

## Enhancing Accessibility of Electronic Theses and Dissertations

### Summary

Old Dominion University (ODU), in cooperation with the University Libraries at Virginia Tech (VT), requests a 1.5 years planning grant from the National Leadership Grants for Libraries program to support the exploratory phase of enhancing the accessibility of electronic theses and dissertations (ETDs) for blind and low-vision (BLV) library users. This planning project supports *Goal 3: Improve ability to provide broad access*, and aligns with the *Objective 3.1: Advance digital inclusion*. The limited accessibility of present ETDs pose a significant barrier to BLV users' academic and professional pursuits, hindering their ability to engage with scholarly research and contribute to their respective fields. Towards addressing this issue, in this planning project, we will conduct exploratory user study with diverse BLV participant groups to uncover in-depth: (i) The exact nature of accessibility barriers faced by BLV users when they interact with ETDs; (ii) The interaction behavior and strategies of BLV users in ETDs; and (iii) The BLV users' needs and preferences regarding ETDs. The design, recruitment, and ethical conduction of the study will be guided by accessibility experts from the ODU's Office of Educational Accessibility and The Lighthouse Guild – a non-profit organization that provides an assortment of assistive services to thousands of BLV individuals in the NY/NJ/CT tri-state area. The project results that will stem from the analyses of collected study data will include: (i) A report on the research, technical, and implementation challenges that will need to be addressed to make ETDs more inclusive for BLV users, including the influence of hosting platforms such as ProQuest and the universities' internal digital repositories; (ii) Design requirements for future assistive technologies to increase accessibility of ETDs; and (iii) Platform-agnostic accessibility suggestions for authors to make their ETDs more usable for BLV users.

### Project Justification

It is estimated that there are 253 million people with visual impairments worldwide, including 36 million people who are blind (NIH). In the United States alone, there are approximately 32.2 million adults with vision loss (AFB). Blind and low vision (BLV) people are attending college at higher rates than ever before, yet their academic achievements are not comparable to those of their peers without disabilities [1]. A contributing factor to this discrepancy in academic outcomes is the limited accessibility and usability of digital learning resources including complex scholarly articles such as ETDs. In a small pilot interviews with 5 BLV graduate students at ODU, we discovered that ETDs were notoriously difficult to interact with, even if their contents were technically *accessible* with assistive technologies. The complaints included prolonged navigation time and effort, and incomplete text alternatives for pictures. As higher education attainment is known to significantly improve employment outcomes for blind and low vision people [2], it is important for BLV people to be able to engage in scholarly activities with the same ease and efficiency as their peers without disabilities. Therefore, there is a need to improve the accessibility and usability of scholarly digital content such as ETDs.

Addressing this need will first require an understanding of the present experience of BLV users with ETDs, the exact underlying accessibility/usability issues, and the user preferences and needs regarding potential solutions. The planning grant will therefore be used to fund this preliminary investigation whose outcomes will help inform the design and development of future assistive technology solutions to improve the accessibility of scholarly content. The project activities and outcomes will therefore contribute towards improving the ability of libraries and archives to provide broad access to its information (Goal 3). The project specifically targets digital inclusion (Objective 3.1), by promoting equitable access to digital scholarly content in libraries for BLV users.

### Background

*Assistive Technologies.* BLV individuals usually rely on third-party assistive technologies such as a screen reader (JAWS, NVDA, VoiceOver) or a screen magnifier (Apple Zoom, Windows Magnifier) to interact with digital content including ETDs on computers. A screen reader, as the name suggests, narrates the content on the computer screen and also provides support for navigating the content using dedicated keyboard shortcuts (e.g., 'H' for next heading, 'P' for next paragraph). A screen magnifier on the other hand, enables BLV users to magnify the content to very high zoom levels (upto 15x) and then pan the content akin to a moving lens to view the different content portions.

