system.
Summary

Television remains an important medium of communication in the day to day lives of most Canadians. Television is more than just entertainment; it is informative and helps build communities. However, a large and growing portion of the population lacks adequate access to the medium due to poor accessibility.

Through a review of existing system and academic literature, as well as field research with low-vision and non-sighted users, this research set out to identify guidelines to be used in the design of a standard solution that could address accessibility issues with television content discovery.

Although low and non-sighted users are using mobile and voice technology, (like VoiceOver by Apple), to improve their access to television content, not everyone in the low-vision and non-sighted community use smartphones, or devices with virtual keyboards. Furthermore, not all online and mobile streaming services are accessible to screen readers. As such, there remains a need to create a completely accessible solution for content discovery on the traditional, digital set-top box.

Based on the field studies Akendi has conducted, two key user personas, Danielle and Omar, were defined. These personas will help designers by bringing users into the design process and will serve as a tool for recruiting participants for future usability testing of any proposed designs.
The Digital TV Experience Map highlights the end-to-end journey that non-sighted users experience. By identifying the current challenges and opportunities, the Experience Map is a catalyst for changes to the tools that deliver content and how companies support their customers.

Finally, a set of guidelines on the topics of input devices, audio description and navigation are provided to facilitate the designers. The guidelines are meant to suggest an approach but do not dictate the final design. Any resulting designs should be validated using actual end-users and improved through an iterative process.
Appendix A: Expert Interviews

Four expert interviews were conducted (February, 2016) with academics involved in research areas related to the topic of this report. Below is a summary of each of these interviews.

Dr. John Zelek (University of Waterloo)

- Responsible for the development of a wayfinding system for visually impaired users
- Discussion on the design of tactile and haptic feedback, which is still very crude
- Went into people’s houses to evaluate navigation, saw cognitive differences between individuals born non-sighted vs. those who became non-sighted later in life
- Says CNIB has technology group that vets technology and that they could perhaps provide an assessment
- Says CNIB may have existing research on the topic

Dr. Sambhavi Chandrashekar (OCAD University)

- Suggested groupings of individuals according to those who are: losing their vision (elderly), individuals non-sighted from birth or a young age, and individuals who became non-sighted later in life
- Recruits through personal channels (listserv); CNIB takes longer
- Designing for extremes makes the design accessible for everyone
- Example of this is the Tecla (assistive device for mobile disabilities)
- Suggested some papers which were incorporated into the background research
Dr. Deborah Gold (CNIB)

- Confirmed that three groupings made sense
- Assessible Media Inc. — a website that people may be using to watch content
- Internal group that reviews products
- Currently re-branding at CNIB and changing focus; in the future there will be more emphasis on assistive technology
- Recruiting though them will involve a lot of personal channels as they don’t have information on when loss of vision occurred

Dr. Deborah Fels (Ryerson University)

- Confirmed that three groupings made sense
- Being able to find programs with audio description is important; currently unable to filter to just shows with descriptive audio
- The non-sighted community tends to be far more complacent than the deaf community
- Tends to say that something is better than nothing
- In group settings, the person who is non-sighted tends not to operate the controller
- Those who use remote controls really struggled to learn it and many added things like tape to make it more accessible
- For these individuals, changing to a different controller would be hard
- Individuals who are non-sighted tend to use their phone for things as it is more accessible
- It can sometimes be more difficult to design for those who have low vision versus those who are non-sighted
- Younger people who are non-sighted tend to watch more content on the internet, not on TV
Appendix B: Participant Interview Details

Participant #1

- 35
- Male
- Technology consultant
- Lives alone
- Blind from birth

Tools

- Mac laptop
- iPhone
- BlackBerry
- iWatch
- Portable braille keyboard
- Voiceover
- Netflix

Key Findings

- Apple is more accessible than Android
- Uses cable only for sports
- Prefers audiobooks/podcasts for entertainment
- Can't tell if AD is available without waiting
- Streaming sites are not fully accessible
- “A lot of online media players drown out screen readers so I prefer not to watch stuff online while doing something else”
- “There is an accessible media player but it’s going to take a while for it to get adopted”
Participant #2

- 50
- Female
- Admin Assistant
- Lives with partner
- Blind from birth

Tools

- Desktop
- Laptop
- JAWS
- Feature phone
- Portable braille keyboard
- Braille labeler
- MP3 player
- Daisy reader

Key Findings

- Watches TV in separate room from her partner
- Her partner provides descriptions if they are watching together (i.e. movie theatres)
- Documentaries easier to follow than other content
- Difficulty aiming remote at set-top box
- Uncomfortable with touchscreens and voice commands
- “If I can’t find it, I have to use my husband’s eyes or call down to the concierge. Why can’t it have a beeper like my phone?”
- “Lately there is a lot of static in the audio quality, which makes it difficult to hear”
Participant #3

