

## I. PROJECT JUSTIFICATION

This project fulfills IMLS National Leadership Grants for Libraries Goal 3 and its objectives 3.1 and 3.3. The objectives of this proposal are to provide broad access to digital collections and maximize reach (Goal 3), particularly, to enhance digital infrastructure and platforms (3.1), and to support the design of accessible and usable digital libraries (DL) to meet the needs of blind and visually impaired (BVI) users (3.3). This will be accomplished by creating a new framework with the DL design guidelines specifically for developing DLs that will support BVI users in mobile contexts. The University of Wisconsin-Milwaukee (UWM) requests \$573,658 over three years. This project **continues upon the UWM's prior IMLS-funded project [Creating digital library DL design guidelines on accessibility, usability and utility for BVI users](#)** (LG-70-16-0038-16), which concluded in 2021. While that project focused on developing guidelines based on the identification of help-seeking situations in BVI users' interaction with DLs **in the PC environment**, this project expands upon that work **in the mobile environment**. We anticipate the following organizations will continue to serve as partners and/or advisory board members for this project: Digital Library Federation, American Library Association, Digital Public Library of America, HathiTrust, New York Botanical Garden Mertz Library, CONTENTdm, ProQuest, Milwaukee Public Libraries, Milwaukee Public Museum, Milwaukee Art Museum, UWM Libraries, Recollection Wisconsin, National Federation of the Blind, American Council of the Blind, Association for the BVI, Learning Ally, and Vision Forward.

**A. The Need:** The global BVI population exceeds 2.2 billion, with 32.2 million residing in the U.S. Mobile devices and apps are widely used by BVI users (screen-reader users have increased from 12% in 2019 to 90% in 2021), but BVI users often face multiple cognitive and physical difficulties during information retrieval (IR) on mobile devices, including issues related to applying gestures correctly, activating voice commands and using navigation elements, as well as compatibility issues with mobile devices and assistive technologies. When such problems, or "help-seeking situations," arise, BVI users seek assistance in order to complete their IR tasks. As BVI users have unique needs, challenges, strategies, and preferences in their interactions with DLs, especially when using mobile devices, this project focuses on those BVI users who are unable to see information presented on a display screen and rely on screen-reader software to use IR systems and to interact with DLs. To offer accessible and usable DLs to BVI users, DL developers and scholars need to have design knowledge that considers the unique help-seeking situations and help needs of BVI users. Previous research has identified diverse types of help-seeking situations when BVI users use mobile devices, but not within DLs. Recently, **our team conducted a pilot study** with 30 participants who searched information in Library of Congress Digital Collections using its mobile web and mobile app, and identified 37 help-seeking situations; among these, about half occurred only in the mobile but not in the PC environment. The **top unique help-seeking situations** include: Difficulty getting a full picture of a DL structure, Confusion about functionalities of search or organization features, Difficulty exiting out of an open item, and Information overload. **These situations prevent BVI users from using sight-centered DLs as their information resources.** However, a systematic examination of BVI users' help-seeking situations in the mobile DL environment has not yet been conducted. **While the diverse formats of DL materials and complicated interfaces pose more challenges for BVI users, no study has been conducted on DLs in mobile contexts.**

**B. The Gap: Limitations of existing guidelines:** Research on the accessibility and usability of DLs has focused on sighted users in the mobile environment, but current guidelines do not address many of the help-seeking situations BVI users face specifically in their use of DLs. Furthermore, the Web Content Accessibility Guidelines (WCAG), a technical standard for Web developers, 1) do not acknowledge the unique problems and challenges faced by BVI users, nor offer strategies to address them; 2) lack clear and specific instructions for librarians to design accessible web resources for disabled users, and 3) are not developed from a usability perspective. Several guidelines (e.g., WCAG 2.0, Mobile Web Best Practices) exist for making online resources more accessible to users with disabilities in mobile contexts, but they generally focus on mobile applications and interactions with the Web and have not taken the complexity of DL structure and content into consideration in the mobile environment.

**C. The Solution and Intended Impacts:** The innovative project addresses the issue of mobile DL accessibility and usability for one of the key underserved groups—BVI users by creating a new framework for designing DLs, in particular the development of design guidelines to address BVI users' help-seeking situations. Results from this project will inform DL researchers and practitioners about the impact of DL design problems on BVI users and enable DL developers to enhance DLs for universal access, thereby increasing BVI users to access to and use of DLs. The results also can be applied to generate guidelines for non-BVI users such as the elderly and people with other types of long or short term disabilities. This project can serve as a model for developing design guidelines for different user groups in diverse library/museum digital platforms. The design guidelines can be implemented into systems such as web search engines, online databases, and online public access catalogs. The project team will submit the guidelines to W3C and other organizations for adoption. As external environments and related technologies change continuously, the PIs plan to conduct future studies to ensure guidelines remain relevant to support BVI users.