*Accessibility and Usability.* Accessibility of digital content has received significant attention in the past couple of decades. There have been plenty of guidelines (e.g., WCAG [3] ) developed for content creators and developers to promote accessibility of digital content for BLV consumers. Most scholarly article publishers and universities also encourage and sometimes require the authors to meet the accessibility requirements while uploading their peer-reviewed manuscripts and theses/dissertations. However, studies have shown that content creators are inconsistent in following the accessibility guidelines [4, 5]. Moreover, accessibility in and of itself does not imply usability – the ease, efficiency, and satisfaction with which the BLV users can interact with the content. The notion of accessibility has evolved over the years, and recent definitions consider usability as an integral aspect of accessibility [6]. However, studies have shown that even the most ‘accessible’ content are barely usable [7, 8], with BLV users requiring significantly more time and effort compared to sighted counterparts to do the same computer tasks including reading and consuming documents [9, 10, 11]. For example, an author can add an ‘alt-text’ to make a picture, e.g., a graph, to make it accessible, however, the comprehensiveness of this alt-text will determine the usability of the picture; if the alt-text does not cover all the details of the picture, a BLV user will not receive the same level of information as that visually perceived by a sighted user.

*Gap in the Current Literature.* While there exist very few works investigating the traditional accessibility of ETDs (e.g., whether there is an alt-text for a picture, if the document is tagged and all fonts embedded) [12, 13, 14], usability of ETDs and other scholarly documents is still an uncharted territory. As a consequence, BLV users accessing ETDs may very well be able to hear/view and navigate all the content using their assistive technology, but their experience may be completely unsatisfactory and arduous. This project therefore fills this gap by also uncovering the usability challenges of ETDs as it pertains to BLV users who rely on assistive technologies to access ETDs.

## **Target Group and Beneficiaries**

The project will specifically target people with vision loss, particularly the blind and low vision community. As mentioned earlier, it is estimated that there are roughly 32.2 million adults with vision loss (AFB) in the United States. The beneficiaries for this project are the same as our target group. While all BLV library users will potentially benefit to different extents from the outcomes and impacts of our project results, the BLV student community (Estimated to be around 55,000 in the United States (AFB)) in particular are likely to derive the maximum benefit from this project.

## **Project Work Plan**

### **Overview**

In this planning project, we will conduct a mixed methods user study with 100 BLV volunteers to uncover in-depth: (a) The various accessibility (including usability) issues encountered by BLV users when they access and interact with ETDs online; (b) The interaction behavior and content-navigation strategies of BLV users when they interact with ETDs; and (c) The preferences and needs of BLV users regarding the interfaces serving ETDs. Informed by the study findings, we will also develop accessibility and usability guidelines for ETDs for overcoming the accessibility challenges and also accommodating user preferences. The work plan will therefore consist of the following major tasks: (i) User study planning; (ii) User study execution; and (iii) Data analysis and reporting.

### **Task 1. User study planning (3 months)**

This task will involve designing the study setup and obtaining IRB approval to conduct the study.

*Design.* We will adopt a mixed methods approach for the study. Specifically, the study will comprise two parts: (i) Usability study where the participants will be asked to complete representative ETD interaction tasks using their preferred assistive technology such as a screen reader; and (ii) Interview study where the participants will be asked to share their prior experience with ETDs and also their ideal ETD-interaction needs and preferences.

The tasks for the usability study will be designed to cover typical ETD-interaction activities. Examples tasks include:

- **Navigation:** Navigate between different sections and subsections of the ETD.

- **Search:** Search for certain specific information in the ETD.
- **Question-Answering:** Answer a question based on the content of ETD.
- **Graphics Interpretation:** Explain the results based on charts and corresponding textual context in ETDs.

To minimize learning effect, an assortment of ETD repositories (e.g., ProQuest) will be considered for the tasks, i.e., each task will be performed by the participant on a different repository. The assignment of tasks to repositories and the ordering of tasks will also be counterbalanced using the standard Latin-Square method [15].