- 44
- Male
- Government worker
- Lives with parents
- Blind from birth

Tools

- Desktop
- JAWS
- Feature phone
- Portable scanner
- Braille printer
- Tactile navigation device

Key Findings

- Websites and documents not accessible by screen readers are frustrating
- Leaves remote with parents to control TV
- Large number of buttons on remote are unknown
- Occasionally goes to broadcaster sites to watch episodes of missed shows
- “Websites that don’t work with screen readers are frustrating because files that are scanned in or pictures that lack text description are not understandable”
- He uses the number pad instead of the up/down buttons: “Sometimes you press too hard or too often on the up down button and you can end up somewhere you don’t want to be”
Participant #4

- 57
- Male
- Disability leave
- Lives alone
- Blind later in life
- Recently had a stroke

Tools

- iPhone
- Desktop
- JAWS
- Siri (occasionally)
- SmartTV

Key Findings

- Tech Support doesn’t understand challenges of troubleshooting for visually impaired users
- Relies on friends dropping in to resolve issues
- Worries about touching the wrong buttons and throwing system off
- Buttons on remote are difficult to target and press
- Navigation of Netflix is difficult
- Difficult to program time on the microwave
- Received support documents in Braille, which he can’t read
- Constantly losing iPhone in house
- “The technology is there but until there is a mainstream use for it, there is no widespread adoption for it to trickle down to the accessibility community”
- “I’ve had a stroke recently and find that the buttons on the remote are too close”
Participant #5

- 54
- Female
- Lives with parents
- Low vision

Tools

- iPhone
- Voiceover
- Siri
- iTunes
- Netflix
- Pirated audio content of current TV shows
- Wifi AD headset used in movie theatres

Key Findings

- Used to sit within a couple feet of TV
- Accepts that she will eventually be blind and acts accordingly
- Provides tech support to her group of friends that are visually impaired
- Adds tactile marker to remote to help locate buttons
- Spends less time in front of TV due to vision loss
- Watches in basement, while mother watches upstairs
- “Because of accessibility issues, I watch a lot less TV than I used to”
- “The one button on the bottom of the remote control allows me to toggle the audio description”
- “I know that there are certain models that have the ability to always turn on audio description, but I don’t have that one”
- “I’ve already watched two audio described movies on my iPhone”
Participant #6

- 37
- Male
- Government employee
- Lives with parent
- Blind from birth

Tools

- Laptop
- JAWS
- Nokia smartphone with QWERTY keyboard

Key Findings

- Needs help to switch between set-top box and Android streaming box
- Unable to use Siri due to speech impediment
- Watches content on YouTube, but can’t skip commercials and on-screen messages are not screen readable
- Slow system response makes it difficult to determine current channel when surfing or pressing numbers
- “Android already has an open source speech synthesizer that can be used with some modification”
- “There is no accessibility to find the timings of programs”
- “With physical keyboards I know that the button is right, I don’t need to first confirm before pressing”
Participant #7

- 62
- Male
- Retired
- Lives with partner
- Blind later in life

Tools

- Just starting with an iPhone
- Extensive home theatre setup for music
- Laptop
- JAWS
- Voiceover
- Siri, but not easy to use
- Shomi (can’t use)
- Universal remote

Key Findings

- Has memorized the sequence of sets through the menus to turn AD on/off
- No staff at Apple store knew that the three finger gesture turns off screen since it is not needed
- Wife records content but she has to control fast forwarding through commercials
- Replaced remote from service provider with a programmable universal remote
- “It wasn’t easy to learn a virtual keyboard. I prefer my laptop keyboard, it’s quicker, but for the convenience the virtual is okay”
- “I have audio description on most times but I need to turn it off sometimes because if you are watching the NFL, they have it in Spanish”
- “I always wonder what channel I am on, because there is no way of knowing”
Participant #8

- 64
- Male
- Retired
- Lives with partner
- Low vision

Tools

- Laptop
- ZoomText
- Magnifying glass
- Netflix on laptop
- Wears sunglasses inside due to light sensitivity

Key Findings

- Navigation of Netflix is difficult with screen magnifiers
- Sits right beside TV to watch
- Identifies channels by looking for channel logo in fixed locations
- Uses call display on TV to identify callers
- Onscreen messages disappear too quickly, text is too small, and contrast is very low
- “We just made it basic, because we were paying a lot of money and not using the channels”
- “He (husband) is my descriptive audio” – participant’s wife (non-sighted)
Participant #9

- 61
- Female
- Retired
- Lives with partner
- Blind later in life

Tools

- Portable audio device for notes and calendar
- Tactile navigation device
- Document scanner and reader
- Talking watch
- iPhone
- JAWS
- Laptop
- Daisy reader