**II. PROJECT WORK PLAN (August 2022-July 2025):** Figure 1 presents the three-year project work plan, including document analysis, user study, guidelines creation and testing, and results dissemination. IRB approval will be secured at the start of the project. The PI, Dr. Xie, has been actively involved in the research of DL for about 20 years and help-seeking for sighted and BVI users for more than 15 years. The co-PI, Dr. Choi, has substantial research experience in designing mobile apps and expertise in user studies. The three consultants include a blind BVI researcher, a WCAG team member, and a digital librarian and DL researcher as well as advisory board members representing multiple stakeholders.

Figure 1. Project Design

| Stage | Objectives  | Research Questions   | Methods  | Outcomes and Deliverables   | Month |
|-------|---|--|--|---|-------|
| S1    | Analyze existing accessibility and usability guidelines for DL design<br>Identify BVI users' unique help-seeking situations in relation to DL accessibility and usability in mobile contexts<br>User study preparation  | 1) What are the limitations of existing DL guidelines on accessibility and usability in addressing help-seeking situations of BVI users in mobile contexts?<br>2) What are the unique help-seeking situations that BVI users encounter in interacting with DLs in mobile contexts? | Document analysis (20 years)<br>Qualitative/ quantitative data analysis<br>IRB approval  | Existing guidelines related to accessibility and usability for the development of DLs<br>Unique help-seeking situations that are associated with accessibility and usability<br>Problems identified from previous research but are not reflected in the existing guidelines   | 0-6   |
| S2    | Conduct blind user study to identify blind users' unique accessibility and usability help-seeking situations<br>Identify the gap between help-seeking situations generated from user study and existing guidelines<br>Develop new draft of guidelines for the DL designs          | 3) What types of guidelines are needed to help BVI users successfully interact with DLs in terms of accessibility and usability in mobile contexts?  | Recruit 96 BVI subjects with four groups (iOS/Android phone and tablet) through National Blind Association<br>Questionnaires, interviews, think aloud protocols, log analysis<br>Qualitative (e.g., open coding) /Quantitative (e.g., ANOVA, regression) Data Analysis | Unique help-seeking situations in relation to accessibility and usability<br>Problems identified from the user study but are not reflected in the existing guidelines<br>New draft guidelines that integrate the user study and document analysis at Stage 1 to address the unique situations   | 7-21  |
| S3    | Gather feedback from accessibility/usability experts, designers/developers, and BVI users<br>Update guidelines for the development of DLs   | 4) What are the perspectives of key DL stakeholders on DL design guidelines related to accessibility and usability for BVI users in mobile contexts?   | 150 subjects with 50 from each group<br>Delphi survey<br>Qualitative/Quantitative Data Analysis  | Modified guidelines on accessibility and usability for DL designs based on different stakeholders' feedback   | 22-28 |
| S4    | Assess existing DLs in mobile contexts based on new guidelines<br>Finalize DL design guidelines<br>Disseminate results and work with different partners and organizations to promote the guidelines<br>Work with different partners and organizations to implement the guidelines | 5) What is the current status of DL design in supporting BVI users to interact with DLs in terms of accessibility and usability in mobile contexts?<br>6) What is the methodology that can be applied to create guidelines to support other types of underserved user groups?      | Assess 5 DLs representing different types of DLs and developed by different types of organizations<br>Focus groups<br>Design Science Methodologies<br>Document analysis<br>Methodology review and analysis   | Problems in existing DL designs for BVI users<br>Framework for DL design for BVI users:<br>1) Guidelines for DL design to satisfy BVI users' needs in relation to accessibility and usability<br>2) Current status of existing DLs and their design problems<br>3) Methodology that can be applied to other underserved groups to generate similar guidelines<br>Dissemination of the framework through multiple channels | 29-36 |

### III. DIVERSITY PLAN

This project focuses on a key underserved group—the BVI users. To ensure that their needs are accurately identified, represented, and portrayed, we will strive for diversity in recruiting study participants across age, gender, race, and other types of demographic data.

### IV. PROJECT RESULTS

Deliverables for this project will include a new framework for creating DLs for BVI users, which will be disseminated to DL developers, practitioners and researchers via conferences, journal publications, social media, and partners/advisory board members. The new framework consists of: 1) the types of help-seeking situations that BVI users encounter in their interactions with DLs via diverse mobile devices; 2) the imitations of the existing guidelines for DLs in mobile contexts; 3) specific DL design guidelines addressing each type of help-seeking situations; 4) a report on the current status of how DLs comply with the new guidelines; and 5) methodology that can be applied to develop similar guidelines for DLs and different types of IR systems to address other types of underserved users' mobile accessibility and usability issues.

**V. BUDGET SUMMARY: UWM requests \$573,658 as follows:** \$200,483 for salary support and \$45,745 for fringe benefits; \$9,000 for materials and supplies (computers and specialized software); \$130,800 for consultant fees, payments to research subjects, and non-resident tuition remission; \$187,630 for indirect costs at UWM's federally negotiated rate.