The interview study will be semi-structured with the experimenter covering a wide range of topics related to ETDs. Some of these topics along with a few example seed questions include:

- **General:** *What assistive technology do you use for ETDs?, Please describe your eye condition., What web browser or other software application do you typical use for accessing ETDs?, Which websites do you typically use for accessing ETDs?.*
- **Interaction Experience with ETDs:** *How often do you access ETDs?, What activities do you typically perform in ETDs?, What are the problems you face while accessing ETDs?, What parts of an ETD do you consider as most important?, How accessible and understandable are the image content in ETDs?.*
- **Interaction Strategies for ETDs:** *How do you typically workaround accessibility problems?, How do you typically navigate content in an ETD?, How do you interpret graphs, charts, and pictures in an ETD?*
- **Needs and preferences:** *Do you have any suggestions for new features in your screen reader/screen magnifier that would make interaction with ETDs easier?, Do you have any suggestions for third-party solution, e.g., a browser extension, that would improve interaction with ETDs?, How would you prefer to navigate and access information in ETDs?.*

*IRB Approval.* Once the study protocol is finalized, we will submit a package to the ODU's Institutional Review Board (IRB) to obtain the necessary permission for conducting user study with BLV individuals. The package will include: (i) Application form describing the full protocol including study tasks and interview questions; (ii) Consent form that will be used at the beginning of the study to obtain formal consent from the BLV participants; (iii) Photo/Video form that will also be used at the beginning of the study to obtain explicit permission from the BLV participants for recording the computer screen while they do the study tasks; and (iv) Recruitment flier for advertising the study through the Lighthouse Guild.

*Personnel and Responsibilities.* This task will be led by Co-PIs Ingram and Graves, given their expertise in ETD management and years of experience in digital libraries. PI Ashok and Co-PI Jayarathna will also assist in the task, leveraging their extensive experience in planning user studies with people having disabilities. PI Ashok will be responsible for obtaining the IRB approval for conducting the user study. Mr. Ingram and Ms. Graves will draft the initial study plan by the end of the first month of the project. The team members will meet weekly in the next month to review and discuss the study plan and iteratively make improvements until settling on a final study plan. We will use the Google Docs online editing tool to collaboratively edit and manage the study plan. The final study plan will be included in scholarly publications resulting from the project in order to ensure reproducibility of results. Once the plan is decided, PI Ashok will draft the required IRB documents in the third month and submit the package for approval from the ODU's IRB.

## **Task 2. User study with BLV participants (6 months)**

This task will involve recruiting participants, conducting the study, and collecting/managing the data.

*Participants.* Once we receive IRB approval, we will recruit 100 participants with the assistance from the ODU's Office of Educational Accessibility and the Lighthouse Guild, NY (letters attached). As the focus of the project is on ETDs, to avoid confounds, the inclusion criteria will require eligible participants to be either college students

or have at least a college degree and be familiar with ETDs and online library repositories. The criteria will also require BLV participants to be proficient in using assistive technologies (e.g., screen reader, screen magnifier) and moreover not have any other disabilities (e.g., hearing, speech, motor) that will interfere with their ability to perform the assigned study activities. The inclusion criteria will be enforced via pre-study phone interviews with interested BLV participants. All participants who clear the interview will be considered as eligible to participate in the study. The project team will then select the participants from this eligible pool in a way that ensures adequate representation of diverse factors including gender, race, and socio-economic status. These selected participants will be invited to participate in the study.

*Apparatus.* We will conduct the study both in-person (50 participants) and remotely (50 participants). The primary location for the in-person studies will be The Lighthouse Guild (see attached letter) given the sizeable BLV population in the region and also the availability of convenient travel options for BLV users to visit the study location. The remote studies will be conducted via teleconferencing software such as Zoom with participants from outside the NY/NJ/CT tri-state area who may not have convenient travel options to participate in the in-person studies. While the remote participants will use their own preferred computers and assistive technologies to do the study tasks, the in-person participants will also be encouraged to bring their own laptops for the study. If needed, we will also provide a laptop with standard QWERTY keyboard and all assistive technologies installed to the participant to do the tasks. In this case, sufficient time will be allocated before the study for the participant to customize the computer settings (e.g., speech rate, volume) to match their preferences.