Key Findings

- Will learn opera synopsis prior to attending due to difficulty in reading captions
- Used safety pins to code clothes in closet
- Investigating Apple TV with help from others
- Male voices are easier to understand
- Reducing amount of time spent watching TV due to lack of enjoyment
- Loses the remote frequently
- “If you lose your vision you better have a brain in your head otherwise I have no idea what you do”
- “It's been over a month and it's still not going because you need to see something to get started” (Apple TV)
- “I am constantly learning, my brain gets so tired”
- “I've got this watch which is ugly as sin but it has the big buttons on the side that are easy to use”
- “When I don't have audio support I don't use it”
- “I never watch alone, because I need someone to fill in the gaps of what's happening on the screen”
Participant #10

> 47
> Female
> Home office
> Lives with partner
> Blind later in life

Tools

> JAWS
> Laptop
> eReader
> iPhone
> Siri
> Dragon Speech

Key Findings

> Records content but AD is not stored
> Watches in a separate room on main floor while husband goes to basement
> Has difficulties with Braille
> Doesn’t like it when technical support asks her to get someone in the household on the phone
> “JAWS works great in English, but not so great in French”
> “Change in the size of the footprint of the screen makes it difficult to re-learn where everything is” (why she doesn’t upgrade iPhone)
> “The Apple TV is quite accessible and I can do what I want with it, while the Rogers and Bell boxes are not”
Participant #11

- 40
- Male
- Disability leave
- Lives with roommates
- Low vision

Tools

- Computer
- Zoomtext
- iPhone
- Siri

Key Findings

- Changes in menu structure and layout between iOS updates is frustrating
- Impossible to use onscreen keyboard for search
- Unable to see labels on remote, relies on memory
- Doesn’t turn on AD when watching with others to avoid being disruptive
- Stopped going to movies due to negative experience
- Can’t watch content on computer because screen is too close
- “I’m old enough that keyboarding wasn’t a skill, so I hunt and peck, which is challenging with the diminished field”
- “The learning curve is the OnDemand and search function, which is mind bogglingly difficult”
Participant #12

- 44
- Female
- Lives alone
- Low vision

Tools

- iPhone
- Siri
- Kurzweil reader
- Kobo
- Scope

Key Findings

- Difficult to locate phone and remote in cluttered room
- Occasionally uses a scope to read Guide information
- Liked it when the set-top box used to provide the time, which was easier to read
- “I only use the keyboard (on the iPhone) when the auto dictate makes mistakes”

Participant #13

- 20
- Male
- Lives with housemates
- Low vision

Tools

- Laptop
- ZoomText
- Feature phone

Key Findings

- Easier to read light on dark background, than dark on light background
Participant #14

- 22
- Female
- Student
- Lives with parents
- Blind later in life

Tools

- iPhone
- Voiceover

Key Findings

- Doesn’t like bothering parents with AD, would prefer independent listening
- Braille stickers peeled off and made things worse
- Changes in regular schedule programming throws off mental schedule of shows
- Needs to pause shows so others can describe action
- Easier to find content on YouTube
- “We tried to put braille stickers on the remote but they kept peeling off”
- “When I have description on with other people I can tell it bothers them”
- “I usually pause when watching with others so that someone can provide a description of what happened”
Participant #15

- 21
- Male
- Student
- Lives with parents
- Low vision

Tools

- Chromecast
- Android phone
- Tablet
- Scope
- Skype

Key Findings

- Sets up PVR using app on phone
- Uses phone app to control TV
- Connection between app and TV does not frequently work
- Unable to read Guide in app
- Uses scope for subtitle when control can be controlled
- Watches content on phone because he can get really close
- “I don’t try to do too much with the remote. The app (Rogers Home Edition) is pretty user friendly”
- After technical issues: “The app didn’t work. I’m not sure if that’s my fault or Rogers fault”
References


36. Statistics Canada Figure 1 Percentage distribution of hours per week viewing television and using computers, household population aged 20 years or older, Canada, 2007. (2007). Retrieved May 30, 2016, from www.statcan.gc.ca/pub/82-003-x/2008002/article/10600/c-g/5202421-eng.htm


ABOUT AKENDI

Akendi is a human experience design firm, leveraging equal parts user experience research and creative design excellence. We are passionate about the creation of intentional experiences, whether those involve digital products, physical products, mobile, web or bricks-and-mortar interactions.

We provide strategic insights and analysis about customer and user behaviour, combine this knowledge with inspired design, and architect the user experience to meet organization goals. The result is intentional products and services that enable organizations to improve effectiveness, engage users and provide remarkable customer experiences.

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