*Procedure.* We will first explain the purpose of the study to the participants and obtain their explicit informed consent. Then, the participants will be given enough ‘practice’ time to refresh their memory regarding ETDs, practice with their assistive technologies, and customize the computer and assistive technology settings (in case they are using our laptop instead of their own). The participants will then be asked to complete the study tasks in the predetermined counterbalanced order. After finishing the study tasks, the participants will be administered standard questionnaires such as System Usability Scale (SUS) [16] and NASA Task Load Index (TLX) [17] to assess the participants’ perceived usability of ETDs. Next, the participants will engage in semi-structured interviews to provide the qualitative feedback regarding ETDs. Finally, the study will conclude with exit interviews covering participants’ experience in the study and also addressing their questions regarding the project.

*Data Collection.* From the study, we will collect the following types of data for each participant:

- **Objective Metrics.** This will include quantitative data such as task completion times, failure rates, and the number of user input actions, which are measured while the participants do the assigned study tasks.
- **Subjective Metrics.** This will include scores generated from subjective questionnaires such as SUS and NASA-TLX.
- **Gaze Metrics.** This will include the gaze data collected from low vision BLV participants in the study who use screen magnifiers to interact with ETDs. We will rely on third-party Tobii eye-tracker hardware to capture the gaze data as the low vision participants do the tasks.
- **Interview Feedback.** This will include the qualitative data provided by the BLV participants in the semi-structured interviews. All qualitative data will be transcribed to text format before analysis.
- **Experimenter Notes.** This will include the qualitative data recorded by the study experimenter which will capture peculiar participant behavior while doing the tasks.
- **Video and Screen Recordings.** This will include the multimedia data capturing the participants’ on-screen activities while they do the study tasks.

All collected data will be stored and managed based on approved IRB protocols. No identifiable information regarding any participant will be stored, pseudonyms will be used instead of actual names.

*Personnel and Responsibilities.* PI Ashok will lead this task with Co-PI Jayarathna providing assistance in recruiting participants. The recruitment flier for the study will be distributed by the Lighthouse Guild (see attached letter) to attract potential study subjects. PI Ashok along with a graduate student will conduct both in-person studies at the Lighthouse Guild and remote studies with BLV participants via Zoom; he has significant prior experience in conducting both types of user studies. Overall, 4 studies (2 online, 2 in-person) will be conducted (25 participants each). Recruitment activities will be done in the first and the fourth month of the six months assigned to this task. In-person user studies will be conducted in the second and the fifth month, and the remote studies will be conducted in the third and sixth month.

Data collection will be done by the graduate student under the strict supervision of PI Ashok. All team members have completed the required Citi training to conduct human subjects studies and responsibly collect data. In the project duration corresponding to this task, the team will meet online once every two weeks to discuss the status of the task’s activities: participant recruitment, study execution, and proper data collection, and make adjustments (e.g., increase participant recruitment efforts, recruitment more participants in subsequent studies due to cancellations in the previous study) to the plan as needed.

### **Task 3. Data Analysis and Reporting (9 months)**

This task will mainly involve in-depth analysis of the collected study data to: (i) Uncover the accessibility and usability pain points of BLV users when they interact with ETDs across different platforms such as ProQuest, SemanticScholar, and the universities’ local ETD repositories; and (ii) Develop accessibility and usability recommendations for ETDs to overcome these pain points.

*Data Analysis Methods.* The quantitative data will be analyzed using both descriptive and inferential statistics. Specifically, we will use an intersectional lens to investigate if there was a significant influence of diverse factors such as gender, race, socio-economic status, eye condition, education, on the observed quantitative metrics such as task completion times, task failure rate, SUS scores, and TLX scores. To determine the significant differences in metrics between participant groups, we will employ appropriate statistical testing methods such as ANOVA, Wilcoxon Signed Rank test, and t-test, depending on the nature of observed data (i.e., normal distribution). The significant differences (if any) between different BLV groups will help illuminate the unique challenges and pain points of these groups.

Interview and experimenter notes data will be analyzed using qualitative analysis methods. Specifically, we will use grounding theory-based open-coding and axial-coding methods [18] to iteratively go over the qualitative data and uncover BLV users’ pain points, user behavior patterns, user needs and preferences, etc. One investigator will first analyze the interview transcripts of the first five participants and develop the open codes. Then the full team will discuss the set of codes and modify this set if necessary. Using this set, two investigators will independently code all the transcripts and resolve disagreements if the inter-annotator agreement is under 0.8 (which is considered good alignment). The investigators will iteratively go through the coding and conflict resolution process until the agreement score exceeds 0.8. The full team will then meet to devise the higher-level axial codes or ‘themes’ for further categorizing the low-level open codes. Again, two investigators will independently go over the open-coded transcripts and assign axial codes iteratively until the annotator agreement is over 0.8. The final set of themes uncovered will represent the common patterns across the study participants, that will provide insights into their experiences, challenges, and preferences regarding ETDs. In our qualitative analysis too, we will use an intersectional lens to examine the experiences and perspectives of participants from different backgrounds. When reporting our findings, we will ensure that the voices and experiences of participants of various backgrounds are accurately represented. We will also highlight any unique challenges or insights that arise from the intersection of different identities and backgrounds.

*Develop Accessibility and Usability Guidelines for ETDs.* Based on the insights gained from the user study, we will develop accessibility and usability guidelines for ETDs along the following three dimensions:

- **Usability recommendations for ETD authors.** While there are plenty of accessibility guidelines for document creators [], many of which are enforced by ETD publishers and universities, to the best of our

knowledge, there are no guidelines for ensuring usability of ETDs for BLV users. Therefore, drawing from the usability study results, we will develop usability guidelines (e.g., details in image captions, comprehensive ‘alt-text’, size of paragraphs and sentences, table of contents) that will inform ETD authors about good practices that will enhance usability for BLV readers.

- **Accessibility and usability suggestions for ETD publishers/repositories.** We will also develop accessibility and usability suggestions for ETD publishers based on the the study observations. We will specifically focus on the front-end of these repositories, i.e., their webpages serving ETDs, as it is relatively easier and feasible to modify underlying HTML content to enhance usability.
- **Design requirements for assistive technology developers.** Studies have shown that web developers and content authors are inconsistent in their implementation of accessibility guidelines [4]. Therefore, the most practical alternative option to enhancing accessibility and usability is developing third-party assistive technologies (e.g., a browser extension) that address the various access barriers without having to depend on web developers or content creators/publishers [10, 19, 20, 21]. Towards this, based on the study results, we will collate a set of research, technical, and implementation challenges that assistive technology developers must address to enhance the accessibility and usability of ETDs.

*Personnel and Responsibilities.* PI Ashok will be responsible for the analyses on the quantitative data given his prior experience in this area. Co-PI Jayarathna will be in-charge of analyzing the gaze data, leveraging his expertise in advanced gaze analytics. Dr. Wu will lead the qualitative analysis of interview data, given his background in natural language processing and content analysis. PI Ashok and Co-PI Jayarathna will jointly lead the development of accessibility and usability guidelines, given their background in Human Computer Interaction. During the last nine months of the project assigned to this task, the team members will meet monthly to discuss the study findings, validity of results and analyses, and implications of the study insights. Any errors in analyses discovered in a meeting will be noted and discussed in a subsequent meeting to verify if they have been fixed. In the meetings, the team will also discuss the status of documentation and dissemination activities, and inspect the content for correctness before making it public.

### **Dissemination.**

The deliverables will include monthly progress reports, white papers, journal articles, peer-reviewed conference papers, posters, and invited talks. We will present our accepted papers/posters in-person at the premier web and accessibility conferences such as ACM ASSETS and ACM WWW that attract accessibility researchers and assistive technology developers from all over the world. We will also share our findings and reports with the Lighthouse Guild in New York City, so that they can propagate these results to their vast network of accessibility researchers, trainers, and university/library collaborators throughout the US (see letter attached). We will present our findings at the annual Global Accessibility Awareness Day event held annually at the ODU Libraries, which will be live-streamed over the internet to viewers around the world. All the resulting digital products will be shared with the IMLS in the form of project reports and moreover made publicly available on GitHub and a dedicated project website. We will also disseminate intermediate research findings via X (Twitter) and blogs. All project team members will actively participate in the dissemination activities.

### **Diversity Plan**

Our project recognizes the importance of diversity and inclusion in research and aims to foster an environment that embraces and values individuals of diverse backgrounds. Our diversity plan is closely related to the aims of the proposal and our engagement with the university community, and blind and low-vision (BLV) individuals. We will reach out to a diverse range of BLV participants for our user studies and strive to ensure representation of individuals with various backgrounds and experiences. This approach will allow us to gather insights and perspectives that are inclusive and reflective of the diverse needs of BLV users. We will also ensure that all project-related materials, including recruitment materials, consent forms, study plans, and analysis reports are accessible and inclusive. When analyzing the data collected from our user studies, we will use an intersectional

lens to examine the experiences and perspectives of participants from different backgrounds. We will carefully consider the potential influence of diverse factors, such as race, gender, and socio-economic status, on participants' interactions with ETDs. When reporting our findings, we will ensure that the voices and experiences of participants of various backgrounds are accurately represented. By incorporating accessibility considerations throughout the project, we will create an inclusive research environment that promotes equal participation and engagement.

*Accessibility Considerations.* Accessibility is a key aspect of our project, given its focus on improving the access to ETDs for blind screen reader users. We will ensure that all project-related materials, including recruitment materials, consent forms, and study instruments, are accessible and inclusive. We will follow accessibility guidelines and standards to ensure that our digital resources, such as scholarly articles, project website, presentations, and talks, are accessible and usable by individuals with disabilities.

## **Project Team and Roles**

The collaborative efforts of the five investigators (Dr. Vikas Ashok (ODU, Computer Science), Mr. William Ingram (Associate Dean and Executive Director for IT in the VT University Libraries), Dr. Jian Wu (ODU, Computer Science), Dr. Sampath Jayarathna (ODU, Computer Science), and Ms. Tonia Graves (ODU, Librarian), in this grant proposal bring together a diverse range of expertise, contributing to the strength and comprehensiveness of the project. Dr. Ashok's expertise is in Accessible Computing and Human Computer Interaction, and he will be in charge of supervising all the project activities. He will also closely supervise a graduate research assistant who will conduct the study and collect data. Mr. Ingram and Ms. Graves will jointly lead the study planning activity, leveraging their deep knowledge of digital libraries and ETD management. Dr. Wu's expertise is in natural language processing and content analysis, and he will be in charge of conducting the qualitative analysis of subjective data from participants. Dr. Jayarathna will supervise the analysis of objective data that includes gaze information, tapping into his broad knowledge in eye tracking and data analytics. Apart from the team meetings pertaining to the individual tasks, the full team will meet remotely via a teleconferencing software (e.g., Zoom) once at the start of every month to track progress and make adjustments to the overall project plan if needed, and will also meet in person at the end of each of the three major project activities to assess if it was successfully completed as per the plan.

## **Project Results**

The planning project will yield the following outcomes:

*Plan for conducting ETD accessibility study.* A comprehensive white paper detailing the full study setup and execution protocol including full list of study tasks and interview questionnaire. This paper is intended to ensure reproducibility of the project activities and verifiability of the project findings.

*Accessibility/usability barriers in ETDs.* A comprehensive white paper report, potential peer-reviewed conference manuscript, journal article, poster, and presentation, detailing the BLV users' pain points while interacting with ETDs. This will shed light on the current status of ETD accessibility and usability in libraries and digital repositories, and therefore illuminate avenues for future research and implementation projects to address the uncovered issues.

*BLV interaction behavior and preferences with ETDs.* A comprehensive report, potential peer-reviewed conference manuscript, journal article, poster, and presentation, describing how BLV users navigate and forage information in ETDs. This information is valuable for assistive technology developers to design tailored solutions for convenient BLV interaction with not only ETDs but also other long scholarly documents such as books having complex layouts similar to ETDs.

*Accessibility and usability guidelines for ETDs.* A white paper, potential poster, scholarly publication, and talk presentation, providing a comprehensive set of accessibility and usability recommendations for ETD authors, publishers and digital repositories, and assistive technology developers, to enhance the inclusivity of ETDs for BLV users. These recommendations will help ETD authors and publishers create more inclusive ETDs. The recommendations and design requirements to the assistive technology developers will also implicitly highlight the various research and implementation challenges that need to be addressed to develop viable solutions to the various

ETD accessibility and usability problems, thereby paving the way for future research and implementation projects in this important field.

Except for some of the raw user study data, all other results (listed above) will be made publicly available via Github and a dedicated project website hosted on secure web servers maintained by the ODU CS Department. As per IRB protocols, raw user study data that potentially compromise the privacy and identity of human subjects cannot be shared publicly. The pre-print versions of scholarly articles will also be uploaded on arXiv.org so that everyone can access the project details and findings free of cost. ODU also has an agreement with the Association for Computing Machinery under which all publications by ODU faculty in the ACM Digital Library are made open-access to the public.

The sharing of all project deliverables via Github, arXiv, and scholarly repositories such as ACM Digital Library, will ensure long-term preservation and availability of the generated digital products well beyond the conclusion of the project.





# Digital Products Plan

## Type

The project will generate the following types of data:

- *Raw User Study Data.* This will include the CSV format files containing the quantitative user study metrics such as the task completion times, failure rates, input actions, etc., as well as the qualitative MP4 audio files capturing the user interview responses and the corresponding transcribed plain text (TXT) files. Video files capturing user actions on the computer screen during the study will be stored in MP4 format. The gaze data from low vision participants will also be stored as CSV files.
- *Coding schema.* The entire coding schema for qualitative analysis of interview data will be made available in both the DOCX and PDF formats.
- *Scholarly Articles and Reports.* The entire study setup details and the aggregated study results and insights will be collated into publications that will be made available in multiple formats – PDF, HTML, and DOCX files.
- *Posters, Presentations, and Talks* – The posters, presentations, and talks describing project study setup and findings will be made available in PPT, PDF, and MP4 formats.
- *Accessibility and Usability Recommendations for ETDs.* The developed recommendations and guidelines will be made available in DOCX and PDF file formats. These recommendations will also be included in the scholarly articles and reports that will be produced during the course of the project.

## Availability

Except for some of the raw user study data, all other data generated (listed above) will be made publicly available via Github and a dedicated project website hosted on secure web servers maintained by the ODU CS Department. As per IRB protocols, raw user study data that can potentially compromise the privacy and identity of human subjects cannot be shared publicly. The pre-print versions of scholarly articles will also be uploaded on arXiv.org so that everyone can access the project details and findings free of cost. ODU also has an agreement with the Association for Computing Machinery under which all publications by ODU faculty in the ACM Digital Library are made open-access to the public.

## Access

We will retain the copyrights to our published works. All scholarly documents and reports generated in the project will be publicly shared under the Creative Commons Attribution License (CC BY) to maximize access and promote re-use.

## Sustainability

The sharing of all project deliverables via Github, arXiv, and scholarly repositories such as ACM Digital Library, will ensure long-term preservation and availability of the generated digital products.